AN ROINN OIDEACHAIS AGUS EOLAÍOCHTA

LEAVING CERTIFICATE EXAMINATION, 2002

PHYSICS – ORDINARY LEVEL

MONDAY, 17 JUNE – MORNING 9.30 TO 12.30

Answer **three** questions from **section A** and **five** questions from **section B**.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

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1. You have carried out an experiment to measure *g*, the acceleration due to gravity.

Draw a labelled diagram of the apparatus you used. (12)

Describe the procedure involved in measuring the time in this experiment. (9)

As well as measuring time, what other measurement did you take? (6)

Outline how you got a value for *g* from your measurements. (9)

Name one precaution you took to get an accurate result. (4)

2. In a report of an experiment to investigate the variation of fundamental frequency of a stretched string with length, a student wrote the following.

"The wire was set vibrating at a known frequency.
The length of the wire was adjusted until it vibrated at its fundamental frequency. The length was recorded.
A different frequency was applied to the wire and new measurements were taken.
This procedure was repeated a few times."

How was the wire set vibrating? (9)
How was the length adjusted? (6)

The table shows the measurements recorded by the student.

fundamental frequency/Hz	650	395	290	260	192	174	163
length/m	0.20	0.33	0.45	0.50	0.66	0.75	0.80
$\frac{1}{\text{length}}$ /m^{-1}							

Copy the table and complete the last row by calculating $\frac{1}{\text{length}}$ for each measurement. (6)

Plot a graph on graph paper of fundamental frequency against $\frac{1}{\text{length}}$. Put fundamental frequency on the vertical axis. (12)

What does the graph tell you about the relationship between fundamental frequency and length? (7)

3. A student carried out an experiment to measure the focal length of a concave mirror. The student placed an object at different positions in front of the mirror so that a real image was formed in each case.

The table shows the measurements recorded by the student for the object distance u and the image distance v.

u/cm	20	30	40	50
v/cm	64	43	41	35

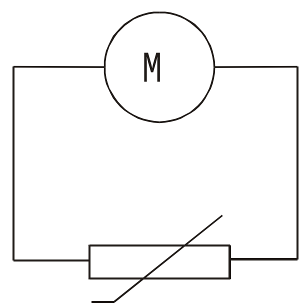
Draw a labelled diagram showing how the apparatus was arranged. (9)

Describe how the student found the position of the image. (7)

Show on your diagram the object distance u and the image distance v. (6)

Using the formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ or otherwise and the above data, find an average value for the focal length f of the mirror. (18)

4. The circuit diagram shows a thermistor connected to a meter M. A student used the circuit to measure the resistance R of the thermistor at different temperatures θ.



Name the meter M used to measure the resistance of the thermistor. (6)

Explain, with the aid of a labelled diagram, how the student varied the temperature of the thermistor. (9)

How did the student measure the temperature of the thermistor? (6)

The table shows the measurements recorded by the student.

θ/°C	20	30	40	50	60	70	80	90
R/Ω	1300	900	640	460	340	260	200	150

Draw a graph on graph paper of resistance R against temperature θ. Put temperature on the horizontal axis. (12)

Using your graph, estimate the temperature of the thermistor when the meter M read 740 Ω. (7)

SECTION B (280 marks)

Answer **five** questions from this section.
Each question carries 56 marks.

5. Answer any **eight** of the following parts *(a), (b), (c),* etc.

(a) What is friction? (7)

(b) A car of mass 800 kg is travelling at 10 m s^{-1}. What is its kinetic energy? ($E_k = \frac{1}{2}mv^2$) (7)

(c) In the following table, match the scientist in the first column with the law in the second column. (7)

A. Michael Faraday	1. Law of refraction
B. Isaac Newton	2. Law of electromagnetic induction
C. Willebrord Snell	3. Law of gravitation

(d) What is the effect of increasing the U-value of a structure? (7)

(e) What physical quantity is measured in decibels? (7)

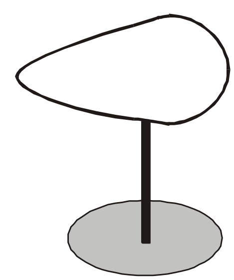
(f) A lens has a power of +50 m^{-1}. What type of lens is it and what is its focal length? ($P = \frac{1}{f}$) (7)

(g) What is meant by a thermometric property? (7)

(h) Give an example of the Doppler effect. (7)

(i) What is the purpose of a miniature circuit breaker (MCB) in an electrical circuit? (7)

(j) A pear-shaped conductor is placed on an insulated stand as shown. The conductor is given a positive charge. Copy the diagram and show how the charge is distributed over the conductor. (7)



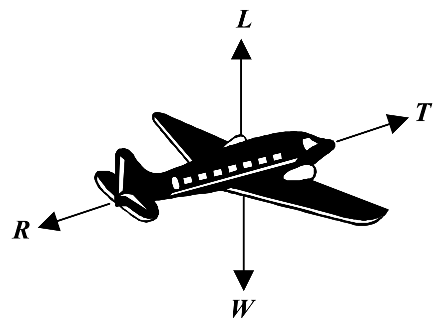
6. Define (i) velocity, (ii) acceleration. (12)

Copy and complete the following statement of Newton's first law of motion.

"An object stays at rest or moves with constant velocity (i.e. it does not accelerate) unless………………..." (6)

The diagram shows the forces acting on an aircraft travelling horizontally at a constant speed through the air.

L is the upward force acting on the aircraft.
W is the weight of the aircraft.
T is the force due to the engines.
R is the force due to air resistance.



What happens to the aircraft when the force *L* is greater than the weight of the aircraft? (6)

What happens to the aircraft when the force *T* is greater than the force *R*? (6)

The force *T* exerted by the engines is 20 000 N. Calculate the work done by the engines while the aircraft travels a distance of 500 km. (6)

The aircraft was travelling at a speed of 60 m s^{-1} when it landed on the runway. It took two minutes to stop. Calculate the acceleration of the aircraft while coming to a stop. (9)

The aircraft had a mass of 50 000 kg. What was the force required to stop the aircraft? (6)

Using Newton's first law of motion, explain what would happen to the passengers if they were not wearing seatbelts while the aircraft was landing. (5)

($W = Fs$; $v = u + at$; $F = ma$)

7. The dispersion of white light can be produced by <u>refraction</u> or <u>diffraction</u>. Explain the underlined terms. (18)

Describe an experiment to demonstrate the dispersion of white light. (12)

The following table gives examples of electromagnetic waves and their typical wavelengths.

wave	radio	microwave	infrared	light	ultraviolet
wavelength	100 m	0.1m	1μm	600 nm	10 nm

Name one property that all of these waves have in common. (6)

What is the frequency of the radio waves? The speed of light is 3×10^8 m s^{-1}. (6)

Describe how infrared radiation can be detected. (6)

Give two uses of microwaves. (8)

($c = f\lambda$)

8. Explain (i) potential difference, (ii) electric current. (12)

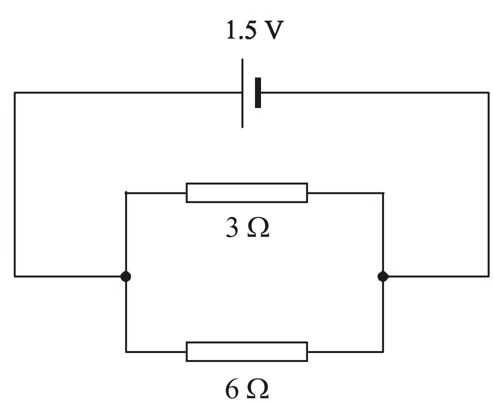
Give one difference between conduction in metals and conduction in semiconductors. (6)

A circuit consists of a 3 Ω resistor and a 6 Ω resistor connected in parallel to a 1.5 V d.c. supply as shown.

Calculate the total resistance of the two resistors. (9)

Calculate the current flowing in the circuit. (6)

What is the current in the 3 Ω resistor? (6)



Semiconductors can be made p-type or n-type. How is a semiconductor made p-type? (6)

Draw a diagram showing a p-n junction connected in forward bias to a d.c. supply. (6)

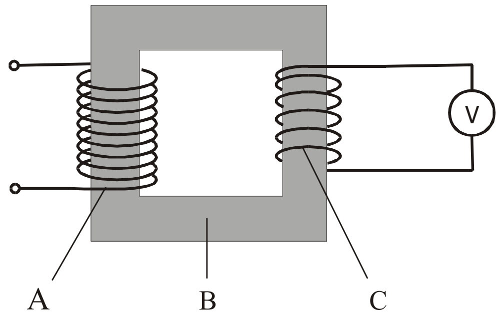
Give two uses of semiconductors. (5)

($V = IR$; $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$)

9. What is electromagnetic induction? (9)

Describe an experiment to demonstrate electromagnetic induction. (12)

The transformer is a device based on the principle of electromagnetic induction.
Name two devices that use transformers. (6)



Name the parts of the transformer labelled A, B and C in the diagram. (9)

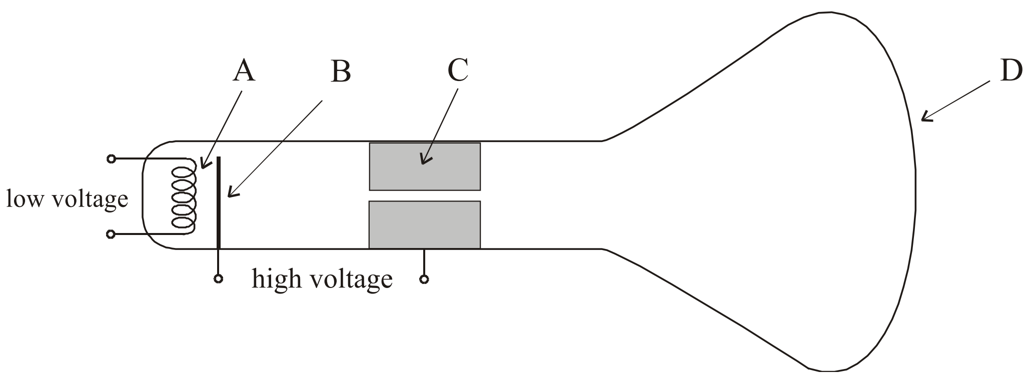
The mains electricity supply (230 V) is connected to A, which has 400 turns. C has 100 turns. What is the reading on the voltmeter? (9)

How is the part labelled B designed to make the transformer more efficient? (6)

The efficiency of a transformer is 90%. What does this mean? (5)

$(\frac{V_i}{V_o} = \frac{N_p}{N_s})$

10. What is thermionic emission? (9)

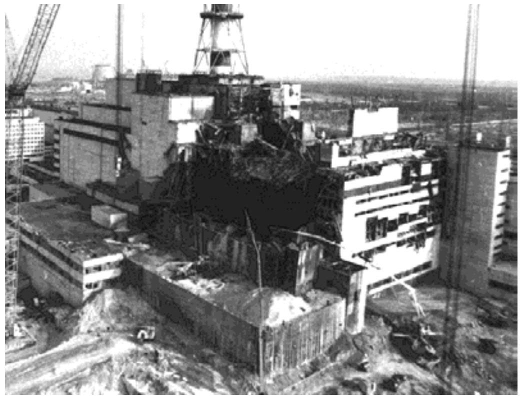


The diagram shows a simple cathode ray tube.
Name the parts labeled A, B, C and D in the diagram. (12)
Give the function of any two of these parts. (12)
How can the beam of electrons be deflected? (6)
Give a use of a cathode ray tube. (3)

In an X-ray tube, electrons are also produced by thermionic emission.
Draw a sketch of an X-ray tube. (11)

Why is a lead shield normally put around an X-ray tube? (3)

11. Read the following passage and answer the accompanying questions.



Chernobyl

The world's most devastating nuclear accident happened at Chernobyl in the Ukraine in 1986. In the early hours of the morning of 26 April of that year, there were two loud explosions that blew the roof off and completely destroyed the No. 4 reactor, releasing during the course of the following days, 6 to 7 tonnes of radioactive material, with a total activity of about 10^{18} becquerels, into the atmosphere.

The discharge included over a hundred radioisotopes, but iodine and caesium isotopes were of main relevance from a human health and environmental point of view. Contamination in the surrounding areas was widespread, with the half-life of some of the materials measured in thousands of years.

Large numbers of people involved in the initial clean up of the plant received average total body radiation doses of about 100 mSv - about five times the maximum dose permitted for workers in nuclear facilities. Average worldwide total body radiation dose from natural 'background' radiation is about 2.4 mSv annually.

During, and soon after the accident and the initial clean-up, at least 30 plant personnel and firefighters died from burns and radiation. In the eight years following the accident, a further 300 suffered radiation sickness, and there are possible links between the accident and increased numbers of thyroid cancers in neighbouring regions.

(Adapted from "Physics – a teacher's handbook", Dept. of Education and Science.)

(a) What is meant by a nuclear accident? (7)

(b) The No. 4 reactor was a fission reactor. What is nuclear fission? (7)

(c) Name two parts of a nuclear fission reactor. (7)

(d) What is measured in becquerels? (7)

(e) Give two examples of radioisotopes. (7)

(f) What is meant by the half-life of a substance? (7)

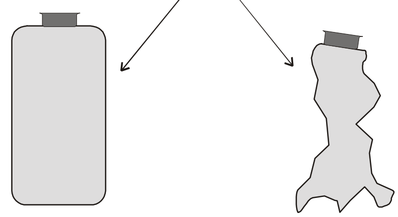
(g) What is meant by background radiation? (7)

(h) Give two effects of radiation on the human body. (7)

12. Answer any **two** of the following parts *(a), (b), (c), (d).*

(a) What is meant by pressure? Give the unit of pressure. (9)

Name an instrument used to measure pressure. (6)



When air is removed from the metal container shown in the diagram, it collapses. Explain why. (9)

The wind exerts a horizontal force of 1000 N on a wall of area 20 m^2. Calculate the pressure at the wall. (4)

$(p = \frac{F}{A})$

(b) Define specific heat capacity. (9)

An electric kettle contains 1.5 kg of water. The specific heat capacity of water is 4180 J kg^{-1} K^{-1}. Calculate the amount of energy required to raise the temperature of the water from 15 ^oC to 100 ^oC. (9)

The kettle takes 4 minutes to heat the water from 15 ^oC to 100 ^oC. Calculate the power of the kettle. (Assume all the energy supplied is used to heat the water.) (6)

Why is the heating element of an electric kettle near the bottom? (4)

$(Q = mc\Delta\theta;\ P = \frac{W}{t})$

(c) Define capacitance. (6)

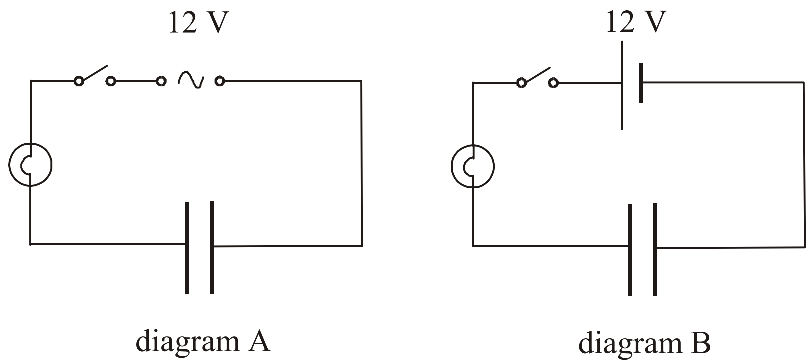


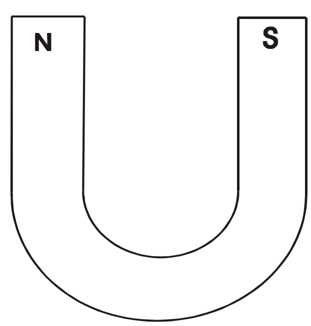
Diagram A shows a capacitor connected to a bulb and a 12 V a.c. supply.

Diagram B shows the same capacitor connected to the bulb, but connected to a 12 V d.c. supply.

What happens in each case when the switch is closed? Explain your answer. (10)

Describe an experiment to demonstrate that a capacitor can store energy. (12)

(d) The diagram shows a U-shaped magnet. Copy the diagram and show on it the magnetic field lines due to the magnet. (6)



Describe an experiment to demonstrate that a current-carrying conductor in a magnetic field experiences a force. (12)

List two factors that affect the size of the force on the conductor. (6)

Name one device that is based on the principle that a current-carrying conductor in a magnetic field experiences a force. (4)

Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2003

PHYSICS – ORDINARY LEVEL

MONDAY, 16 JUNE – MORNING 9.30 TO 12.30

Answer **three** questions from **section A** and **five** questions from **section B**.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

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1. A student carried out an experiment to investigate the relationship between the force applied to a body and the acceleration of the body. The table shows the measurements recorded by the student.

Force / N	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
Acceleration / cm s^{-2}	8.4	17.6	25.4	35.0	43.9	51.5	60.4	70.0

Draw a labelled diagram of the apparatus used in the experiment. (9)

How was the effect of friction reduced in the experiment? (6)

Describe how the student measured the applied force. (9)

Plot a graph, on graph paper, of the acceleration against the applied force. (12)

What does your graph tell you about the relationship between the acceleration of the body and the force applied to it? (4)

2. In a report of an experiment to measure the specific latent heat of fusion of ice, a student wrote the following.

"Ice at 0 ^{o}C was added to water in a calorimeter.
When the ice had melted measurements were taken.
The specific latent heat of fusion of ice was then calculated."

Draw a labelled diagram of the apparatus used. (12)

What measurements did the student take before adding the ice to the water? (9)

What did the student do with the ice before adding it to the water? (6)

How did the student find the mass of the ice? (9)

Give one precaution that the student took to get an accurate result. (4)

3. In an experiment to measure the speed of sound in air, a student found the frequency and the wavelength of a sound wave.

Draw a labelled diagram of the apparatus used in the experiment. (12)

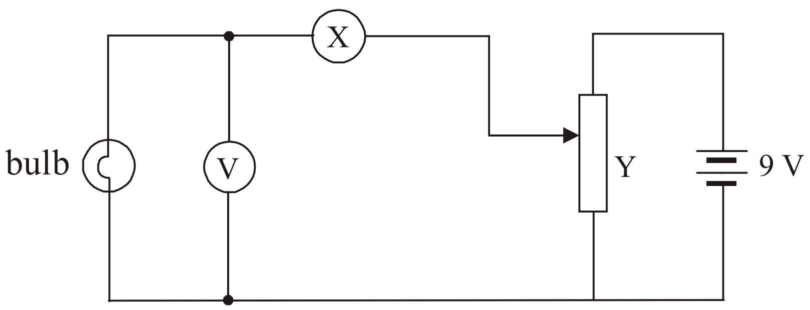
Describe how the student found the wavelength of the sound wave. (9)

How did the student find the frequency of the sound wave? (6)

How did the student calculate the speed of sound in air? (9)

Give one precaution that the student took to get an accurate result. (4)

4. The diagram shows the circuit used by a student to investigate the variation of current with potential difference for a filament bulb.



Name the apparatus X. What does it measure? (6)

Name the apparatus Y. What does it do? (6)

The table shows the values obtained for the current and the potential difference during the experiment.

Potential difference / V	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0
Current / A	1.0	1.5	1.9	2.3	2.6	2.9	3.2	3.5

Draw a graph, on graph paper, of the current against the potential difference. (12)

The resistance of the bulb is 2.0 Ω when the current is 1.5 A.
Use your graph to find the resistance of the bulb when the current is 3 A. (10)
Explain why the resistance of the bulb when the current is 1.5 A is different from its resistance when the current is 3 A. (6)

SECTION B (280 marks)

Answer **five** questions from this section.
Each question carries 56 marks.

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5. Answer any **eight** of the following parts *(a), (b), (c),* etc.

(a) What is the momentum of an object with a mass of 5 kg travelling at 10 m s^{-1}? (7)

(b) State Boyle's law. (7)

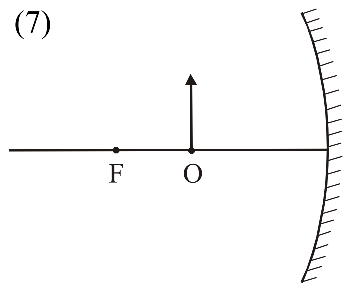
(c) Name a renewable source of energy. (7)

(d) The temperature of a body is 300 K. What is its temperature in degrees Celsius? (7)

(e) Name two methods by which heat can be transferred. (7)

(f) Give one difference between light waves and sound waves. (7)

(g) Describe the image that is formed in a concave mirror when an object is placed inside the focus, as shown in the diagram. (7)



(h) State one energy conversion that takes place in an electrical generator. (7)

(i) What is a transformer used for? (7)

(j) Give two properties of the electron. (7)

($p = mv$)

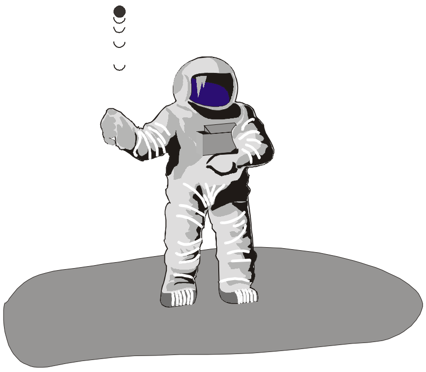
6. Copy and complete the following statement of Newton's law of universal gravitation.

"Any two point masses attract each other with a ……..… which is proportional to the product of their …….... and inversely proportional to the ……..………...…………. between them." (12)

What is meant by the term acceleration due to gravity? (6)

An astronaut of mass 120 kg is on the surface of the moon, where the acceleration due to gravity is 1.6 m s^{-2}. What is the weight of the astronaut on the surface of the moon? (6)

The astronaut throws a stone straight up from the surface of the moon with an initial speed of 25 m s^{-1}. Describe how the speed of the stone changes as it reaches its highest point.
Calculate the highest point reached by the stone. (18)



Calculate how high the astronaut can throw the same stone with the same initial speed of 25 m s^{-1} when on the surface of the earth, where the acceleration due to gravity is 9.8 m s^{-2}. (9)

Why is the acceleration due to gravity on the moon less than the acceleration due to gravity on the earth? (5)

($W = mg$; $v^2 = u^2 + 2as$)

7. State the laws of refraction of light. (12)

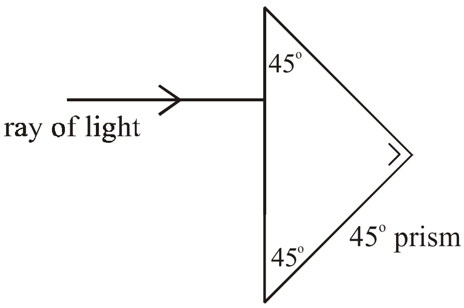
Explain, with the aid of a labelled diagram, (i) total internal reflection, (ii) critical angle. (12)

The diagram shows a 45° prism made of glass. The critical angle for the glass is 42°.
Calculate the refractive index of the glass. (9)

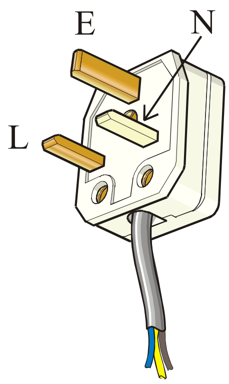
The diagram shows a ray of light entering the prism from air.
Copy the diagram and show the path of the ray through the prism and back into the air.
Explain why the ray follows the path that you have shown. (15)

Give two uses of total internal reflection. (8)

($n = \dfrac{1}{\sin C}$)



8. What is an electric current? (6)



Give the standard colour of the insulation on the wires connected to each of the terminals L, N and E on the plug in the diagram. What is the purpose of the wire connected to the terminal E on the plug? (15)

Explain why a fuse is used in a plug. (6)

The fuse in the plug of an electric kettle was replaced with a 5 A fuse. The kettle has a power rating of 2 kW when connected to the ESB mains voltage of 230 V.

Calculate the current that flows when the kettle is first plugged in.

This current will only flow for a very short time. Explain why. (15)

Bonding is a safety precaution used in domestic electric circuits. How does bonding improve safety in the home? (9)

Name a device that is often used nowadays in domestic electric circuits instead of fuses. (5)

(P = VI)

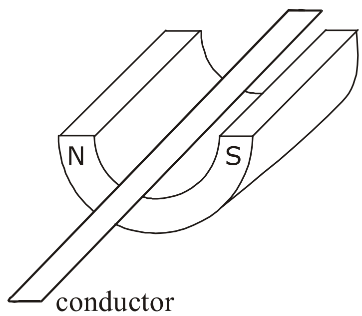
9. What is a magnetic field? (6)

The earth has a magnetic field. Give one use of the earth's magnetic field. (5)

Hans Oersted discovered the magnetic effect of an electric current in 1820 while demonstrating electricity to his students. Describe how you would demonstrate the magnetic effect of an electric current. (18)

Draw a sketch of the magnetic field around a straight wire carrying a current. Your diagram should show the direction of the current and the direction of the magnetic field. (9)

In an experiment, a thin light conductor is placed between the poles of a U-shaped magnet as shown in the diagram. Describe what happens when a current flows through the conductor.
Name two devices that are based on the effect demonstrated in this experiment. (12)

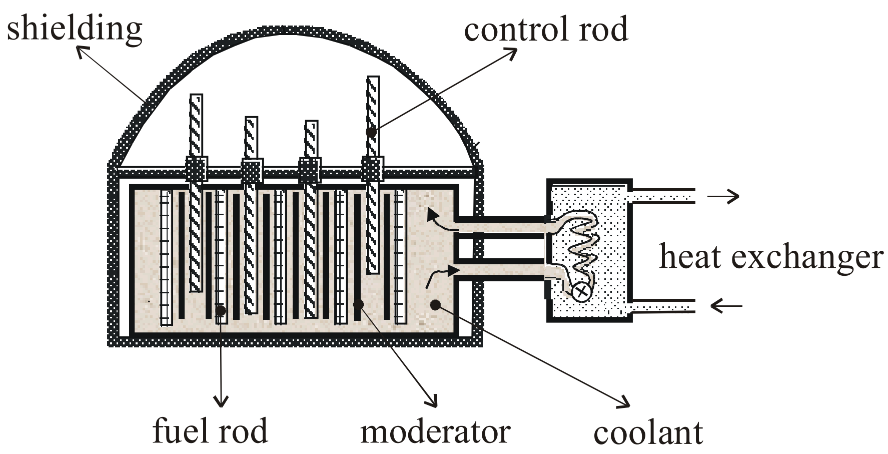


What would happen if (i) a larger current flowed in the conductor, (ii) the current flowed in the opposite direction through the conductor? (6)

10. What is radioactivity? (6)

The diagram shows the basic structure of a nuclear reactor.

A nuclear reactor contains (i) fuel rods, (ii) control rods, (iii) moderator, (iv) heat exchanger. Give the function of any two of these. (12)



In a nuclear reactor, energy is released by nuclear fission when a chain reaction occurs.
What is nuclear fission?
What is a chain reaction? (18)

Thick shielding is placed around a nuclear reactor because of the penetrating power of the radiation emitted. Name three types of radiation that are present in a nuclear reactor.
Name an instrument used to detect radiation. (14)

Plutonium is produced in a nuclear reactor. It is a highly radioactive substance with a very long half-life. When the fuel in a nuclear reactor is used up, the fuel rods are reprocessed to remove the plutonium.
Give two precautions that are taken when storing the plutonium. (6)

11. Read the following passage and answer the accompanying questions.

The operation of semiconductor devices depends on the effects that occur when p-type and n-type semiconductor material are in close contact. This is achieved by taking a single crystal of silicon and doping separate but adjacent layers of it with suitable impurities. The junction between the p-type and the n-type layers is referred to as the *p–n junction* and this is the key to some very important aspects of semiconductor theory. Devices such as diodes, transistors, silicon-controlled rectifiers, etc., all contain one or more p–n junctions.

("Physics – a teacher's handbook", Dept. of Education and Science.)

(a) What is a semiconductor? (7)

(b) Name a material used in the manufacture of semiconductors. (7)

(c) Name the two types of charge carriers in semiconductors. (7)

(d) What is meant by doping? (7)

(e) Give one difference between a p-type semiconductor and an n-type semiconductor. (7)

(f) What is a p-n junction? (7)

(g) What is a diode? (7)

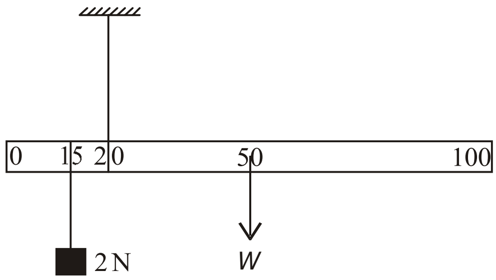
(h) Give an example of a device that contains a rectifier. (7)

12. Answer any **two** of the following parts *(a), (b), (c), (d).*

(a) Define the moment of a force. (6)

Explain why the handle on a door is on the opposite side to the hinges of the door. (7)

A metre stick is suspended by a thread at the 20 cm mark as shown in the diagram. The weight *W* of the metre stick acts through the 50 cm mark. A weight of 2 N is placed at the 15 cm mark.



Calculate the moment of the 2 N weight about the 20 cm mark. (5)

What is the moment of *W* about the 20 cm mark? (5)

If the metre stick is in equilibrium, find the value of *W*. (5)

($M = Fd$)

(b) Name two primary colours. (6)

What are complementary colours? (6)

White light is made up of light of different colours. Describe an experiment to demonstrate this. (9)

The diagram shows a simple form of the electromagnetic spectrum, with wavelength increasing from left to right.

short wavelength	⟶	long wavelength
gamma rays	light	radio waves

Copy this diagram and indicate on it the positions of the following:

microwaves; infrared; ultraviolet; X-rays. (7)

(c) What is the unit of electric charge? (6)

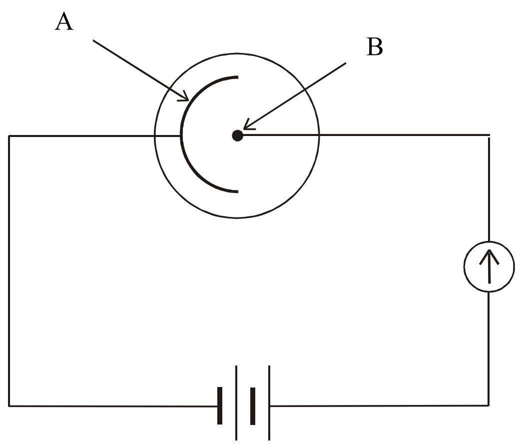
Describe, with the aid of a labelled diagram, how you would charge a conductor by induction. (12)

The build-up of electric charge can lead to explosions. Give two examples where this could happen. (6)

How can the build-up of electric charge on an object be reduced? (4)

(d) What is a photon? (6)

The diagram shows a photocell connected in series with a sensitive galvanometer and a battery. Name the parts labelled A and B. (6)



What happens at A when light falls on it? (6)

What happens in the circuit when the light falling on A gets brighter? (6)

Give an application of a photocell. (4)

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Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2004

PHYSICS – ORDINARY LEVEL

MONDAY, 21 JUNE – MORNING 9.30 TO 12.30

Answer **three** questions from **section A** and **five** questions from **section B**.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

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1. In an experiment to verify Boyle's law, a student measured the volume of a gas at different pressures. The table shows the measurements recorded by the student.

Pressure /kPa	100	111	125	143	167	200	250
Volume /cm^3	5.0	4.5	4.0	3.5	3.0	2.5	2.0
$\frac{1}{\text{volume}}$ /cm^{-3}			0.25				

Draw a labelled diagram of the apparatus used in this experiment. (12)

Copy this table and fill in the last row by calculating $\frac{1}{\text{volume}}$ for each measurement. (7)

Plot a graph on graph paper of pressure against $\frac{1}{\text{volume}}$. (12)

Explain how your graph verifies Boyle's law. (6)

Give one precaution that the student took in carrying out the experiment. (3)

2. In a report of an experiment to measure the specific heat capacity of a substance (e.g. water *or* a metal), a student wrote the following.

"I assembled the apparatus needed for the experiment.
During the experiment I took a number of measurements of mass and temperature.
I used these measurements to calculate the specific heat capacity of the substance."

Draw a labelled diagram of the apparatus used. (12)

What measurements of mass did the student take during the experiment? (6)

What temperature measurements did the student take during the experiment? (6)

Give a formula used to calculate the specific heat capacity of the substance. (10)

Give one precaution that the student took to get an accurate result. (6)

3. You carried out an experiment to measure the wavelength of a monochromatic light source.

Name a monochromatic light source. (6)

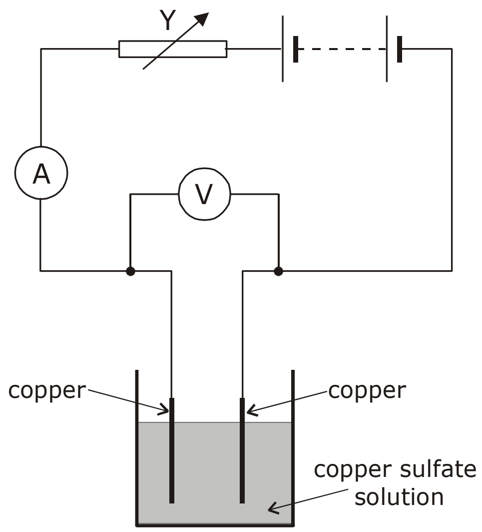
Draw a labelled diagram of the apparatus that you used in the experiment. (12)

What readings did you take during the experiment? (9)

What formula did you use to calculate the wavelength of the light? (9)

Give one precaution that you took to get an accurate result. (4)

4. The diagram shows a circuit used to investigate the variation of current with potential difference for a copper sulfate solution.



Name the instrument used to measure the current. (6)

How was the potential difference measured in the experiment? (4)

Name the apparatus Y and give its function in the experiment. (9)

The following table shows the values recorded for the current and the potential difference during the experiment.

Potential Difference/V	0	0.5	1.0	1.5	2.0	2.5	3.0
Current/A	0	0.3	0.6	0.9	1.2	1.5	1.8

Using the data in the table, draw a graph on graph paper of the current against the potential difference. Put current on the horizontal axis. (12)

Calculate the slope of your graph and hence determine the resistance of the copper sulfate solution. (9)

SECTION B (280 marks)

Answer **five** questions from this section.
Each question carries 56 marks.

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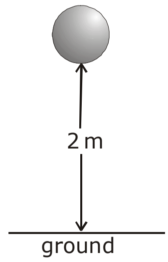
5. Answer any **eight** of the following parts *(a), (b), (c),* etc.

(a) A student holds a metal ball 2 m above the ground.
The mass of the ball is 5 kg.
Calculate the potential energy of the ball. (7)
($E_p = mgh$, acceleration due to gravity, $g = 9.8$ m s^{-2})



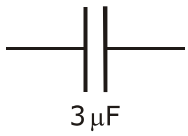
(b) Explain the term thermometric property. (7)

(c) Give one application of the Doppler effect. (7)

(d) Name two primary colours of light. (7)

(e) Which one of the following is **not** part of the electromagnetic spectrum?
sound waves **microwaves** **ultraviolet radiation** (7)

(f) Name the electrical component represented in the diagram. (7)



(g) Name two safety devices that are used in domestic electric circuits. (7)

(h) A conductor of length 50 cm is carrying a current of 5 A. It is placed at right angles to a magnetic field of flux density 3 T. Calculate the force on the conductor.
($F = IlB$) (7)

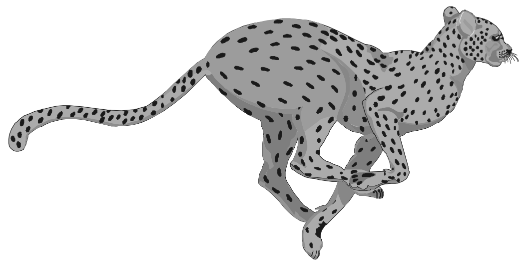
(i) Which one of the following is emitted from a metal surface when suitable light shines on the metal?
protons **neutrons** **electrons** **atoms** (7)

(j) What is nuclear fission? (7)

6. Define (i) velocity, (ii) acceleration. (12)

Describe an experiment to measure the velocity of a moving object. (12)

The cheetah is one of the fastest land animals.



A cheetah can go from rest up to a velocity of 28 m s^{-1} in just 4 seconds and stay running at this velocity for a further 10 seconds.

Sketch a velocity–time graph to show the variation of velocity with time for the cheetah during these 14 seconds. (11)

Calculate the acceleration of the cheetah during the first 4 seconds. (9)

Calculate the resultant force acting on the cheetah while it is accelerating. The mass of the cheetah is 150 kg. (6)

Name two forces acting on the cheetah while it is running. (6)

($v = u + at$, $F = ma$)

7. Heat can be transferred by conduction. What is meant by conduction?
Name two other ways of transferring heat. (12)

Describe an experiment to show how different solids conduct heat at different rates. (12)

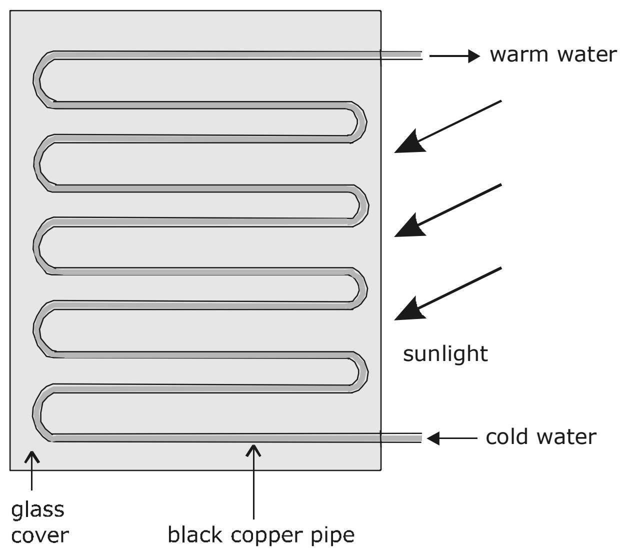
The *U*-value of a house is a measure of the rate of heat loss to the surroundings.
Give two ways in which the *U*-value of a house can be reduced. (8)

The diagram shows a solar panel (solar heater) which can be used in the heating of a house.
What energy conversion takes place in a solar panel? (6)

(i) Why are the pipes in the solar panel usually made from copper? (6)

(ii) Why are the pipes in the solar panel usually painted black? (6)

(iii) Why does warm water rise to the top of the solar panel? (6)

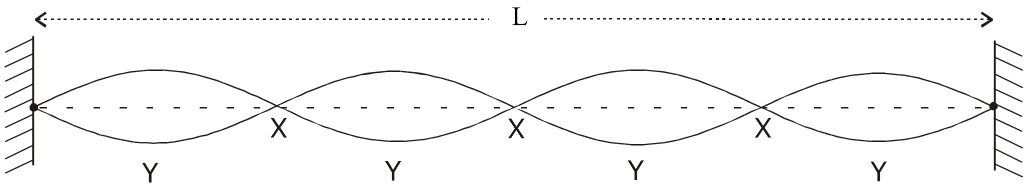


8. Sound from a vibrating object can cause diffraction and interference.

Explain the underlined terms. (12)

Describe an experiment to demonstrate the interference of sound. (11)

The diagram shows a stationary wave (standing wave) on a vibrating stretched string.



What is the name given to the points on the string marked (i) X, (ii) Y?

How many wavelengths are contained in the distance marked L? (15)

State two factors on which the natural frequency of a stretched string depends. (9)

A note of wavelength 1.4 m is produced from a stretched string. If the speed of sound in air is 340 m s^{-1}, calculate the frequency of the note. (9)

($c = f\lambda$)

9. What is an electric current?

An electric current can cause a heating effect. Name two other effects of an electric current. (18)

Describe an experiment to show the heating effect of an electric current.
State two factors on which the heating effect of an electric current depends. (18)

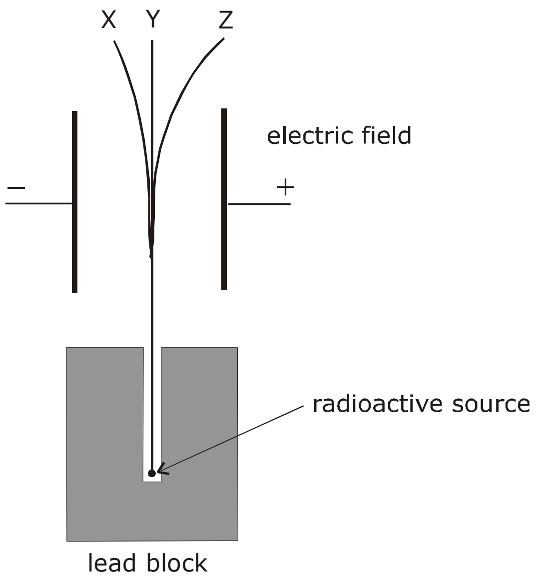
An electric heater has a power rating of 2 kW when connected to the ESB mains supply of 230 V. Calculate the current that flows through the heater. (6)

What is the kilowatt-hour? (6)
Calculate the cost of using a 2 kW electric heater for 3 hours at 10 cent per kilowatt-hour. (8)

($P = VI$)

10. What is radioactivity? (9)
Name the French physicist who discovered radioactivity in 1896. (6)

The diagram illustrates that three types of radiation are emitted from a radioactive source.



Name the radiations labelled (i) X, (ii) Y, (iii) Z, in the diagram.
Which one is the most ionising? (18)

Name a detector of ionising radiation.
Outline the principle on which the detector works. (12)

Great care has to be taken when dealing with radioactive sources.
Give:

(i) two precautions that should be taken when dealing with radioactive sources;
(ii) one use of a radioactive source;
(iii) one harmful effect of radiation. (11)

11. Read the following passage and answer the accompanying questions.

Optical fibres are made of very transparent glass or plastic. The fibres contain at least two layers. Guiding light in an optical fibre depends on how light travels through different media. Light waves are bent, or refracted, as they pass between materials of different refractive index. The amount of bending depends on the refractive index and the angle at which light strikes the surface.

Sometimes light cannot leave the material of higher refractive index. If it strikes the surface at a large enough angle, it is reflected back into the material. The critical angle, for what is called total internal reflection, depends on the difference in refractive indexes. An optical fibre guides light by using total internal reflection.

(Adapted from New Scientist, 13 October 1990)

(a) Draw a diagram to show how a ray of light is transmitted through an optical fibre. (7)

(b) How is the escape of light from the sides of an optical fibre prevented? (7)

(c) Name a material that is used in the manufacture of optical fibres. (7)

(d) What is the bending of light as it moves from one medium to another called? (7)

(e) What is meant by the refractive index of a material? (7)

(f) Define the critical angle. (7)

(g) When will total internal reflection occur? (7)

(h) Give one use for optical fibres. (7)

12. Answer any **two** of the following parts *(a), (b), (c), (d).*

(a) Define momentum. Give the unit of momentum. (9)

State the principle of conservation of momentum. (9)

The diagram shows a child stepping out of a boat onto a pier. The child has a mass of 40 kg and steps out with an initial velocity of 2 m s^{-1} towards the pier. The boat, which was initially at rest, has a mass of 50 kg. Calculate the initial velocity of the boat immediately after the child steps out. (10)

($p = mv$)

(b) A concave mirror can produce a real or a virtual image, depending on the position of the object.

Give one difference between a real image and a virtual image. (6)

Use a ray diagram to show the formation of a real image by a concave mirror. (6)

A concave mirror has a focal length of 20 cm. An object is placed 30 cm in front of the mirror. How far from the mirror will the image be formed? (10)

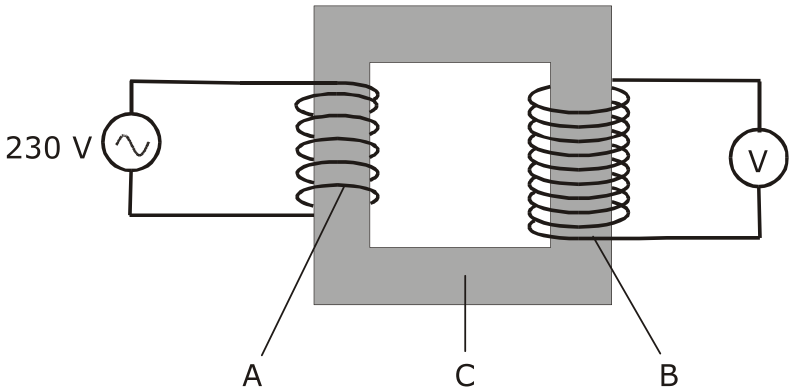
Give two uses for a concave mirror. (6)

$$\left(\frac{1}{f} = \frac{1}{u} + \frac{1}{v}\right)$$

(c) A transformer is a device based on the principle of electromagnetic induction.

What is electromagnetic induction?
Name another device that is based on electromagnetic induction. (9)

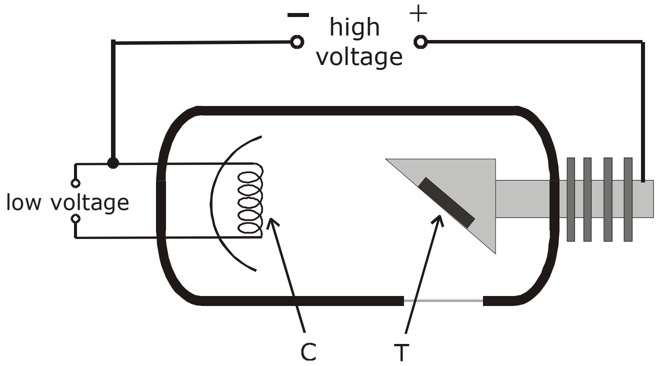
Name the parts of the transformer labelled A, B and C in the diagram. (9)



Part A has 400 turns of wire and part B has 1200 turns. Part A is connected to a 230 V a.c. supply. What is the voltage across part B? (10)

$\left(\frac{V_i}{V_o} = \frac{N_p}{N_s}\right)$

(d) The diagram shows an X-ray tube.



What are X-rays? (6)

How are electrons emitted from the cathode C? (6)

What is the function of the high voltage across the X-ray tube? (6)

Name a suitable material for the target T in the X-ray tube.
Give one use of X-rays. (10)

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Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2005

PHYSICS – ORDINARY LEVEL

MONDAY, 20 JUNE – MORNING 9.30 to 12.30

Answer **three** questions from **section A** and **five** questions from **section B**.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

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1. In an experiment to investigate the relationship between force and acceleration a student applied a force to a body and measured the resulting acceleration. The table shows the measurements recorded by the student.

Force / N	0.1	0.2	0.3	0.4	0.5	0.6	0.7
acceleration / m s^{-2}	0.10	0.22	0.32	0.44	0.55	0.65	0.76

Draw a labelled diagram of the apparatus used in the experiment. (9)

Outline how the student measured the applied force. (6)

Plot a graph, on graph paper of the acceleration against the applied force. Put acceleration on the horizontal axis (X-axis). (12)

Calculate the slope of your graph and hence determine the mass of the body. (9)

Give one precaution that the student took during the experiment. (4)

2. In a report of an experiment to measure the specific latent heat of vaporisation of water, a student wrote the following.

"Steam at 100 ^{o}C was added to cold water in a calorimeter.
When the steam had condensed, measurements were taken.
The specific latent heat of vaporisation of water was then calculated."

Draw a labelled diagram of the apparatus used. (12)

List two measurements that the student took before adding the steam to the water. (9)

How did the student find the mass of steam that was added to the water? (9)

How did the student make sure that only steam, and not hot water, was added to the calorimeter? (6)

Give one precaution that the student took to prevent heat loss from the calorimeter. (4)

3. You carried out an experiment to measure the focal length of a converging lens.

Draw a labelled diagram of the apparatus that you used in the experiment. (12)

Describe how you found the position of the image formed by the lens. (6)

What measurements did you take? (9)

How did you get a value for the focal length of the converging lens from your measurements? (9)

Give one precaution that you took to get an accurate result. (4)

4. In an experiment to measure the resistivity of the material of a wire, a student measured the length, diameter and the resistance of a sample of nichrome wire.

The table shows the measurements recorded by the student.

resistance of the wire / Ω	26.4		
length of the wire / mm	685		
diameter of the wire / mm	0.20	0.19	0.21

(i) Describe how the student measured the resistance of the wire. (6)

(ii) Name the instrument used to measure the diameter of the wire.
Why did the student measure the diameter of the wire in three different places? (12)

(iii) Using the data, calculate the diameter of the wire.
Hence calculate the cross-sectional area of the wire. $(A = \pi r^2)$ (12)

(iv) Calculate the resistivity of nichrome using the formula $\rho = \frac{RA}{L}$. (6)

(v) Give one precaution that the student took when measuring the length of the wire. (4)

SECTION B (280 marks)

Answer **five** questions from this section.
Each question carries 56 marks.

5. Answer any **eight** of the following parts *(a), (b), (c),* etc.

(a) State the principle of conservation of momentum. (7)

(b) A car accelerates from 10 m s^{-1} to 30 m s^{-1} in 5 seconds.
What is its acceleration? ($v = u + at$). (7)

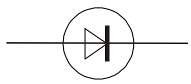
(c) Which one of the following is the unit of power? (7)

joule **kelvin** **kilogram** **watt**

(d) Name two methods by which heat can be transferred. (7)

(e) A wave motion has a frequency of 5 hz and a wavelength of 200 m.
Calculate the speed of the wave. ($c = f\lambda$) (7)

(f) Infrared radiation is part of the electromagnetic spectrum. Name two other radiations that are part of the electromagnetic spectrum. (7)

(g) Name the electrical component represented in the diagram.  (7)

(h) List two safety devices that are used in domestic electric circuits. (7)

(i) What is the photoelectric effect? (7)

(j) Name a material used as shielding in a nuclear reactor. (7)

6. Define pressure and give the unit of pressure. (12)

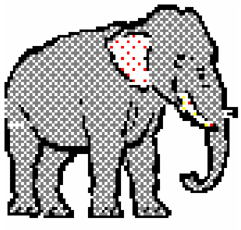
Name an instrument used to measure pressure. (5)

The earth is covered with a layer of air called the atmosphere. What holds this layer of air close to the earth? (6)

Describe an experiment to show that the atmosphere exerts pressure. (12)

The type of weather we get depends on the atmospheric pressure. Describe the kind of weather we get when the atmospheric pressure is high. (6)

The African elephant is the largest land animal.



An elephant weighs 40 000 N and is standing on all four feet each of area 0.2 m^2. Calculate the pressure exerted on the ground by the elephant. (9)

Why would the pressure on the ground be greater if the elephant stood up on just two feet? (6)

($P = F/A$)

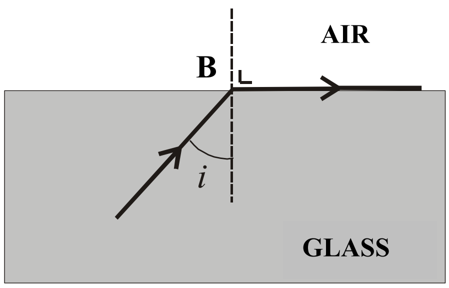
7. Reflection and refraction can both occur to rays of light.

What is meant by the reflection of light?

State the laws of reflection of light. (15)

Describe an experiment to demonstrate one of the laws of reflection of light. (12)

The diagram shows a ray of light travelling from glass to air.
At B the ray of light undergoes refraction.



Explain what is meant by refraction. (6)

What special name is given to the angle of incidence *i*, when the effect shown in the diagram occurs? (6)

In the diagram the value of the angle *i* is 41.8^{o}.
Calculate a value for the refractive index of the glass. (6)

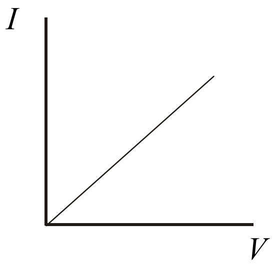
Draw a diagram to show what happens to the ray of light when the angle of incidence *i* is increased to 45^{o}. (6)

Give one application of the effect shown in the diagram you have drawn. (5)

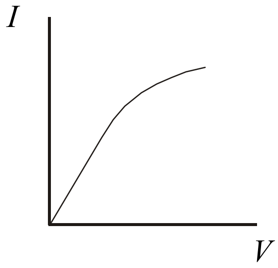
$$(n = \frac{1}{\sin C})$$

8. State Ohm's Law. (9)

The graphs show how current (I) varies with potential difference (V) for (a) a metal, (b) a filament bulb.



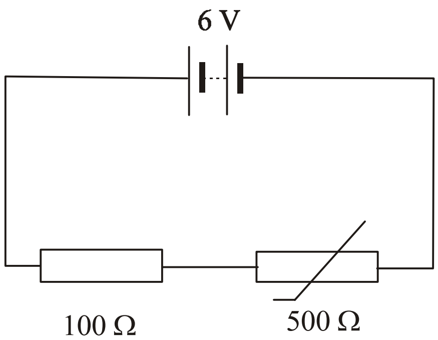
(a) a metal



(b) a filament bulb

Which conductor obeys Ohm's law? Explain your answer. (12)

The circuit diagram shows a 100 Ω resistor and a thermistor connected in series with a 6 V battery. At a certain temperature the resistance of the thermistor is 500 Ω.



Calculate

(i) the total resistance of the circuit;

(ii) the current flowing in the circuit;

(iii) the potential difference across the 100 Ω resistor. (18)

As the thermistor is heated, what happens to

(iv) the resistance of the circuit?

(v) the potential difference across the 100 Ω resistor? (12)

Give a use for a thermistor. (5)

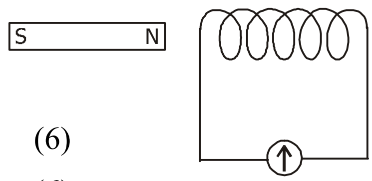
9. What is a magnetic field? (6)

Draw a sketch of the magnetic field around a bar magnet. (9)

Describe an experiment to show that a current carrying conductor in a magnetic field experiences a force.

List two factors that affect the size of the force on the conductor. (18)

A coil of wire is connected to a sensitive galvanometer as shown in the diagram.



What is observed when the magnet is moved towards the coil? (6)

Explain why this occurs. (6)

Describe what happens when the speed of the magnet is increased. (6)

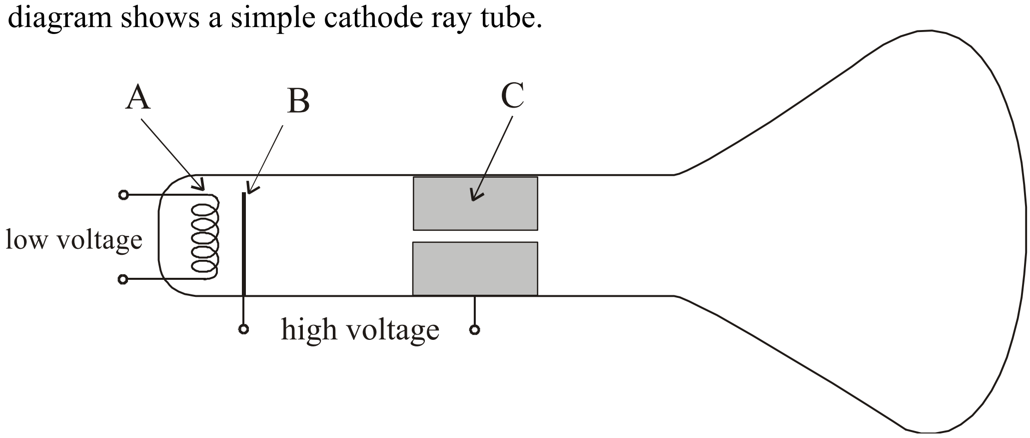
Give one application of this effect. (5)

10. The electron is one of the three main subatomic particles.

Give two properties of the electron.

Name another subatomic particle. (12)

The diagram shows a simple cathode ray tube.



Name the parts labelled A, B and C. (12)

Electrons are emitted from A, accelerated across the tube and strike the screen.

(i) Explain how the electrons are emitted from A. (9)

(ii) What causes the electrons to be accelerated across the tube? (6)

(iii) What happens when the electrons hit the screen? (6)

(iv) How can a beam of electrons be deflected? (6)

(v) Give one use of a cathode ray tube. (5)

11. Read the following passage and answer the accompanying questions.

There are different forms of energy. Fuels such as coal, oil and wood contain chemical energy. When these fuels are burnt, the chemical energy changes into heat and light energy. Electricity is the most important form of energy in the industrialised world, because it can be transported over long distances via cables. It is produced by converting the chemical energy from coal, oil or natural gas in power stations.

In a hydroelectric power station the potential energy of a height of water is released as the water flows through a turbine, generating electricity.

Energy sources fall into two broad groups: renewable and non-renewable. Renewable energy sources are those which replenish themselves naturally and will always be available – hydroelectric power, solar energy, wind and wave power, tidal energy and geothermal energy. Non-renewable energy sources are those of which there are limited supplies and once used are gone forever. These include coal, oil, natural gas and uranium.

(Adapted from the Hutchinson Encyclopaedia of Science, 1998).

(a) Define energy. (7)

(b) What energy conversion takes place when a fuel is burnt? (7)

(c) Name one method of producing electricity. (7)

(d) Give one factor on which the potential energy of a body depends. (7)

(e) What type of energy is associated with wind, waves and moving water? (7)

(f) Give one disadvantage of non-renewable energy sources. (7)

(g) How does the sun produce heat and light? (7)

(h) In Einstein's equation $E = mc^2$, what does c represent? (7)

12. Answer any **two** of the following parts *(a), (b), (c), (d).*

(a) To calibrate a thermometer, a thermometric property and two fixed points are needed.

What does a thermometer measure? (6)

What are the two fixed points on the Celsius scale? (6)

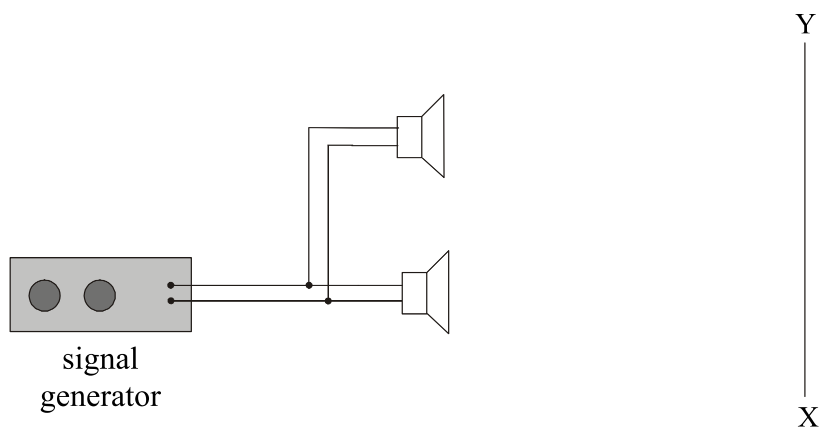
Explain the term thermometric property. (6)

Name the thermometric property used in a mercury thermometer. (6)

Give an example of another thermometric property. (4)

(b) What is meant by (i) diffraction, (ii) interference, of a wave? (12)

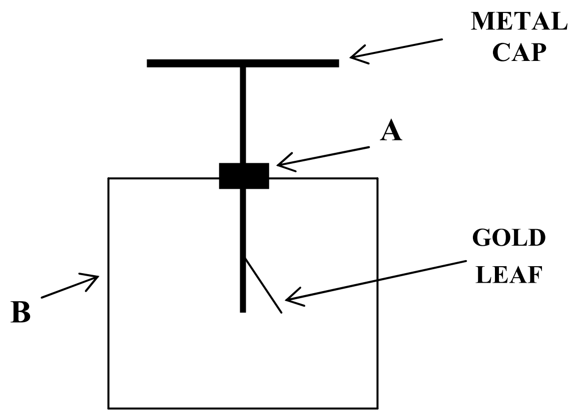
In an experiment, a signal generator was connected to two loudspeakers, as shown in the diagram. Both speakers are emitting a note of the same frequency and same amplitude.



A person walks along the line XY. Describe what the person hears.
What does this experiment demonstrate about the nature of sound? (12)

What is meant by the amplitude of a wave? (4)

(c) The diagram shows a gold leaf electroscope.



Name the parts labelled A and B. (6)

Give one use of an electroscope. (6)

Explain why the gold leaf diverges when a positively charged rod is brought close to the metal cap. (9)

The positively charged rod is held close to the electroscope and the metal cap is then earthed. Explain why the gold leaf collapses. (7)

(d) Na–25 is a radioactive isotope of sodium. It has a half life of 1 minute.

What is meant by radioactivity? (6)

Name a detector of radioactivity. (6)

Explain the term half life. (6)

What fraction of a sample of Na–25 remains after 3 minutes? (6)

Give one use of a radioactive isotope. (4)

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Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION 2006

PHYSICS – ORDINARY LEVEL

MONDAY, 19 JUNE – MORNING 9:30 TO 12:30

Answer **three** questions from **section A** and **five** questions from **section B**.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

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1. In a report of an experiment to verify the principle of conservation of momentum, a student wrote the following:

> I assembled the apparatus needed for the experiment. During the experiment I recorded the mass of the trolleys and I took measurements to calculate their velocities. I then used this data to verify the principle of conservation of momentum.

(i) Draw a labelled diagram of the apparatus used in the experiment. (12)

(ii) How did the student measure the mass of the trolleys? (6)

(iii) Explain how the student calculated the velocity of the trolleys. (9)

(iv) How did the student determine the momentum of the trolleys? (6)

(v) How did the student verify the principle of conservation of momentum? (7)

2. A student carried out an experiment to verify Snell's law of refraction by measuring the angle of incidence *i* and the angle of refraction *r* for a ray of light entering a glass block. The student repeated this procedure two more times. The data recorded by the student is shown in the table.

(i) Draw a labelled diagram of the apparatus used in the experiment. (12)

(ii) Describe how the student found the position of the refracted ray. (9)

(iii) How did the student measure the angle of refraction? (4)

(iv) Copy this table and complete it in your answerbook. (9)

angle of incidence *i*	angle of refraction *r*	sin *i*	sin *r*	$\frac{\sin i}{\sin r}$
30^o	19^o			
45^o	28^o			
65^o	37^o			

(v) Use the data to verify Snell's law of refraction. (6)

3. A student carried out an experiment to investigate how the fundamental frequency of a stretched string varied with its length. The following is an extract from her report.

> I set the string vibrating and adjusted its length until it was vibrating at its fundamental frequency. I then recorded the length of the vibrating string and its fundamental frequency. I repeated this procedure for different lengths of the stretched string. Finally, I plotted a graph of the fundamental frequency of the vibrating string against the inverse of its length.

(i) Draw a labelled diagram of the apparatus used in the experiment. (12)

(ii) Indicate on your diagram the length of the string that was measured. (6)

(iii) Describe how the student set the string vibrating. (7)

(iv) How did the student know that the string was vibrating at its fundamental frequency? (6)

(v) Draw a sketch of the graph expected in this experiment. (9)

4. In an experiment to investigate the variation of resistance with temperature for a metallic conductor in the form of a wire, a student measured the resistance of the conductor at different temperatures. The table shows the measurements recorded by the student.

Temperature / ^{o}C	20	30	40	50	60	70	80
Resistance / Ω	45.6	49.2	52.8	57.6	60.0	63.6	68.4

(i) How did the student measure the resistance of the wire? (6)

(ii) Describe, with the aid of a diagram, how the student varied the temperature of the wire. (9)

(iii) Using the data in the table, draw a graph on graph paper of the resistance of the conductor against its temperature. Put temperature on the horizontal axis (X-axis). (12)

(iv) Use the graph to estimate the temperature of the conductor when its resistance is 50 Ω. (7)

(v) What does your graph tell you about the relationship between the resistance of a metallic conductor and its temperature? (6)

SECTION B (280 marks)

Answer **five** questions from this section.
Each question carries 56 marks.

5. Answer any **eight** of the following parts *(a), (b), (c),* etc.

(a) A person pushed a car a distance of 15 m with a force of 500 N. Calculate the work done by the person. (7)
($W = Fs$)

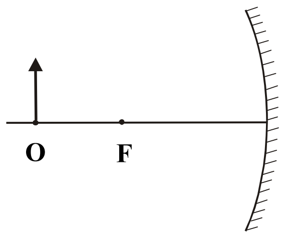
(b) Which one of the following instruments can be used to measured the density of a liquid?

barometer **hydrometer** **thermometer** (7)

(c) What is friction? (7)

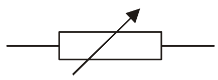
(d) Give one example of a thermometric property. (7)

(e) Copy and complete in your answerbook the following diagram to show how a concave mirror forms an image of an object O, which is placed outside the focus F of the mirror. (7)



(f) Give one use of a spectrometer. (7)

(g) Name the electrical component represented in the diagram. (7)



(h) State Ohm's law. (7)

(i) Give one use of a capacitor. (7)

(j) Give two properties of the electron. (7)

6. Define the term force and give the unit in which force is measured. (9)

Force is a vector quantity. Explain what this means. (6)

Newton's law of universal gravitation is used to calculate the force between two bodies such as the moon and the earth.
Give two factors which affect the size of the gravitational force between two bodies. (9)

Explain the term acceleration due to gravity, *g*. (9)

An astronaut carries out an experiment to measure the acceleration due to gravity on the surface of the moon. He drops an object from a height of 1.6 m above the surface of the moon and the object takes 1.4 s to fall. Use this data to show that the acceleration due to gravity on the surface of the moon is 1.6 m s^{-2}. (9)

The moon

The astronaut has a mass of 120 kg. Calculate his weight on the surface of the moon. (6)

Why is the astronaut's weight greater on earth than on the moon? (5)

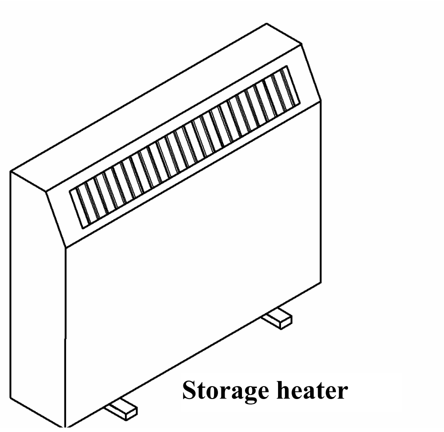
The earth is surrounded by a layer of air, called its atmosphere. Explain why the moon does not have an atmosphere. (3)

($W = mg, \ s = ut + \frac{1}{2}at^2$)

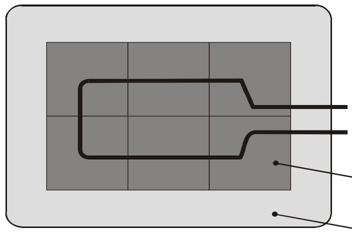
7. Heat can be transferred in a room by convection.
What is convection? Name two other ways of transferring heat. (12)

Describe an experiment to demonstrate convection in a liquid. (12)

In an electric storage heater, bricks with a high specific heat capacity are heated overnight by passing an electric current through a heating coil in the bricks. The bricks are surrounded by insulation.



Storage heater



Internal view

Why is insulation used to surround the bricks?
Name a material that could be used as insulation. (12)

Explain how the storage heater heats the air in a room. (8)

The total mass of the bricks in the storage heater is 80 kg and their specific heat capacity is 1500 J kg^{-1} K^{-1}. During a ten-hour period the temperature of the bricks rose from 15 ^oC to 300 ^oC.

Calculate:

(i) the energy gained by the bricks;

(ii) the power of the heating coil. (12)

($Q = mc\Delta\theta$, $P = \frac{W}{t}$)

8. Describe, using diagrams, the difference between transverse waves and longitudinal waves. (12)

The speed of sound depends on the medium through which the sound is travelling.
Explain how sound travels through a medium. (9)

Describe an experiment to demonstrate that sound requires a medium to travel. (15)

A ship detects the seabed by reflecting a pulse of high frequency sound from the seabed. The sound pulse is detected 0.4 s after it was sent out and the speed of sound in water is 1500 m s^{-1}.
Calculate

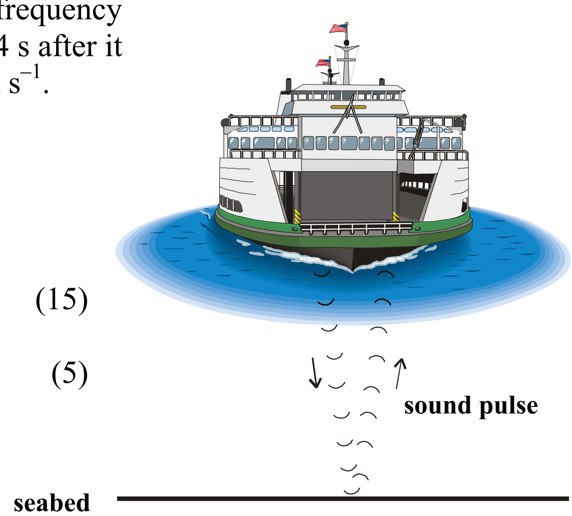
(i) the time taken for the pulse to reach the seabed;

(ii) the depth of water under the ship;

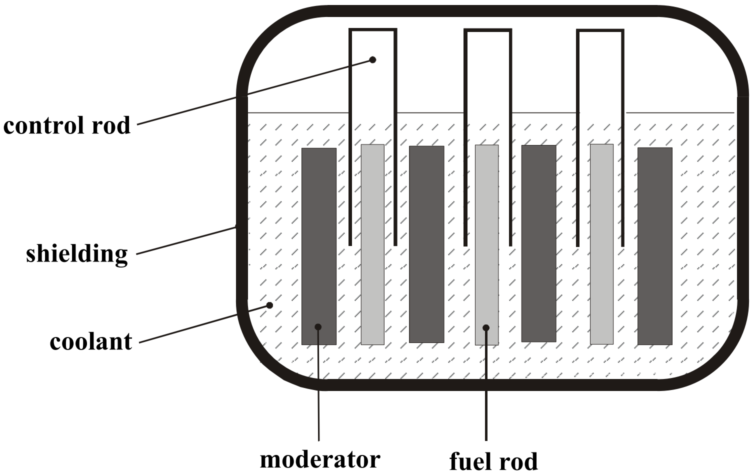
(iii) the wavelength of the sound pulse when its frequency is 50 000 Hz. (15)

Why is the speed of sound greater in water than in air? (5)

$(c = f\lambda,\ \ v = \frac{s}{t})$



9. The diagram shows a simple nuclear fission reactor.



Energy is released in a fission reactor when a chain reaction occurs in the fuel rods.

(i) What is meant by fission? Name a material in which fission occurs. (12)

(ii) Describe how a chain reaction occurs in the fuel rods.
Explain how the chain reaction is controlled. (15)

(iii) What is the purpose of the shielding? Name a material that is used as shielding. (12)

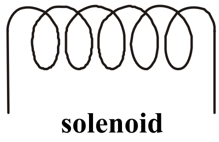
(iv) Describe what happens to the coolant when the reactor is working. (5)

(v) Give one effect of a nuclear fission reactor on the environment. (6)

(vi) Give one precaution that should be taken when storing radioactive materials. (6)

10. What is a magnetic field?

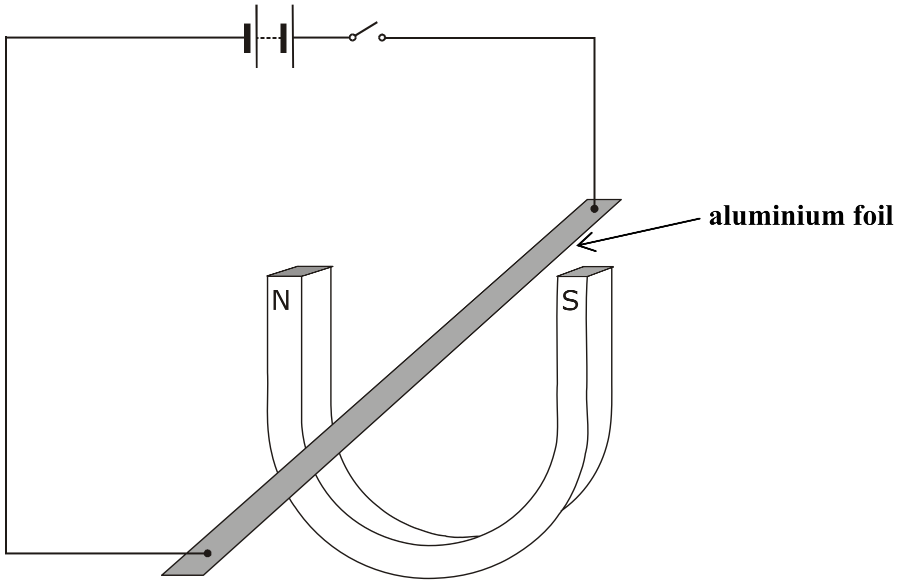
Describe an experiment to show the magnetic field due to a current in a solenoid. (18)



A solenoid carrying a current and containing an iron core is known as an electromagnet.

Give one use of an electromagnet. State one advantage of an electromagnet over an ordinary magnet. (9)

The diagram shows an experiment to demonstrate that a current-carrying conductor experiences a force in a magnetic field. A strip of aluminium foil is placed at right angles to a U-shaped magnet. The foil is connected in series with a battery and a switch.



When the switch is closed the aluminium foil experiences an upward force.

Name a device based on this effect. (6)

Describe what will happen if

(i) the current flows in the opposite direction;

(ii) a larger current flows through the aluminium foil;

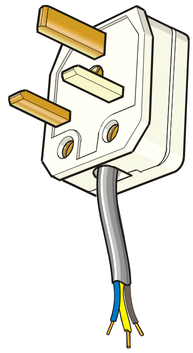
(iii) the aluminium foil is placed parallel to the magnetic field. (15)

Calculate the force on the aluminium foil if its length is 10 cm and a current of 1.5 A flows through it when it is placed in a magnetic field of flux density 3.0 T. (8)

($F = IlB$)

11. Read this passage and answer the questions below.

Electricity is so much part of modern living that we often take it for granted. It is a powerful and versatile energy of great use in the home but can be dangerous if not used properly. The electricity connection into your home comes through the ESB main fuse and the ESB meter. Almost all new electrical appliances now come complete with a fitted 13 Amp, 3-pin plug. Remember, a wrongly wired plug can result in a serious or fatal accident. The first thing to know is the colour code for connecting the cables to the appropriate pin/terminal in the plug. The cables consist of a metal conductor covered in coloured plastic.



When wiring a plug it is most important that all the screw connections are fully tightened. You should leave a little extra slack on the earth wire. You must also fit the correct size fuse. When an appliance is *double insulated* it does not need to be earthed. These appliances will only have two wires, the brown live and the blue neutral, they do not have an earth wire.

(Adapted from *The Safe Use Of Electricity In The Home* by The ESB.)

(a) Give one use for electricity in the home. (7)

(b) What is the function of the ESB meter? (7)

(c) What will happen when a current of 20 A flows through a fuse marked 13 A? (7)

(d) Give one safety precaution that should be taken when wiring a plug. (7)

(e) What is the colour of the earth wire in an electric cable? (7)

(f) Name a common material used to conduct electricity in electric cables. (7)

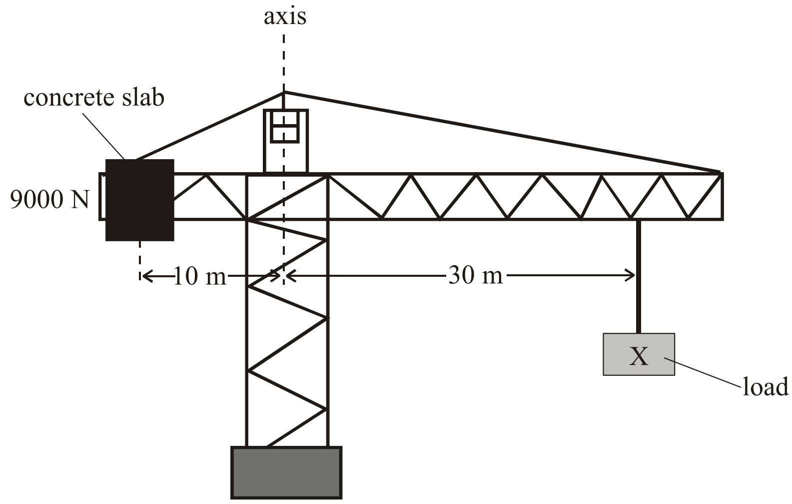
(g) Why is the coating on electric cables made from plastic? (7)

(h) Why are some appliances **not** earthed? (7)

12. Answer any **two** of the following parts *(a), (b), (c), (d)*.

(a) Define the moment of a force. (6)

The diagram shows a crane in equilibrium.



Give one condition that is necessary for the crane to be in equilibrium. (6)

What is the moment of the 9000 N concrete slab about the axis of the crane? (6)

Calculate the value of the load marked X. (6)

A crane is an example of a lever. Give another example of a lever. (4)

(b) The diagram shows the relative positions of electromagnetic radiations in terms of their wavelength.

gamma rays	**A**	UV	light	IR	microwaves	**B**

(i) Name the radiations marked **A** and **B**. (6)

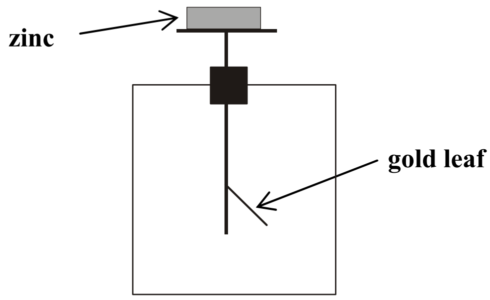
(ii) Give one property which is common to all electromagnetic radiations. (6)

(iii) Which one of the radiations has the shortest wavelength? (6)

(iv) Describe how IR radiation is detected. (6)

(v) Give one use for microwaves. (4)

(c) In an experiment to demonstrate the photoelectric effect, a piece of zinc is placed on a gold leaf electroscope, as shown. The zinc is given a negative charge causing the gold leaf to deflect.



Explain why the gold leaf deflects when the zinc is given a negative charge. (9)

Ultraviolet radiation is then shone on the charged zinc and the gold leaf falls. Explain why. (9)

What is observed when the experiment is repeated using infrared radiation? (6)

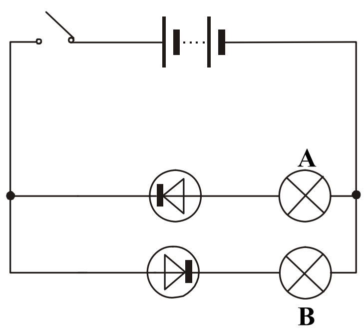
Give one application of the photoelectric effect. (4)

(d) A semiconductor material can be doped to form a p-n junction (semiconductor diode).

Explain the underlined terms. (12)

Name a material used as a semiconductor. (6)

The circuit diagram shows 2 semiconductor diodes and 2 bulbs, labelled **A** and **B**, connected to a 6 V d.c. supply.



What is observed when the switch is closed? Explain why? (10)

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M35

Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION 2007

PHYSICS – ORDINARY LEVEL

MONDAY 18 JUNE – MORNING 9:30 TO 12:30

Answer **three** questions from **section A** and **five** questions from **section B**.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

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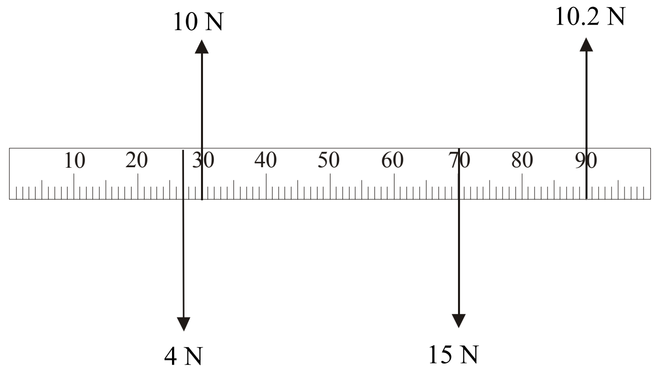
1. A student investigated the laws of equilibrium for a set of co-planar forces acting on a metre stick. The weight of the metre stick was 1.2 N and its centre of gravity was at the 50 cm mark. The student applied the forces shown to the metre stick until it was in equilibrium.



(i) How did the student know the metre stick was in equilibrium? (4)

(ii) Copy the diagram and show **all** the forces acting on the metre stick. (6)

(iii) (a) Find the total upward force acting on the metre stick.

(b) Find the total downward force acting on the metre stick.

(c) Explain how these values verify one of the laws of equilibrium. (15)

(iv) (a) Find the sum of the anticlockwise moments of the upward forces about the 0 mark.

(b) Find the sum of the clockwise moments of the downward forces about the 0 mark.

(c) Explain how these values verify the other law of equilibrium. (15)

2. You carried out an experiment to measure the wavelength of a monochromatic light source using a diffraction grating. The diffraction grating had 600 lines per mm.

(i) Draw a labelled diagram of the apparatus you used. (12)

(ii) Name a source of monochromatic light. (4)

(iii) State what measurements you took during the experiment. (6)

(iv) What is the distance between each line on the diffraction grating? (6)

(v) How did you determine the wavelength of the light? (6)

(vi) Give one precaution that you took to get an accurate result. (6)

3. A student carried out an experiment to obtain the calibration curve of a thermometer. The following is an extract from her report.

I placed the thermometer I was calibrating in a beaker of water along with a mercury thermometer which I used as the standard. I recorded the value of the thermometric property of my thermometer and the temperature of the water as shown on the mercury thermometer. I repeated this procedure at different temperatures. The following is the table of results that I obtained.

Temperature/°C	0	20	40	60	80	100
Value of thermometric property	4	12	24	40	64	150

(i) Draw a labelled diagram of the apparatus used in the experiment. (12)

(ii) Using the data in the table, draw a graph on graph paper of the value of the thermometric property against its temperature. Put temperature on the horizontal axis (X-axis). (12)

(iii) Use your graph to estimate the temperature when the value of the thermometric property is 50. (6)

(iv) Give an example of a thermometric property. (6)

(v) How was the value of this thermometric property measured? (4)

4. In an experiment to verify Joule's law, a heating coil was placed in a fixed mass of water. A current I was allowed to flow through the coil for a fixed length of time and the rise in temperature $\Delta\theta$ was recorded. This was repeated for different values of I.
The table shows the data recorded.

(i) Draw a labelled diagram of the apparatus used. (12)

(ii) How was the current changed during the experiment? (4)

(iii) Copy the table and complete it in your answerbook. (6)

I/A	1.0	1.5	2.0	2.5	3.0	3.5	4.0
I^2/A^2			4				
$\Delta\theta$/°C	2.2	5.0	8.8	13.8	20.0	26.0	35.2

(iv) Using the data in the completed table, draw a graph on graph paper of $\Delta\theta$ against I^2. Put I^2 on the horizontal axis (X-axis). (12)

(v) Explain how your graph verifies Joule's law ($\Delta\theta \propto I^2$). (6)

SECTION B (280 marks)

Answer **five** questions from this section.
Each question carries 56 marks.

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5. Answer any **eight** of the following parts *(a), (b), (c),* etc.

(a) State Newton's second law of motion. (7)

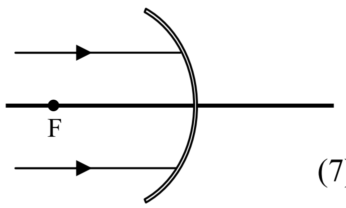
(b) Which of the following is **not** a renewable source of energy?

wind **nuclear** **solar** **hydroelectric** (7)

(c) The temperature of a body is 34 °C. What is its temperature in kelvin? (7)

(d) Name two methods by which heat can be transferred. (7)

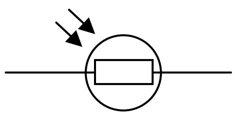
(e) The diagram shows parallel rays of light approaching a concave mirror. Copy the diagram and show the paths of the rays after they strike the mirror. (7)



(f) Give one application of the Doppler effect. (7)

(g) Name two safety devices that are used in domestic electric circuits. (7)

(h) Name the electrical component represented in the diagram. (7)

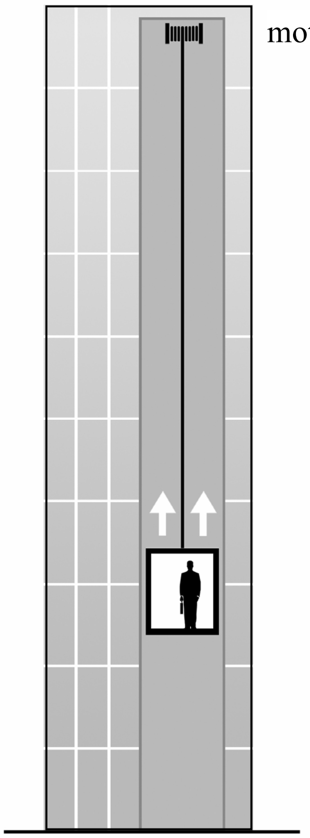


(i) Draw a sketch of the magnetic field around a bar magnet. (7)

(j) The half life of a radioactive element is 3 days. What fraction of a sample of the radioactive element will remain after 9 days? (7)

6. Define (i) work, (ii) power, and give the unit of measurement for each one. (18)

What is the difference between potential energy and kinetic energy? (6)



An empty lift has a weight of 7200 N and is powered by an electric motor. The lift takes a person up 25 m in 40 seconds. The person weighs 800 N.

Calculate:

(i) the total weight raised by the lift's motor (4)

(ii) the work done by the lift's motor (6)

(iii) the power output of the motor (6)

(iv) the energy gained by the person in taking the lift. (6)

If instead the person climbed the stairs to the same height in 2 minutes, calculate the power generated by the person in climbing the stairs. (5)

Give two disadvantages of using a lift. (5)

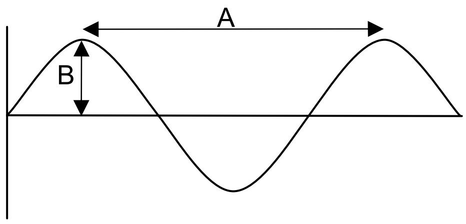
$$(W = Fs,\ P = \frac{W}{t})$$

7. Resonance occurs when a vibrating object causes vibrations in nearby objects which have the same natural frequency.

Explain the underlined terms. (12)

Describe an experiment to demonstrate resonance. (12)

The diagram shows the waveform of a musical note.



What is the name given to (i) the distance **A**, (ii) height **B**? (9)

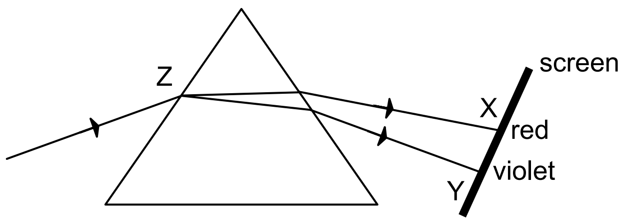
Explain what is meant by the frequency of a wave. (6)

State the wave property on which (i) the loudness, (ii) the pitch, of a note depends. (8)

A tin-whistle produces a note of 256 Hz. Calculate the wavelength of this note.
The speed of sound in air is 340 m s^{-1} (9)

($c = f\lambda$)

8. *(a)* Dispersion occurs when a beam of white light passes through a prism forming a spectrum on a screen, as shown in the diagram.



(i) What is meant by the terms *dispersion* and *spectrum*? (10)

(ii) What happens to the white light when it enters the prism at **Z**? (6)

(iii) Name the invisible radiation formed on the screen at (i) region **X**, (ii) region **Y**. (9)

(iv) Describe how to detect one of these invisible radiations. (12)

(v) Give a use for one of these invisible radiations. (6)

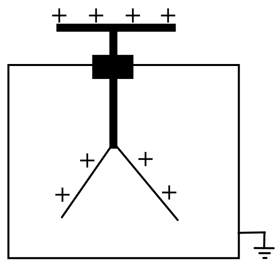
(b) The colour on a TV screen is made by mixing the primary colours.

(i) Name the primary colours. (9)

(ii) How is a secondary colour (e.g. yellow) produced on a TV screen? (4)

9. *(a)* State Coulomb's law of force between charges. (9)

The diagram shows a positively charged gold leaf electroscope.

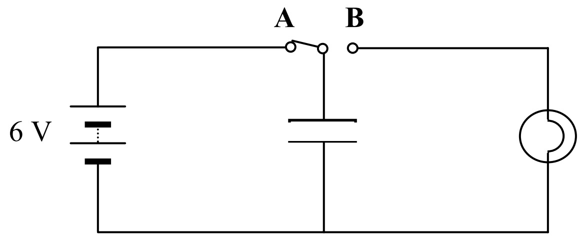


(i) Describe how an electroscope is given a positive charge. (9)

(ii) What is observed when the cap of an electroscope is earthed? Why does this happen? (9)

(iii) How is the cap of the electroscope earthed? (6)

(b) A capacitor is connected to a switch, a battery and a bulb as shown in the diagram. When the switch is moved from position **A** to position **B**, the bulb lights briefly.



(i) What happens to the capacitor when the switch is in position **A**? (6)

(ii) Why does the bulb light when the switch is in position **B**? (6)

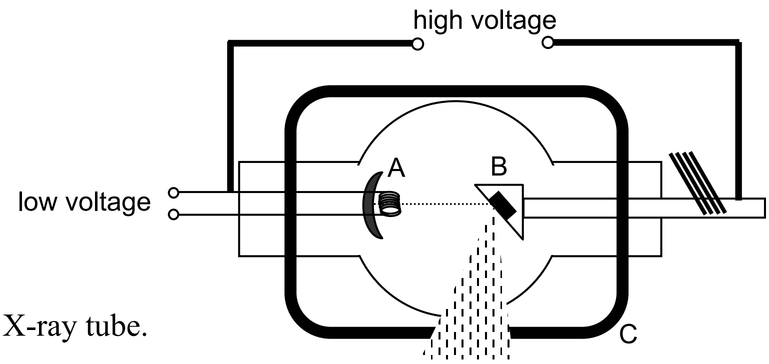
(iii) When the switch is in position **A** the capacitor has a charge of 0.6 C, calculate its capacitance. (6)

(iv) Give a use for a capacitor. (5)

$(C = \frac{Q}{V})$

10. X-rays were discovered by Wilhelm Röntgen in 1895.

What are X-rays? Give one use for X-rays. (12)



The diagram shows a simple X-ray tube.

Name the parts labelled **A**, **B** and **C**. (12)

Electrons are emitted from **A**, accelerated across the tube and strike **B**.

(i) Explain how the electrons are emitted from **A**. (12)

(ii) What is the purpose of the high voltage supply? (6)

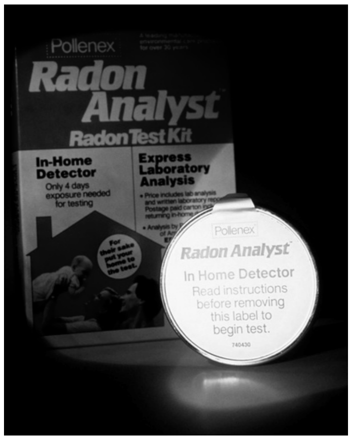
(iii) What happens when the electrons hit part **B**? (4)

(iv) Name a suitable material to use for part **B**. (6)

(v) Give one safety precaution when using X-rays. (4)

11. Read this passage and answer the questions below.

Radon is a naturally occurring radioactive gas. It originates from the decay of uranium, which is present in small quantities in rocks and soils. Radon is colourless, odourless and tasteless and can only be detected using special equipment, like a Geiger-Müller tube, that can measure the radiation it releases. Because it is a gas, radon can move freely through the soil and enter the atmosphere. When radon reaches the open air, it is quickly diluted to harmless concentrations, but when it enters an enclosed space, such as a house, it can sometimes accumulate to unacceptably high concentrations. Radon can enter a building from the ground through small cracks in floors and through gaps around pipes and cables. Radon is drawn from the ground into a building because the indoor air pressure is usually lower than outdoors. Being radioactive, radon decays releasing radiation. When radon is inhaled into the lungs the radiation released can cause damage to the lung tissue.



(Adapted from *Understanding Radon, A Householder's Guide* by the RPII.)

(a) What is radioactivity? (7)

(b) What is the source of radon? (7)

(c) Name a detector of radiation. (7)

(d) How does radon enter a building? (7)

(e) How can the build-up of radon in the home be prevented? (7)

(f) Why is radon dangerous? (7)

(g) Why is radon harmless in the open air? (7)

(h) Name a radioactive element other than radon. (7)

12. Answer any **two** of the following parts *(a), (b), (c), (d)*.

(a) State the principle of conservation of momentum.

A rocket is launched by expelling gas from its engines. Use the principle of conservation of momentum to explain why a rocket rises. (16)

The diagram shows two shopping trolleys each of mass 12 kg on a smooth level floor. Trolley **A** moving at 3.5 m s^{-1} strikes trolley **B**, which is at rest.
After the collision both trolleys move together in the same direction.

Calculate:

(i) the initial momentum of trolley **A**

(ii) the common velocity of the trolleys after the collision. (12)

($p = mu$)

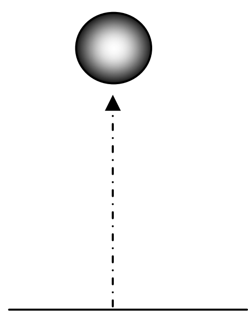
(b) (i) Define pressure.

Describe an experiment to demonstrate that the atmosphere exerts pressure. (14)

(ii) State Boyle's law.

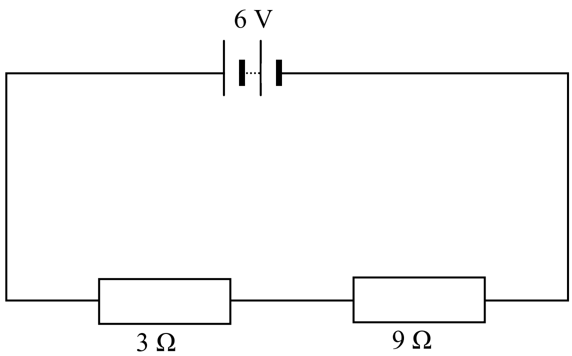
A balloon rises through the atmosphere while the temperature remains constant.
The volume of the balloon is 2 m^3 at ground level where the pressure is 1000 hPa.

Find the volume of the balloon when it has risen to a height where the atmospheric pressure is 500 hPa.



What will happen to the balloon as it continues to rise? (14)

(c) State Ohm's law. (6)



The circuit diagram shows two resistors connected in series with a 6 V battery.

Calculate:

(i) the total resistance of the circuit (6)

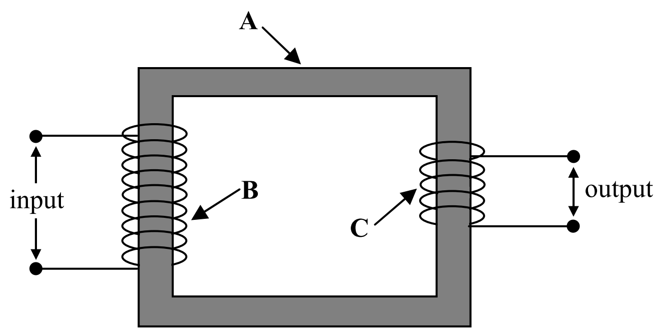
(ii) the current in the circuit (6)

(iii) the potential difference across the 9 Ω resistor. (6)

Name an instrument used to measure potential difference. (4)

($V=IR$)

(d) What is electromagnetic induction? (10)



The diagram shows a transformer.

(i) Name the parts labelled **A** and **B**.

(ii) The input voltage is 230 V. Part **B** has 4600 turns and part **C** has 120 turns. Calculate the output voltage.

(iii) Name a device that uses a transformer. (18)

$\left(\frac{V_i}{V_o} = \frac{N_p}{N_s}\right)$

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Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION 2008

PHYSICS – ORDINARY LEVEL

MONDAY, 16 JUNE – MORNING 9:30 TO 12:30

Answer **three** questions from **section A** and **five** questions from **section B**.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

---

1. A student carried out an experiment to find the acceleration of a moving trolley. The student measured the velocity of the trolley at different times and plotted a graph which was then used to find its acceleration. The table shows the data recorded.

velocity/m s^{-1}	0.9	1.7	2.5	3.3	4.1	4.9
time/s	0	2	4	6	8	10

(i) Describe, with the aid of a diagram, how the student measured the velocity of the trolley. (15)

(ii) Using the data in the table, draw a graph on graph paper of the trolley's velocity against time. Put time on the horizontal axis (X-axis). (15)

(iii) Find the slope of your graph and hence determine the acceleration of the trolley. (10)

2. You carried out an experiment to find the speed of sound in air, in which you measured the frequency and the wavelength of a sound wave.

(i) With the aid of a diagram describe the adjustments you carried out during the experiment. (12)

(ii) How did you find the frequency of the sound wave? (6)

(iii) How did you measure the wavelength of the sound wave? (9)

(iv) How did you calculate the speed of sound in air? (9)

(v) Give one precaution you took to get an accurate result. (4)

3. An experiment was carried out to measure the refractive index of a substance. The experiment was repeated a number of times.

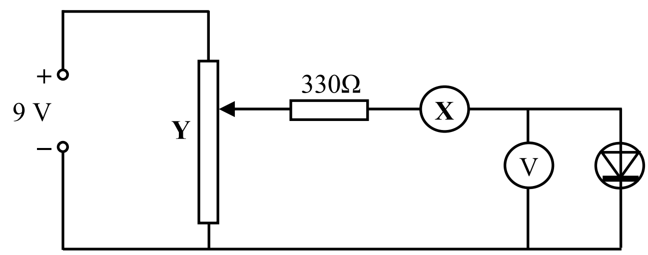
(i) Draw a labelled diagram of the apparatus that could be used in this experiment. (12)

(ii) What measurements were taken during the experiment? (12)

(iii) How was the refractive index of the substance calculated? (10)

(iv) Why was the experiment repeated? (6)

4. The diagram shows a circuit used to investigate the variation of current with potential difference for a semiconductor diode in forward bias.



(i) Name the apparatus **X**. What does it measure? (6)

(ii) Name the apparatus **Y**. What does it do? (6)

(iii) What is the function of the 330 Ω resistor in this circuit? (6)

The table shows the values of the potential difference used and its corresponding current recorded during the experiment.

potential difference/V	0	0.2	0.4	0.6	0.8	1.0
current/mA	0	3	6	14	50	100

Using the data in the table, draw a graph on graph paper of the current against the potential difference. Put potential difference on the horizontal axis (X-axis). (12)

What does the graph tell you about the variation of current with potential difference for a semiconductor diode? (10)

SECTION B (280 marks)

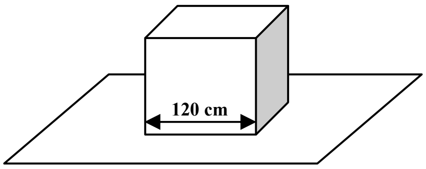
Answer **five** questions from this section.
Each question carries 56 marks.

---

5. Answer any **eight** of the following parts (*a*), (*b*), (*c*), etc.

(*a*) State the principle of conservation of momentum. (7)

(*b*) A solid block in the shape of a cube of length 120 cm rests on a table. The weight of the block is 25 N. Calculate the pressure it exerts on the table. (7)
$(P = \frac{F}{A})$



(*c*) Which of the following is the unit of energy? (7)

kelvin **watt** **newton** **joule**

(*d*) What physical quantity is measured in decibels? (7)

(*e*) A concave lens has a power of 0.1 cm^{-1}. What is the focal length of the lens? (7)
$(P = \frac{1}{f})$

(*f*) Give one effect of static electricity? (7)

(*g*) Give two uses for the instrument shown. (7)

(*h*) What is the colour of the live wire in an electric cable? (7)

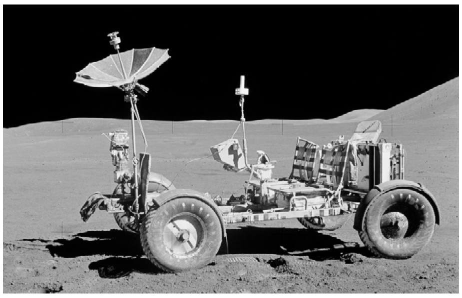
(*i*) State two properties of X-rays. (7)

(*j*) What is nuclear fusion? (7)

6. The weight of an object is due to the gravitational force acting on it.
Newton investigated the factors which affect this force.

Define force and give the unit of force.
State Newton's law of universal gravitation. (18)

Calculate the acceleration due to gravity on the moon.
The radius of the moon is 1.7×10^6 m and the mass of the moon is 7×10^{22} kg. (16)

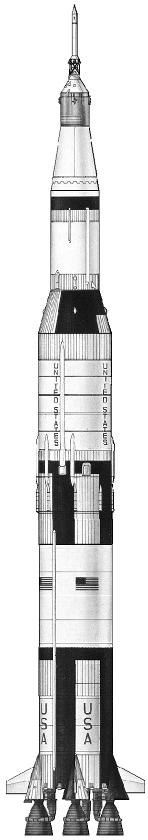


A lunar buggy designed to travel on the surface of the moon had a mass of 2000 kg when built on the earth.

(i) What is the weight of the buggy on earth?

(ii) What is the mass of the buggy on the moon?

(iii) What is the weight of the buggy on the moon? (16)



A powerful rocket is required to leave the surface of the earth.
A less powerful rocket is required to leave the surface of the moon.
Explain why. (6)

($W = mg$, $g = \dfrac{GM}{R^2}$, $G = 6.7 \times 10^{-11}$ N m^2 kg^{-2},
acceleration due to gravity on earth = 9.8 m s^{-2})

7. The temperature of an object is measured using a thermometer, which is based on the variation of its thermometric property.

(i) What is meant by temperature?

(ii) What is the unit of temperature?

(iii) Give an example of a thermometric property. (18)

The rise in temperature of an object depends on the amount of heat transferred to it and on its specific heat capacity.

(iv) What is heat?

(v) Name three ways in which heat can be transferred.

(vi) Define specific heat capacity. (21)

A saucepan containing 500 g of water at a temperature of 20 °C is left on a 2 kW ring of an electric cooker until it reaches a temperature of 100 °C. All the electrical energy supplied is used to heat the water.

Calculate:

(i) the rise in temperature of the water;

(ii) the energy required to heat the water to 100 °C;

(iii) the amount of energy the ring supplies every second;

(iv) the time it will take to heat the water to 100 °C. (17)

($Q = mc\Delta\theta$, $P = \frac{W}{t}$, specific heat capacity of water = 4200 J kg^{-1} K^{-1})

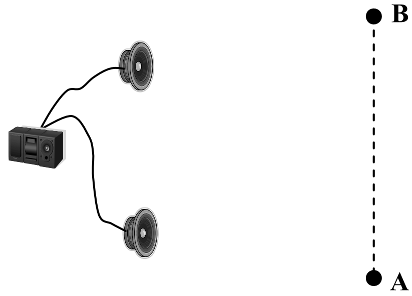
8. The diagram shows a signal generator connected to two loudspeakers emitting the same note.

A person walks slowly along the line **AB**.

(i) What will the person notice?

(ii) Why does this effect occur?

(iii) What does this tell us about sound? (21)



Describe an experiment to demonstrate that sound requires a medium to travel. (14)

The pitch of a note emitted by the siren of a fast moving ambulance appears to change as it passes a stationary observer.

(i) Name this phenomenon.

(ii) Explain how this phenomenon occurs.

(iii) Give an application of this phenomenon. (21)

9. An electric current flows in a conductor when there is a potential difference between its ends.

(i) What is an electric current? (6)

(ii) Give two effects of an electric current. (6)

(iii) Name a source of potential difference. (4)

Describe an experiment to investigate if a substance is a conductor or an insulator. (10)

The two headlights of a truck are connected in parallel to a 24 V supply.

(i) Draw a circuit diagram to show how the headlights are connected to the supply. (6)

(ii) What is the advantage of connecting them in parallel? (6)

(iii) Why should a fuse be included in such a circuit? (6)

The resistance of each headlight is 20 Ω.

Calculate:

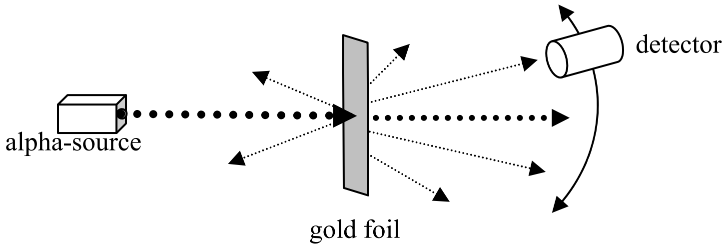
(iv) the total resistance in the circuit; (6)

(v) the current flowing in the circuit. (6)

$(V = IR\,;\quad \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2})$

10. Give two properties of an electron. (9)

The diagram shows the arrangement used by Rutherford to investigate the structure of the atom. During the investigation he fired alpha-particles at a thin sheet of gold foil in a vacuum.



(i) What are alpha-particles? (9)

(ii) Describe what happened to the alpha-particles during the experiment. (9)

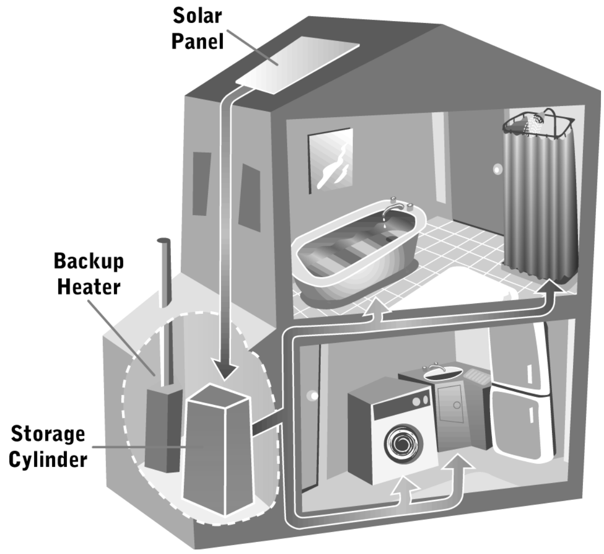
(iii) What conclusion did Rutherford make about the structure of the atom? (9)

(iv) How are the electrons arranged in the atom? (9)

(v) Name a device used to detect alpha-particles. (6)

(vi) Why was it necessary to carry out this experiment in a vacuum? (5)

11. Read this passage and answer the questions below.



Energy is essential to the comfort of our homes. There are many ways of reducing energy needs and meeting those needs with renewable sources. The main sources of renewable energy are the sun (solar energy), the wind, moving water (hydropower, wave and tidal energy), heat below the surface of the earth (geothermal energy) and biomass (wood, waste, crops).

Solar heating systems are used in many homes. These systems have two main parts: a solar panel and a hot water storage cylinder. Typically, a panel is placed on the roof, facing directly south. However, a good output can still be achieved between south-east and south-west.

The sun heats a black metal plate in the panel, which, in turn, heats water in pipes in the panel. To move the heated water between the panel and the storage cylinder, a system either uses a pump or the tendency of water to naturally circulate as it is heated. The solar water heating system needs to be backed up by a conventional heat source.

(Adapted from '*Renewable energy in the home' a guide* by Sustainable Energy Ireland.)

(*a*) State two uses of energy in the home. (7)

(*b*) Give two ways to reduce energy needs in the home. (7)

(*c*) List the main sources of renewable energy. (7)

(*d*) What are the main parts of a solar heating system? (7)

(*e*) Why does a solar panel need to face south? (7)

(*f*) What is the function of the backup heater? (7)

(*g*) Why are parts of the solar panel painted black? (7)

(*h*) What is the name given to the tendency of water to circulate as it is heated? (7)

12. Answer any **two** of the following parts (*a*), (*b*), (*c*), (*d*).

(*a*) Define (i) velocity, (ii) acceleration. (9)

A speedboat starts from rest and reaches a velocity of 20 m s^{-1} in 10 seconds.
It continues at this velocity for a further 5 seconds.
The speedboat then comes to a stop in the next 4 seconds.

(i) Draw a velocity-time graph to show the variation of velocity of the boat during its journey. (6)

(ii) Use your graph to estimate the velocity of the speedboat after 6 seconds. (3)

(iii) Calculate the acceleration of the boat during the first 10 seconds. (6)

(iv) What was the distance travelled by the boat when it was moving at a constant velocity? (4)

($v = u + at$)

(*b*) Sunlight is made up of different colours and invisible radiations.

(i) How would you show the presence of the different colours in light? (9)

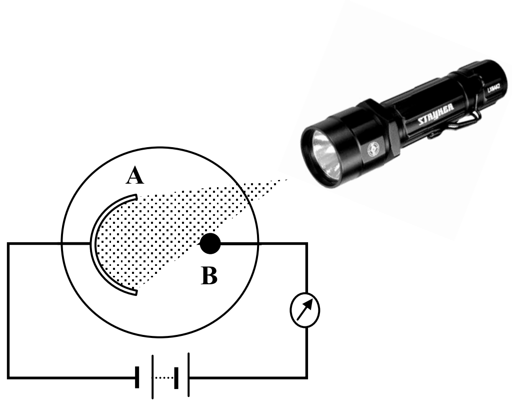
(ii) Name two radiations in sunlight that the eye cannot detect. (6)

(iii) Describe how to detect one of these radiations. (9)

(iv) Give a use for this radiation. (4)

(*c*) What is the photoelectric effect? (6)

A photocell is connected to a sensitive galvanometer as shown in the diagram. When light from the torch falls on the photocell, a current is detected by the galvanometer.



(i) Name the parts of the photocell labelled **A** and **B**. (6)

(ii) How can you vary the brightness of the light falling on the photocell? (6)

(iii) How does the brightness of the light effect the current? (4)

(iv) Give a use for a photocell. (6)

(*d*) What is electromagnetic induction? (6)

A magnet and a coil can be used to produce electricity.
How would you demonstrate this? (16)

The electricity produced is a.c. What is meant by a.c.? (6)

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2009. M 35

Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2009

PHYSICS – ORDINARY LEVEL

MONDAY 15 JUNE – MORNING 9:30 TO 12:30

Answer **three** questions from **Section A** and **five** questions from **Section B**.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

---

1. You carried out an experiment to measure *g*, the acceleration due to gravity.

(i) Draw a labelled diagram of the apparatus you used. (12)

(ii) State what measurements you took during the experiment. (6)

(iii) Describe how you took one of these measurements. (9)

(iv) How did you calculate the value of *g* from your measurements? (9)

(v) Give one precaution that you took to get an accurate result. (4)

2. A student carried out an experiment to measure the specific latent heat of fusion of ice. The following is an extract from her report.

> "In my experiment, I prepared ice which was at 0 °C and I added it to warm water in a calorimeter. I waited for all the ice to melt before taking more measurements. I used my measurements to calculate the specific latent heat of fusion of ice."

(i) Draw a labelled diagram of the apparatus used in the experiment. (12)

(ii) What measurements did the student take in the experiment? (12)

(iii) How did the student prepare the ice for the experiment? (4)

(iv) How did the student know the ice was at 0 °C? (6)

(v) Why did the student use warm water in the experiment? (6)

3. In an experiment, a student investigated the variation of the fundamental frequency *f* of a stretched string with its length *l*. During the experiment the student kept the tension in the string constant. The table shows the data recorded by the student.

f/Hz	100	150	200	250	300	350	400
l/m	0.50	0.33	0.25	0.20	0.166	0.142	0.125
$\frac{1}{l}$/m^{-1}						7.04	

(i) Describe, with the aid of a diagram, how the student obtained the data. (12)

(ii) Why was the tension in the string kept constant during the experiment? (6)

(iii) Copy this table and fill in the last row by calculating $\frac{1}{l}$ for each measurement. (6)

(iv) Plot a graph on graph paper to show the relationship between the fundamental frequency and the length of the stretched string (put $\frac{1}{l}$ on the X-axis). (12)

(v) What does your graph tell you about the relationship between the fundamental frequency of a stretched string and its length? (4)

4. In an experiment to investigate the variation of the resistance *R* of a thermistor with its temperature θ, a student measured the resistance of the thermistor at different temperatures. The table shows the measurements recorded by the student.

θ/°C	20	30	40	50	60	70	80
R/Ω	2000	1300	800	400	200	90	40

(i) Draw a labelled diagram of the apparatus used in this experiment. (12)

(ii) How did the student measure the resistance of the thermistor? (6)

(iii) Plot a graph on graph paper to show the relationship between the resistance *R* of the thermistor and its temperature θ (put θ on the X-axis). (12)

(iv) Use your graph to estimate the temperature of the thermistor when its resistance is 1000 Ω. (4)

(v) What does your graph tell you about the relationship between the resistance of a thermistor and its temperature? (6)

SECTION B (280 marks)

Answer **five** questions from this section.
Each question carries 56 marks.

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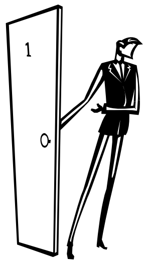
5. Answer any **eight** of the following parts *(a), (b), (c),* etc.

(a) State the principle of conservation of momentum. (7)



(b) A man opens a door by applying a force of 5 N to the door. The distance from the point of application of the force to the fulcrum is 120 cm. Calculate the moment of the applied force. (7)
($M = Fd$)

(c) Which of the following is the unit of energy? (7)

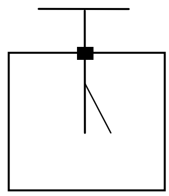
kilogram **watt** **joule** **ampere**

(d) Calculate the wavelength of a radio wave whose frequency is 252 kHz. (7)
($c = f\lambda$, $c = 3.0 \times 10^8$ m s^{-1})

(e) Draw a diagram to show the path of a ray of light travelling through an optical fibre. (7)

(f) Name the property on which the pitch of a musical note depends. (7)

(g) Name the instrument shown in the diagram. (7)



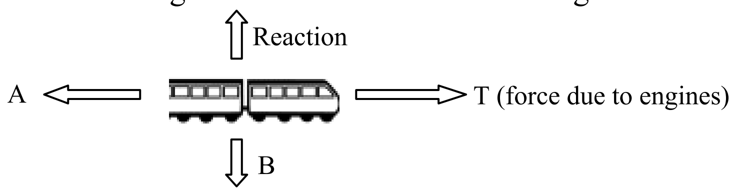
(h) What are isotopes? (7)

(i) Give one application of the photoelectric effect. (7)

(j) List **two** properties of X-rays. (7)

6. Define (i) velocity, (ii) friction. (6)

The diagram shows the forces acting on a train which was travelling horizontally.



A train of mass 30000 kg started from a station and accelerated at 0.5 m s^{-2} to reach its top speed of 50 m s^{-1} and maintained this speed for 90 minutes.

As the train approached the next station the driver applied the brakes uniformly to bring the train to a stop in a distance of 500 m.

(i) Calculate how long it took the train to reach its top speed. (4)

(ii) Calculate how far it travelled at its top speed. (6)

(iii) Calculate the acceleration experienced by the train when the brakes were applied. (6)

(iv) What was the force acting on the train when the brakes were applied? (6)

(v) Calculate the kinetic energy lost by the train in stopping. (6)

(vi) What happened to the kinetic energy lost by the train? (6)

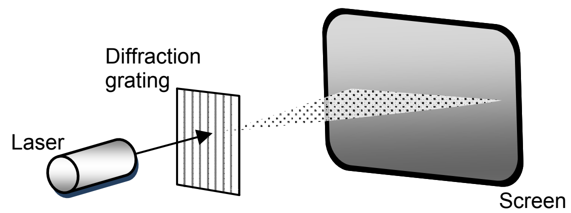
(vii) Name the force A and the force B acting on the train, as shown in the diagram. (4)

(viii) Describe the motion of the train when the force A is equal to the force T. (4)

(ix) Sketch a velocity-time graph of the train's journey. (8)

($v = u + at$, $v^2 = u^2 + 2as$, $s = ut + ½at^2$, $E_k = ½mv^2$, $F = ma$)

7. In an experiment a beam of <u>monochromatic light</u> passes through a <u>diffraction grating</u> and strikes a screen.



(i) Explain the underlined terms. (12)

(ii) Describe what is observed on the screen. (6)

(iii) Explain, with the aid of a diagram, how this phenomenon occurs. (14)

(iv) What does this experiment tell us about the nature of light? (6)

(v) Name the property of light that can be determined in this experiment. (6)

(vi) What measurements must be taken to determine the property you named? (12)

8. Plugs are used to connect electrical appliances in the home to the 230 volt ESB supply. Modern plugs contain a small fuse which comes with a rating of 1A, 2A, 3A, 5A or 13A. The electrical energy supplied by ESB to the home is measured in kWh (*kilowatt-hour*).

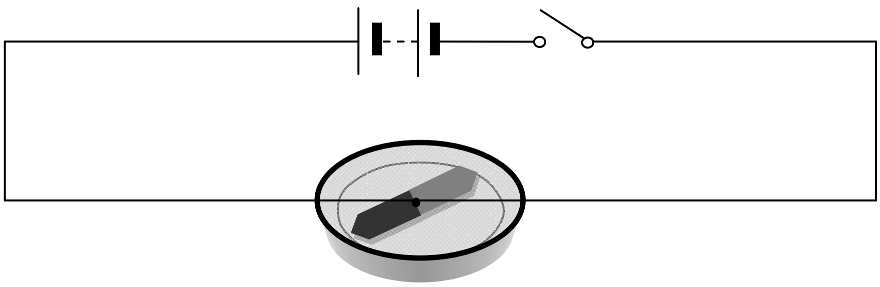
(i) What is the colour of the wire that should be connected to the fuse in a plug? (6)
(ii) What is the function of a fuse? (6)
(iii) Explain how a fuse works. (9)
(iv) Name another device with the same function as a fuse. (4)
(v) A coffee maker has a power rating of 800 W.
What is the most suitable fuse to use in the plug of the coffee maker? (9)
(vi) Why would it be dangerous to use a fuse with too high a rating? (6)

If the coffee maker was in use for 150 minutes, calculate:
(vii) The number of units of electricity used by the coffee maker. (10)
(viii) The cost of the electricity used if each unit costs 15 cent. (6)

($P = VI$)

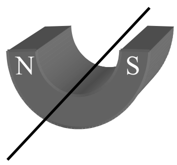
9. A magnetic field exists in the vicinity of a magnet. What is a magnetic field? (6)
Describe an experiment to show the shape of the magnetic field around a U-shaped magnet. (12)

The diagram shows a compass placed near a wire connected to a battery and a switch.



(i) Why happens to the compass when the switch is closed? (6)
(ii) What does this tell you about an electric current? (6)
(iii) What happens to the compass when the switch is opened? (6)

The wire is then placed between the poles of a U-shaped magnet, as shown in the diagram.



(iv) Describe what happens to the wire when a current flows through it. (6)
(v) What would happen if the current flowed in the opposite direction? (6)
(vi) Name two devices that are based on this effect. (8)

10. Radioactive elements are unstable and decay with the release of radiation.

How would you detect radiation? (6)

Name the three types of radiation.

(i) Which radiation is negatively charged?

(ii) Which radiation has the shortest range?

(iii) Which radiation is not affected by electric fields? (12)

Nuclear fission occurs in a nuclear reactor.

(iv) What is nuclear fission? (6)

(v) What is the role of neutrons in nuclear fission? (6)

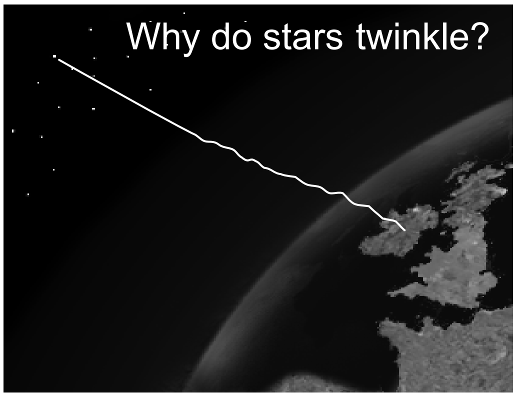
(vi) Name a fuel used in a nuclear reactor. (6)

(vii) In a nuclear reactor, how can the fission be controlled or stopped? (6)

(viii) How is the energy produced in a nuclear reactor used to generate electricity? (9)

(ix) Give one advantage and one disadvantage of a nuclear reactor as a source of energy. (5)

11. Read this passage and answer the questions below.



Why do stars and the lights of distant objects twinkle?

The twinkling of stars, also known as stellar scintillation, is due to atmospheric turbulence. The turbulence of the air is caused by heat changing the density and thus the refractive index of moving pockets of air in the earth's atmosphere. These moving pockets of air act like lenses, refracting light in random directions and causing the stars to "twinkle" – it looks as though the star moves a bit and that it changes colour, and our eyes interprets this as twinkling.

Heat rising from buildings in towns ensures the air is always turbulent around them. We don't usually notice its effect on the appearance of nearby lights, because the turbulence is small by comparison with the size of the lights. On the other hand, lights from a distant town appear so small that the effect of turbulence on them has a significant impact, which we see as twinkling.

The same phenomenon, incidentally, allows us to tell the difference between stars and planets in the night sky. Planets do not usually twinkle, because they are closer to us; they appear big enough that the twinkling is not noticeable. The point-like images of the immensely distant stars are affected by turbulent air far more than the planets.

Stars closer to the horizon appear to twinkle more than stars that are overhead - because the light from stars near the horizon has to travel through more air than the light from stars overhead and so is subject to more refraction.

(Adapted from '*Why don't Spiders Stick to their Webs? and other everyday Mysteries of Science'* by Robert Matthews, One World publications)

(*a*) What causes the twinkling of stars? (7)

(*b*) Give another name for the twinkling of stars. (7)

(*c*) What is meant by the refraction of light? (7)

(*d*) Name two properties of air that are affected by atmospheric turbulence. (7)

(*e*) Why is the air turbulent in towns? (7)

(*f*) How can you tell the difference between a planet and a star in the night sky? (7)

(*g*) Why do stars close to the horizon twinkle more? (7)

(*h*) A star emits light, what is the source of this energy? (7)

12. Answer any two of the following parts (*a*), (*b*), (*c*), (*d*).

(*a*) Define pressure. (6)

Describe an experiment to show that the pressure in a liquid increases with depth. (12)

A diver is swimming in a lake at a depth of 5 m.
He then dives deeper until he reached a depth of 30 m.
Calculate the increase in pressure on the diver at this new depth.
(10)

($p = \rho g h$; density of water = 1000 kg m^{-3} ; g = 9.8 m s^{-2})

(*b*) What is meant by the temperature of a body? (6)

Name two scales that are used to measure temperature.
What is the boiling point of water on each of these scales? (9)

The diagram shows a laboratory thermometer, what is its thermometric property? (3)

Name one other type of thermometer and state its thermometric of property. (6)

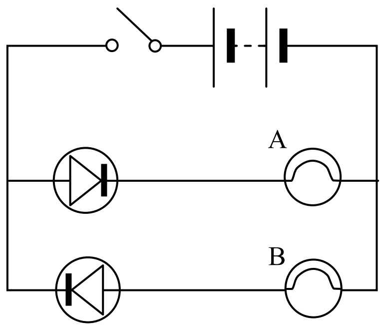
Why is there a need for a standard thermometer? (4)

(*c*) A p-n junction (diode) is formed by <u>doping</u> adjacent layers of a <u>semiconductor</u>.
A depletion layer is formed at their junction.

Explain the underlined terms. (9)

How is a depletion layer formed? (6)

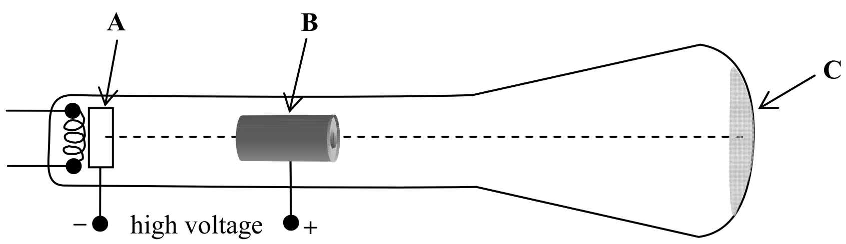
The diagram shows two diodes connected to two bulbs A and B, a 6 V supply and a switch.



What is observed when the switch is closed? (6)

Explain why this happens. (7)

(*d*) The diagram shows a simple cathode ray tube. Thermionic emission occurs at plate **A**.



(i) What is thermionic emission? (6)

(ii) What are cathode rays? (6)

(iii) Why is there a high voltage between **A** and **B**? (6)

(iv) What happens to the cathode rays when they hit the screen **C**? (6)

(v) Give a use for a cathode ray tube. (4)

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2010. M35

Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2010

PHYSICS – ORDINARY LEVEL

MONDAY, 21 JUNE – MORNING, 9:30 to 12:30

Answer **three** questions from **Section A** and **five** questions from **Section B**.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

---

1. You carried out an experiment to investigate the relationship between the acceleration of a body and the force applied to it. You did this by applying a force to a body and measuring the resulting acceleration. The table shows the data recorded during the experiment.

Force / N	0.20	0.25	0.30	0.35	0.40	0.45	0.50
acceleration / m s^{-2}	0.4	0.5	0.6	0.7	0.8	0.9	1.0

(i) Draw a labelled diagram of the apparatus you used. (9)

(ii) How did you measure the applied force? (6)

(iii) How did you minimise the effect of friction during the experiment? (6)

(iv) Plot a graph on graph paper of the body's acceleration against the force applied to it. (12)

(v) What does your graph tell you about the relationship between the acceleration of the body and the force applied to it? (7)

2. A student carried out an experiment to measure the specific heat capacity of a substance. The following is an extract from her report.

> "I set up the apparatus. I took a series of measurements before I heated the substance. I then took further measurements. I used these measurements to find the specific heat capacity of the substance."

(i) Draw a labelled diagram of the apparatus used in the experiment. (12)

(ii) Describe how the mass of the substance was determined. (6)

(iii) What other measurements did the student take during the experiment? (9)

(iv) Give the formula used to calculate the specific heat capacity of the substance. (7)

(v) Give a precaution that the student should have taken to get an accurate result. (6)

3. A student carried out an experiment to measure the focal length of a concave mirror. The student placed an object in front of the mirror so that a real image was formed. The student repeated the experiment by placing the object at different positions and each time recorded the object distance u and the image distance v.

The table shows the data recorded by the student.

u/cm	20	30	50
v/cm	65	32	23

(i) Draw a labelled diagram showing how the apparatus was arranged. (12)

(ii) Mark the distances u and v on your diagram. (6)

(iii) How was the position of the real image located? (6)

(iv) Calculate the value for the focal length f of the mirror using the above data. (12)

(v) Why did the student repeat the experiment? (4)

4. In an experiment to determine the resistivity of the material of a wire, a student measured the length, diameter and resistance of a sample of nichrome wire.

The table shows the data recorded by the student.

R/Ω	20.2		
l/cm	48.8		
d/mm	0.21	0.20	0.18

(i) Describe how the student measured the resistance of the wire. (6)

(ii) Describe how the length of the wire was measured. (4)

(iii) What instrument did the student use to measure the diameter of the wire?
Why did the student measure the diameter of the wire at different places? (12)

(iv) Using the data, calculate the cross-sectional area of the wire. (9)

(v) Find the resistivity of nichrome. (9)

$(\rho = \frac{RA}{l}\ ,\ A = \pi r^2)$

SECTION B (280 marks)

Answer **five** questions from this section.
Each question carries 56 marks.

---

5. Answer any **eight** of the following parts (*a*), (*b*), (*c*), etc.

(*a*) State Boyle's law. (7)

(*b*) A concrete mixer delivered 50 m^3 of concrete to a building site. Calculate the mass of the concrete delivered. (7)

($\rho = \frac{m}{V}$; density of concrete = 2400 kg m^{-3})

(*c*) State Archimedes' Principle. (7)

(*d*) Which one of the following scientists is associated with the refraction of light? (7)

Rutherford **Snell** **Joule** **Einstein**

(*e*) If the temperature of an object is 28 °C, what is its temperature in Kelvin? (7)

(*f*) Give one difference between a light wave and a sound wave. (7)

(*g*) Sketch the magnetic field around a bar magnet. (7)

(*h*) Give a common use of a capacitor. (7)

(*i*) In semiconductors, what is meant by doping? (7)

(*j*) What type of nuclear reaction occurs in a nuclear power station? (7)

6. Define (*a*) momentum, (*b*) kinetic energy. (12)

State the principle of conservation of momentum.
Explain how this principle applies in launching a spacecraft. (12)

An ice skater of mass 50 kg is moving with a speed of 6 m s^{-1} when she collides with another skater of mass 70 kg who is standing still. The two skaters then move off together.

(i) Calculate the momentum of each skater before the collision. (6)

(ii) What is the momentum of the two skaters after the collision? (6)

(iii) Calculate the speed of the two skaters after the collision. (6)

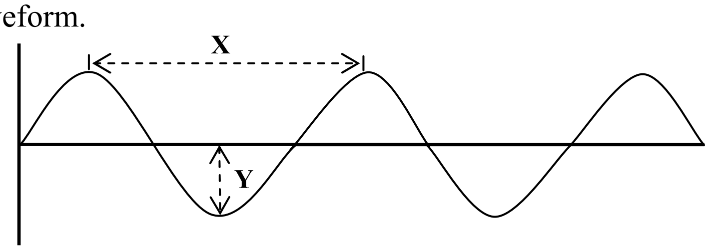
(iv) Calculate the kinetic energy of each skater before the collision. (6)

(v) Calculate the kinetic energy of the two of skaters after the collision. (4)

(vi) Comment on the total kinetic energy values before and after the collision. (4)

($p = mv$, $E_k = ½mv^2$)

7. The diagram shows a waveform.



(i) What is the name given to the distance (*a*) **X**, (*b*) **Y**? (6)

(ii) What is meant by the frequency of a wave? (6)

(iii) Explain the term natural frequency? (6)

(iv) If the natural frequency of a vibrating string is 250 Hz, calculate the wavelength of the sound produced. (9)

(v) State the wave property on which (*c*) the loudness, (*d*) the pitch, of a musical note depends. (9)

Resonance can occur between objects of the same natural frequency.
An opera singer singing a high pitched note can shatter a glass.
Explain why. (6)

Describe a laboratory experiment to demonstrate resonance. (14)

($c = f\lambda$, speed of sound in air = 340 m s^{-1})

8. (*a*) What is heat? (6)

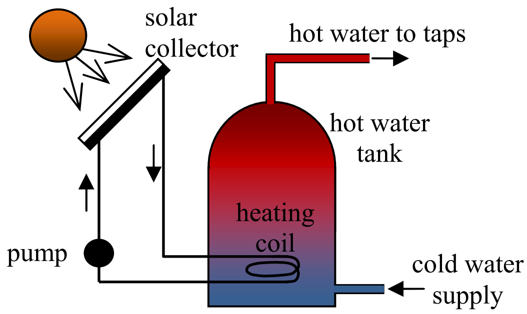
Explain how heat is transferred in a solid. (9)

Describe an experiment to compare the rates of heat transfer through different solids. (12)

Explain the term U-value. (6)

How can the U-value of the walls of a house be reduced? (4)

(*b*) The diagram shows a solar heating system.



(i) How is the sun's energy transferred to the solar collector? (3)

(ii) Why is a solar collector painted black? (3)

(iii) How is the heat transferred from the solar collector to the hot water tank? (3)

(iv) The heating coil in the hot water tank is near the bottom. Explain why. (4)

(v) Give an advantage and a disadvantage of a solar heating system. (6)

9. (*a*) State Coulomb's law of force between electric charges. (9)

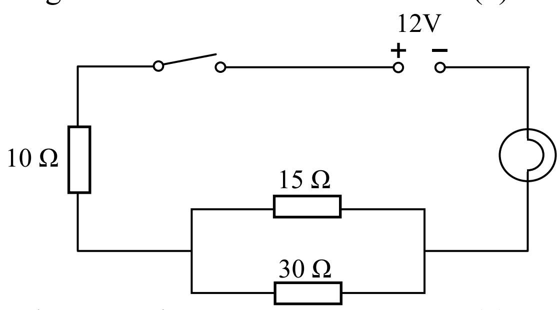
An electric field exists around a charged object.

(i) How would you detect the presence of an electric field? (9)
(ii) What is the unit of electric charge? (4)

Static electricity generated during a storm can cause lightning which can damage buildings. To prevent damage tall buildings have lightning conductors.

(iii) How does the lightning conductor prevent damage to the building? (6)
(iv) Suggest a suitable material for a lightning conductor. (4)

(*b*) State Ohm's law. (6)



The diagram shows a number of resistors connected to a 12 V battery and a bulb whose resistance is 4 Ω.

Calculate:

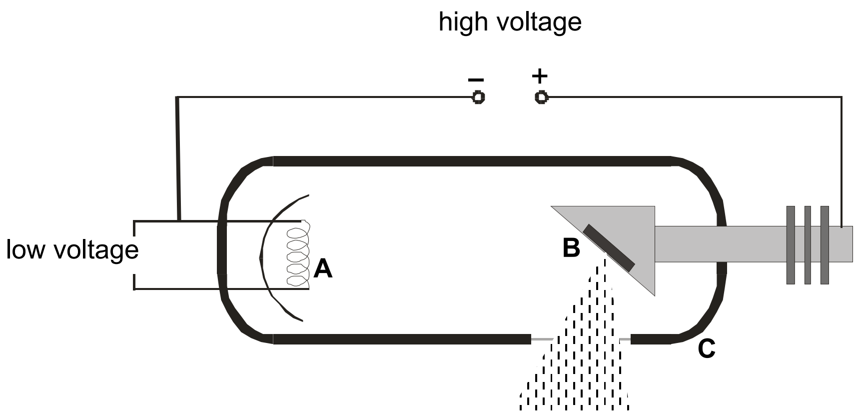
(i) the combined resistance of the 15 Ω and 30 Ω resistors (6)

(ii) the total resistance of the circuit (6)

(iii) the current flowing in the bulb. (6)

$(R = R_1 + R_2\ ;\ \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2})$

10. X-rays are produced when high speed electrons collide with a target in an X-ray tube as shown in the diagram.



(i) What process occurs at the filament **A**? (6)

(ii) Name a substance commonly used as the target **B**. (6)

(iii) List three properties of X-rays. (9)

(iv) Give two uses of X-rays. (6)

(v) State the function of the part marked **C**. (5)

The photoelectric effect can be regarded as the inverse of X-ray production.

(vi) What is meant by the photoelectric effect? (6)

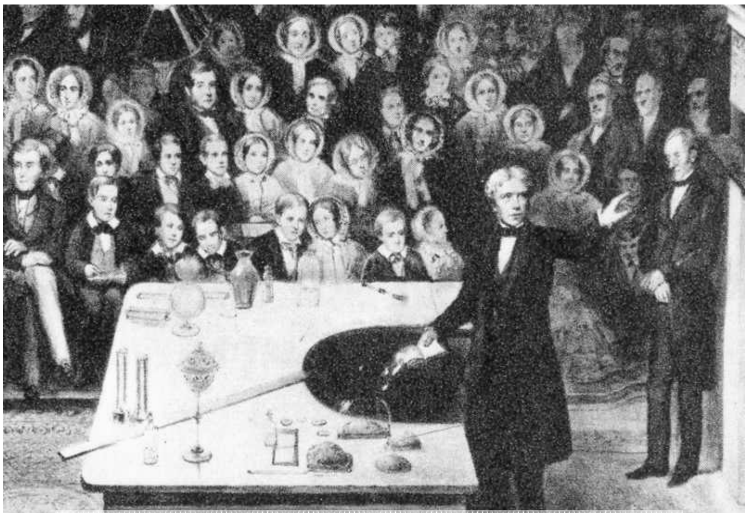
(vii) Describe an experiment to demonstrate the photoelectric effect. (12)

(viii) Give two applications of the photoelectric effect. (6)

11. Read this passage and answer the questions below.

In 1819 the Danish physicist Hans Christian Oersted discovered that an electric current flowing through a wire deflected a compass needle.

A year later the Frenchman François Arago found that a wire carrying an electric current acted as a magnet and could attract iron filings. Soon his compatriot André-Marie Ampère demonstrated that two parallel wires were attracted towards one another if each had a current flowing through it in the same direction. However, the wires repelled each other if the currents flowed in the opposite directions.


Michael Faraday delivering a lecture in 1856.

Intrigued by the fact that a flow of electricity could create magnetism, the great British experimentalist Michael Faraday decided to see if he could generate electricity using magnetism. He pushed a bar magnet in and out of a coil of wire and found an electric current being generated. The current stopped whenever the magnet was motionless within the coil.

(Adapted from '*Quantum' by Manjit Kumar, Icon Books 2008.*)

(*a*) Who discovered that an electric current can deflect a compass needle? (7)

(*b*) What did Arago discover? (7)

(*c*) What happens when currents flow in the same direction in two parallel wires? (7)

(*d*) How could two parallel wires be made to repel each other? (7)

(*e*) Draw a sketch of the apparatus Michael Faraday used to generate electricity. (7)

(*f*) What name is given to the generation of electricity discovered by Michael Faraday? (7)

(*g*) What energy conversions take place in Faraday's experiment? (7)

(*h*) How does Faraday's experiment show that a changing magnetic field is required to generate electricity? (7)

12. Answer any two of the following parts (*a*), (*b*), (*c*), (*d*).

(*a*) The diagram shows a cyclist on a bicycle and their combined mass is 120 kg. The cyclist starts from rest and by pedalling applies a net horizontal force of 60 N to travel along a horizontal road.

Calculate:

(i) the acceleration of the cyclist (6)

(ii) the maximum velocity of the cyclist after 15 seconds (6)

(iii) the distance travelled by the cyclist during the first 15 seconds. (3)

The cyclist stops pedalling after 15 seconds and continues to freewheel for a further 80 m before coming to a stop.

(iv) Why does the bicycle stop? (6)

(v) Calculate the time taken for the cyclist to travel the final 80 m. (7)

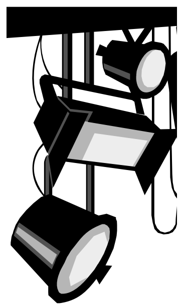
($F = ma$, $v = u + at$, $s = ut + ½at^2$, $s = (\frac{u+v}{2})t$)

(*b*) What is meant by dispersion of light? (6)

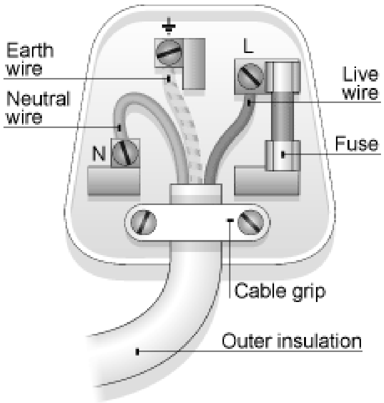
Describe an experiment to demonstrate the dispersion of light. (12)

Give an example of the dispersion of light occurring in nature. (4)

The diagram shows stage lighting similar to that found in most theatres. Only red, green and blue lights are needed to create most lighting effects. Explain why. (6)



(*c*) The diagram shows a plug which contains a fuse, an MCB and an RCD, all of which are used in domestic circuits.



(i) Explain how a fuse works. (6)

(ii) How does the fuse improve safety? (4)

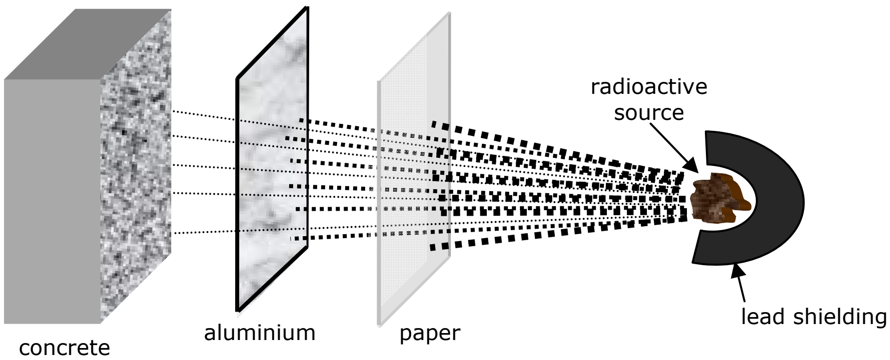
(iii) What is an MCB? (3)

(iv) What is the function of an RCD? (6)

(v) Why should an appliance be earthed? (6)

(vi) Give one other precaution that should be taken to improve safety when using electricity in the home. (3)

(*d*) What is radioactivity? (6)



The diagram shows a radioactive source emitting nuclear radiation which is passing through various materials.

(i) How do you know that the source is emitting three types of radiation? (3)

(ii) Name the radiation blocked by each material. (6)

(iii) Give one danger associated with nuclear radiation. (3)

(iv) State two precautions that should be taken when handling radioactive substances. (4)

(v) Give two uses for radioactive substances. (6)

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Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2011

PHYSICS – ORDINARY LEVEL

MONDAY, 20 JUNE – MORNING, 9:30 to 12:30

Answer **three** questions from **Section A** and **five** questions from **Section B**.

N.B. Relevant data are listed in the Formulae and Tables booklet, which is available from the superintendent.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

---

1. The following is an extract from a student's report of an experiment to verify the principle of conservation of momentum.

"I arranged the apparatus. I then measured the mass of each trolley. During the experiment I took further measurements to determine the velocities of the trolleys. I used my measurements to verify the principle of conservation of momentum."

(i) Draw a labelled diagram of the apparatus used in the experiment. (9)

(ii) How did the student measure the mass of a trolley? (6)

(iii) How did the student determine the velocity of a moving trolley? (12)

(iv) How was the momentum of a trolley determined? (6)

(v) How did the student verify the principle of conservation of momentum? (7)

2. During an experiment to measure the specific latent heat of vaporisation of water, cold water was placed in an insulated copper calorimeter. Dry steam was passed into the water causing a rise in temperature of the water and the calorimeter. The following data were recorded.

Mass of calorimeter	= 73.40 g
Mass of cold water	= 67.50 g
Initial temperature of water + calorimeter	= 10 °C
Temperature of steam	= 100 °C
Mass of steam added	= 1.03 g
Final temperature of water + calorimeter	= 19 °C

(i) Draw a labelled diagram of the apparatus used in the experiment. (9)

(ii) What was the rise in temperature of the water in the experiment? (6)

(iii) Describe how the mass of the cold water was found. (7)

(iv) How was the steam dried? (6)

(v) Calculate:
  (*a*) the heat gained by the water and the calorimeter
  (*b*) the heat lost by the condensed steam
  (*c*) the latent heat of vaporisation of water. (12)

(specific heat capacity of copper = 390 J Kg^{-1} K^{-1} ; specific heat capacity of water = 4180 J Kg^{-1} K^{-1})

3. You carried out an experiment to measure the speed of sound in air by measuring the frequency and wavelength of a sound wave.

(i) Draw a labelled diagram of the apparatus that you used. (9)

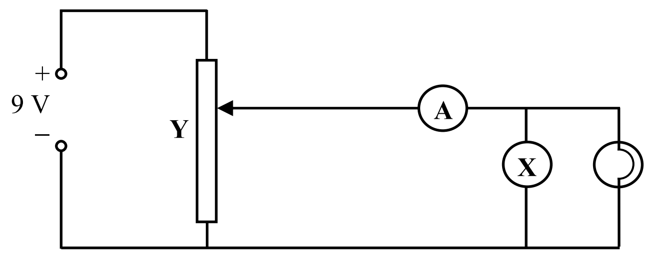
(ii) How did you find the frequency of the sound wave? (6)

(iii) How was the wavelength of the sound wave measured? (9)

(iv) How did you use the measurements to calculate the speed of the sound wave? (12)

(v) Why should you repeat the experiment? (4)

4. The diagram shows a circuit used to investigate the variation of current with potential difference for a filament lamp.



(i) Name the instrument **X**. What does it measure? (4)

(ii) Name the component **Y**. What does it do? (6)

The table shows the values recorded for the current and the potential difference during the investigation.

Potential difference / V	1	2	3	4	5	6	7
Current / A	0.9	1.6	2.1	2.5	2.8	3.0	3.1

(iii) Draw a graph, on graph paper, of the current against the potential difference. (12)

(iv) What does your graph tell you about the variation of current with potential difference for a filament lamp? (9)

(v) Using your graph, calculate the resistance of the lamp when the potential difference across the lamp is 5.5 V. (9)

SECTION B (280 marks)

Answer **five** questions from this section.
Each question carries 56 marks.

5. Answer any **eight** of the following parts (*a*), (*b*), (*c*), etc.

(*a*) What is friction?

(*b*) What is the relationship between *G*, the gravitational constant and *g*, the acceleration due to gravity?

(*c*) A crowbar is an example of a lever. Give another example of a lever.

(*d*) Which one of the following terms is associated with a wave motion?

half-life **interference** **induction** **doping**

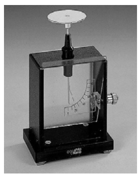
(*e*) Name the three ways by which heat can travel from one place to another.

(*f*) Give two uses of a concave mirror.

(*g*) What is the colour of the earth cable in a standard 3-pin plug?

(*h*) How does a miniature circuit breaker (MCB) improve safety in a domestic circuit?

(*i*) Give a use for an electroscope.



(*j*) Give a disadvantage of a named renewable source of energy.

(8 × 7)

6. State Newton's first law of motion. (6)

A car of mass 1400 kg was travelling with a constant speed of 15 m s^{-1} when it struck a tree and came to a complete stop in 0.4 s.

(i) Draw a diagram of the forces acting on the car before it hit the tree. (9)

(ii) Calculate the acceleration of the car during the collision. (9)

(iii) Calculate the net force acting on the car during the collision. (6)

(iv) Calculate the kinetic energy of the moving car before it struck the tree. (6)

(v) What happened to the kinetic energy of the moving car? (9)

(vi) A back seat passenger could injure other occupants during a collision.

Explain, with reference to Newton's laws of motion, how this could occur.

How is this risk of injury minimised? (11)

7. Light rays can undergo reflection and refraction. Both of these can occur when light is travelling from a denser medium, such as glass, to a less dense medium, such as air.

(i) Explain the underlined terms. (12)

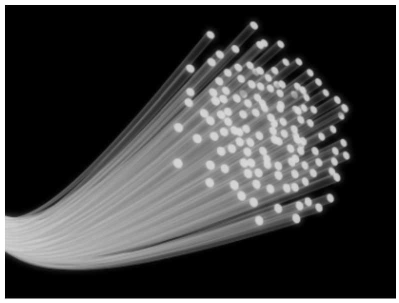
(ii) Give a practical application of the reflection of light. (3)

(iii) State the laws of reflection of light. (9)

(iv) Explain, with the aid of a diagram, how total internal reflection can occur. (9)

(v) What is meant by the 'critical angle' in total internal reflection? (6)

The photo shows an optical fibre which is used for the transmission of data using light waves.



(vi) Draw a diagram to show how light waves travel along an optical fibre. (9)

(vii) Give two advantages of using optical fibres instead of copper wires when transmitting data. (5)

(viii) Optical fibres are also used in medicine.
Give an example of their use in medicine. (3)

8. (*a*) (i) What is meant by a thermometric property? (6)

(ii) Name two different thermometric properties. (6)

(iii) Name two different thermometers. (4)

(iv) Describe how to calibrate a thermometer. (12)

(v) Why is there a need for a standard thermometer? (6)

(*b*) An electric kettle is filled with 500 g of water and is initially at a temperature of 15 °C. The kettle has a power rating of 2 kW.

(i) Calculate the energy required to raise the temperature of the water to 100 °C. (9)

(ii) How much energy is supplied by the kettle every second? (3)

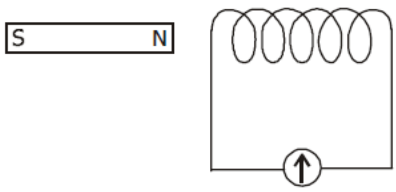
(iii) How long will it take the kettle to heat the water to 100 °C? (6)

(iv) Name a suitable material for the handle of the kettle. Justify your answer. (4)

(specific heat capacity of water = 4180 J Kg^{-1} K^{-1})

9. (*a*) State Faraday's law of electromagnetic induction. (9)

A coil of wire is connected to a sensitive meter, as shown in the diagram.



(i) What is observed on the meter when the magnet is moved towards the coil? (6)

(ii) What is observed on the meter when the magnet is stationary in the coil? (3)

(iii) Explain these observations. (9)

(iv) How would changing the speed of the magnet affect the observations? (5)

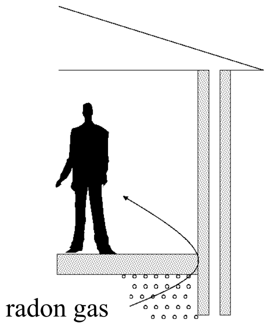
(*b*) Transformers are used to step up or step down a.c. voltages.

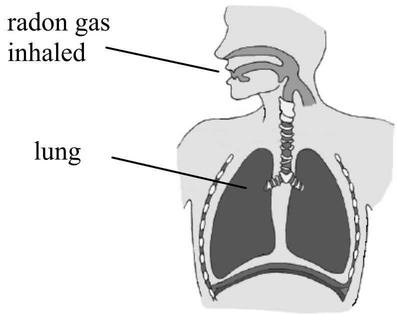
(i) What is meant by a.c.? (6)

(ii) Draw a labelled diagram showing the structure of a transformer. (9)

(iii) The input coil of a transformer has 200 turns of wire and is connected to a 230 V a.c. supply.
What is the voltage across the output coil, when it has 600 turns? (9)

10. Radon is a radioactive gas which emits alpha particles. Radon gas comes into houses through gaps in the floors. Exposure to radon gas can cause lung cancer.





(i) What is radioactivity? (6)

(ii) Name the other two types of radiation emitted by radioactive sources. (6)

(iii) Describe an experiment to distinguish between the three types of radiation. (12)

(iv) List three properties of one of these radiations. (9)

The most stable isotope of radon has a half-life of 4 days.

(v) What are isotopes? (6)

(vi) Why is it important to prevent radon gas entering your home? (5)

(vii) If no more radon gas entered your home, how long would it be until one eight of the radon gas was left? (6)

(viii) Give two uses of radioisotopes. (6)

11. Read this passage and answer the questions below.

Heinrich Hertz, discoverer of the photoelectric effect

Einstein explained the photoelectric effect by using Planck's quantum theory (*E=hf*). The German physicist Heinrich Hertz in 1887 was the first to discover that when light shines on certain metals, they emit electrons. Metals have the property that some of their electrons are only loosely bound within atoms, which is why they are such good conductors of electricity. When light strikes a metallic surface it transfers its energy to the metal, in the same way as when light shines on your skin, causing you to feel warmer. This transfer of energy from the light can agitate electrons in the metal, and some of the loosely bound electrons can be knocked off the surface of the metal.

But the strange features of the photoelectric effect become apparent when one studies the more detailed properties of the released electrons. As the intensity of the light – its brightness – is increased the number of released electrons will also increase, but their speed stays the same. On the other hand, the speed of the released electrons will increase if the frequency of the light shining on the metal is increased.

(Adapted from '*Elegant Universe*' by Brian Greene, Vintage 2000)

(*a*) Who discovered the photoelectric effect?

(*b*) Who explained the photoelectric effect?

(*c*) What happens when light shines on certain metals?

(*d*) Why is a metal a good conductor of electricity?

(*e*) Why does your skin feel warm when light shines on it?

(*f*) In the photoelectric effect, what happens when the intensity of the light is increased?

(*g*) How can the speed of electrons emitted in the photoelectric effect be controlled?

(*h*) Give one application of the photoelectric effect.

(8 × 7)

12. Answer any two of the following parts (*a*), (*b*), (*c*), (*d*).

(*a*) State Boyle's law. (6)

Describe an experiment to demonstrate that the atmosphere exerts a pressure. (12)

Atmospheric pressure at the top of Mount Everest is very low at 3.0×10^4 Pa, which is why climbers need oxygen tanks.

A climber uses a 5.0 litre tank with an internal gas pressure of 4.2×10^6 Pa to supply oxygen.

What volume of gas will be available at the top of Mount Everest, when the gas is released from the tank? (10)

(*b*) Loudness, pitch and quality are characteristics of a musical note. Name the physical property of a sound wave on which each characteristic depends. (12)

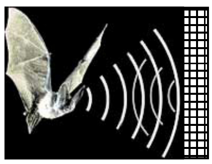
A bat detector allows us to hear the sounds emitted by bats. The detector is needed as humans cannot hear the sounds emitted by bats as they are outside our *frequency limits of audibility*.

(i) What is meant by the frequency limits of audibility? (6)

(ii) What name is given to a sound whose frequency is greater than our upper frequency limit of audibility? (4)

(iii) A bat emitted a sound wave and detected its reflection from a wall 0.02 s later.
Calculate the distance of the bat from the wall. (6)

(speed of sound in air = 340 m s^{-1})



(*c*) What is an electric current, and give its unit of measurement? (9)

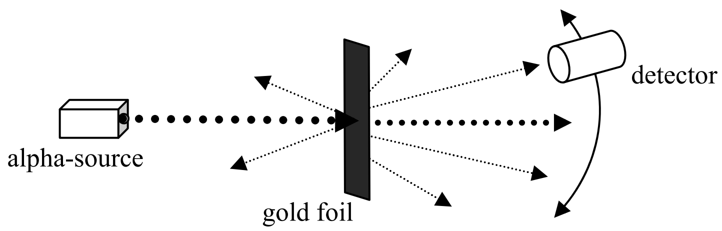
State the three effects of an electric current. (4)

How would you demonstrate one of the effects? (9)

An electric screwdriver has a power rating of 120 W when connected to its 24 V battery.

Calculate the current supplied by the battery when the screwdriver is turned on. (6)

(*d*) The diagram shows an arrangement used to investigate the structure of the atom. During the investigation, alpha-particles were fired at a thin sheet of gold foil in a vacuum.



(i) What are alpha-particles? (6)

(ii) What happened to the alpha-particles in the experiment? (6)

(iii) What did the experiment reveal about the structure of the atom? (6)

(iv) Name the scientist who designed the experiment. (6)

(v) Name a suitable detector of alpha-particles. (4)

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2012. M35

Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2012

PHYSICS – ORDINARY LEVEL

MONDAY, 18 JUNE – MORNING, 9:30 to 12:30

Answer **three** questions from **Section A** and **five** questions from **Section B**.

N.B. Relevant data are listed in the Formulae and Tables booklet, which is available from the Superintendent.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

---

1. A student carried out an experiment to measure the acceleration of a moving trolley. The student measured the initial velocity of the trolley and the final velocity of the trolley, along with another measurement. The student used these measurements to find the acceleration of the trolley.

(i) Draw a diagram to show how the student got the trolley to accelerate. (12)

(ii) Describe how the student measured the final velocity of the trolley. (6)

(iii) What other measurement did the student take? (6)

(iv) How did the student use the measurements to calculate the acceleration of the trolley? (10)

(v) Give a precaution the student took to ensure an accurate result. (6)

2. You carried out an experiment to establish the calibration curve of a thermometer.

(i) Describe, with the aid of a diagram, the procedure you used in the experiment. (12)

(ii) Name the thermometric property of the thermometer you calibrated and describe how the value of this property was measured. (10)

The following table shows the data obtained in an experiment to establish the calibration curve of a thermometer.

Temperature / °C	0	20	40	60	80	100
Value of thermometric property	5	14	29	48	80	130

(iii) Using the data in the table, draw a graph on graph paper to establish the calibration curve. Put temperature on the horizontal axis. (12)

(iv) Use your calibration curve to determine the temperature when the value of the thermometric property is 60. (6)

3. A student carried out an experiment to verify Snell's law of refraction. The student measured the angle of incidence i and the corresponding angle of refraction r for a ray of light passing through a glass block. The student repeated this procedure for different values of the angle i. The data recorded by the student are shown in the table.

(i) Draw a labelled diagram of the apparatus used in the experiment. (9)

(ii) Describe how the student found the path of the ray of light passing through the glass block. (9)

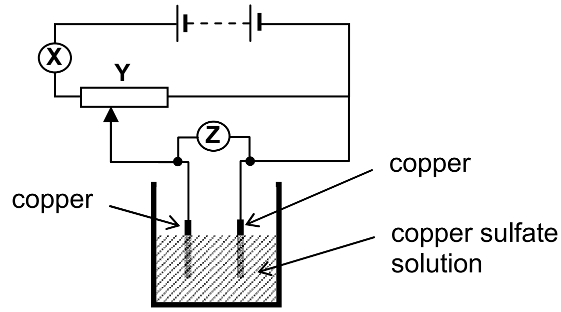
(iii) Indicate on the diagram the angles i and r. (6)

(iv) Copy this table into your answerbook and complete it. (9)

i	r	$\sin i$	$\sin r$	$\frac{\sin i}{\sin r}$
25^o	16^o			
35^o	22^o			
50^o	30^o			
60^o	34^o			

(v) How does the data in the completed table verify Snell's law of refraction? (7)

4. In an experiment to investigate the variation of current I with potential difference V for a copper sulfate solution, the following apparatus was used.



(i) Name the instrument **X**. (6)

(ii) Name the apparatus **Y** and give its function in the experiment. (6)

(iii) How was the potential difference measured in the experiment? (6)

The following table shows the values recorded for the current I and the corresponding potential difference V during the experiment.

V/V	0	1.0	2.0	3.0	4.0	5.0	6.0
I/**A**	0	0.4	0.8	1.2	1.6	2.0	2.4

Using the data in the table, draw a graph on graph paper to show the variation of current with potential difference. (12)

Calculate the slope of your graph.
Use this value to determine the resistance of the copper sulfate solution. (10)

SECTION B (280 marks)

Answer **five** questions from this section.
Each question carries 56 marks.

5. Answer any **eight** of the following parts (*a*), (*b*), (*c*), etc.

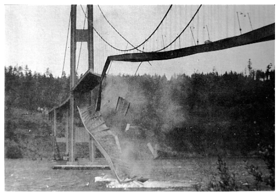
(*a*) A tow-truck pulls a car with a net horizontal force of 500 N.
Calculate the work done in towing the car a distance of 2 km to a garage.

(*b*) Give one factor on which the potential energy of a body depends.

(*c*) Which one of the following instruments is used to measure atmospheric pressure?

hydrometer **barometer** **thermometer** **joulemeter**

(*d*) The Tacoma Narrows Bridge collapsed, soon after construction, due to resonance. What is resonance?



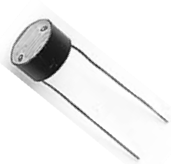
(*e*) A building has a low U-value. What is the advantage of this?

(*f*) Why is a lightning conductor made of copper?

(*g*) Why does a magnet that is free to rotate point north?

(*h*) A transformer is used to change the voltage of an electrical supply.
What is the principle of operation of a transformer?

(*i*) The photo shows an LDR. Draw the electrical circuit symbol for an LDR.

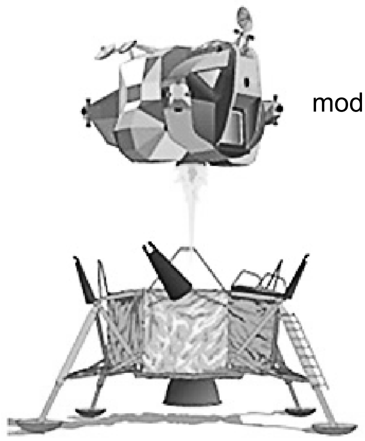


(*j*) What is the main source of energy in the sun?

(8 × 7)

6. What is meant by the term 'acceleration due to gravity'? (6)

A spacecraft of mass 800 kg is on the surface of the moon, where the acceleration due to gravity is 1.6 m s^{-2}.
Compare the weight of the spacecraft on the surface of the moon with its weight on earth, where the acceleration due to gravity is 9.8 m s^{-2}. (9)



The module of the spacecraft has a mass of 600 kg, when it is launched vertically from the surface of the moon with its engine exerting an upward force of 2000 N.

(i) Draw a diagram showing the forces acting on the module at lift-off. (6)

(ii) What is the resultant force on the module? (6)

(iii) Calculate the acceleration of the module during lift-off. (6)

(iv) Calculate the velocity of the module, 20 seconds after lift-off. (6)

(v) Would the engine of the module be able to lift it off the earth's surface? Justify your answer in terms of the forces acting on the module. (9)

(vi) Why is the acceleration due to gravity on the moon less than the acceleration due to gravity on earth? (5)

(vii) Suggest a reason why the module of the spacecraft when launched from the moon does not need a streamlined shape like those that are launched from earth. (3)

7. Under certain conditions, light can undergo <u>diffraction</u> and <u>interference</u>.

(i) Explain the underlined terms. (12)

(ii) Describe an experiment to demonstrate the wave nature of light. (12)

The photograph shows Polaroid sunglasses which reduce glare caused by sunlight.

(iii) Explain the term 'polarisation'. (6)

(iv) Describe an experiment to demonstrate the polarisation of light. (12)

(v) What type of wave motion does light have as indicated by the experiment in part (iv)? (9)

(vi) Why are Polaroid sunglasses more effective than non-Polaroid sunglasses at reducing glare? (5)

8. A plug is used to connect an electrical appliance in the home to the 230 volt mains supply. Modern plugs contain a small fuse which comes with a rating of 1A, 2A, 3A, 5A or 13A. The electrical energy supplied to the home is measured in kW h (*kilowatt-hour*).

(i) What is the colour of the wire that should be connected to the fuse in a plug? (6)

(ii) Why is there a fuse in a plug? (6)

(iii) Explain how a fuse works. (9)

(iv) A vacuum cleaner has a power rating of 900 W. What is the most suitable fuse to use in the plug of the vacuum cleaner? (9)

(v) Why is a fuse of a lower rating unsuitable? (6)

(vi) Name a device found in modern domestic circuits that has the same function as a fuse. (6)

If the vacuum cleaner is used for 90 minutes, calculate

(vii) the number of units of electricity used; (8)

(viii) the cost of the energy used if the price of each unit of electricity is 22 cent. (6)

9. The temperature of an object is a measure of its hotness or coldness.

(i) What is the SI unit of temperature? (6)

(ii) The Celsius scale is the practical temperature scale. How is the degree Celsius (°C) related to the SI unit of temperature? (6)

When heat is transferred to a substance, it causes a rise in temperature or a change in state of the substance, or both.

(iii) What is heat? (6)

(iv) Name the three methods of heat transfer. (6)

(v) What is meant by the change in state of a substance? (3)

(vi) Define specific latent heat. (6)

20 g of ice cubes at 0 °C are added to a glass of warm water. All the ice melts quickly and cools the water to 5 °C. Assuming no heat transfer to the surroundings or to the glass, calculate:

(vii) The energy required to melt the ice. (9)

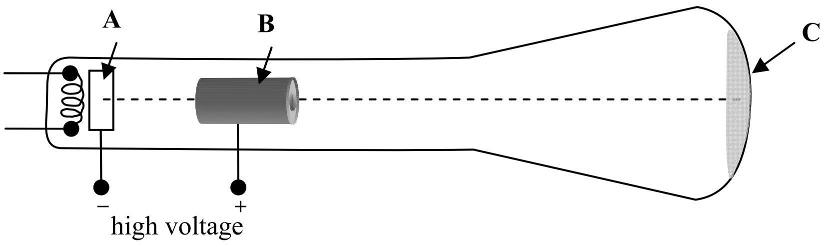
(viii) The energy required to warm the melted ice to 5 °C. (9)

(ix) Why is it important to stir the mixture? (5)

(specific heat capacity of water = 4180 J kg^{-1} K^{-1} ;
specific latent heat of fusion of ice = 3.34×10^5 J kg^{-1})

10. A cathode ray tube and an X-ray tube are practical applications of thermionic emission. In these tubes thermionic emission releases electrons, which are then accelerated into a beam.

An electron is a subatomic particle.
Name another subatomic particle and give two of its properties. (9)



The diagram shows a simple cathode ray tube.

(i) Name the parts labelled **A**, **B**, **C**. (9)

(ii) Give the function of any two of these labelled parts. (9)

(iii) How can the beam of electrons be deflected? (6)

(iv) What happens at **C** when the electrons hit it? (6)

(v) Why is a vacuum needed in a cathode ray tube? (3)

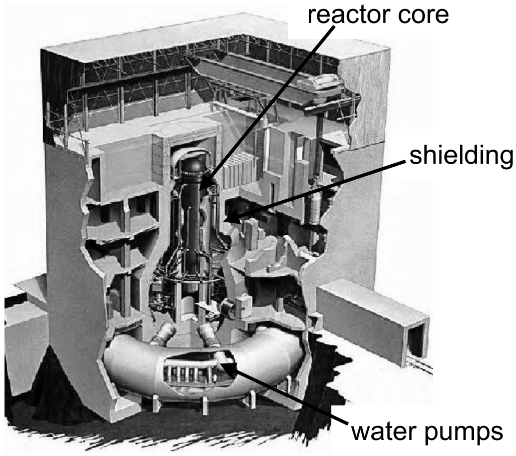
In an X-ray tube, a beam of electrons is used to produce X-rays.

Draw a sketch of an X-ray tube. (11)

Give one safety precaution taken by a radiographer when using an X-ray machine. (3)

11. Read this passage and answer the questions below.

The Fukushima nuclear disaster



In March 2011, following a powerful earthquake, the Fukushima nuclear reactor in Japan was shut down automatically. A nuclear reactor generates heat by splitting atoms of uranium in a process known as nuclear fission. The uranium is contained in the reactor's fuel rods. A chain reaction is set up by the neutrons released during fission and these go on to split more atoms of uranium. The power output of the reactor is adjusted by controlling the number of neutrons that are present. Control rods made of a neutron absorber capture neutrons. Absorbing more neutrons in a control rod means that there are fewer neutrons available to cause fission. Therefore, pushing the control rods deeper into the reactor will reduce its power output, and extracting the control rods will increase it.

The Fukushima nuclear reactor continued to generate heat even after the chain reaction was stopped because of the radioactive decay of the isotopes created during nuclear fission. This decay cannot be stopped and the resulting heat must be removed by circulating cooling water through the reactor core.

When the reactor was shut down due to the earthquake, the pumps to keep the cooling water circulating should have been powered by electricity from the national grid or diesel generators. However, connections to the grid were damaged by the earthquake and the diesel generators were destroyed by the tsunami wave that followed the earthquake. As a result, no cooling was available for the reactor core and this resulted in the explosions and subsequent release of radiation, consisting of radioactive isotopes such as caesium and iodine, into the environment.

(Adapted from '*Wikipedia*', June 2011)

(*a*) What is meant by nuclear fission?

(*b*) What is radioactivity?

(*c*) What is a nuclear chain reaction?

(*d*) What is the function of the control rods?

(*e*) What type of material are control rods made of?

(*f*) Why did the reactor still generate heat even though the chain reaction had stopped?

(*g*) Why is it important to remove the heat generated?

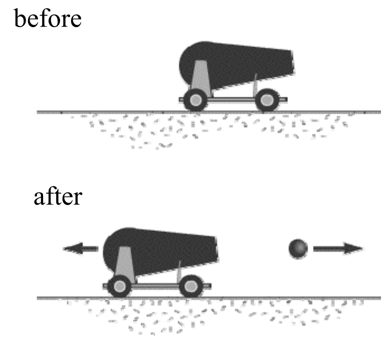
(*h*) Give one advantage of nuclear energy.

(8 × 7)

12. Answer any **two** of the following parts (*a*), (*b*), (*c*), (*d*).

(*a*) State the principle of conservation of momentum. (6)
A cannon of mass 1500 kg containing a cannonball of mass 80 kg was at rest on a horizontal surface as shown. The cannonball was fired from the cannon with an initial horizontal velocity of 60 m s^{-1} and the cannon recoiled.

Calculate
(i) the recoil velocity of the cannon
(ii) the kinetic energy of the cannon as it recoils. (12)



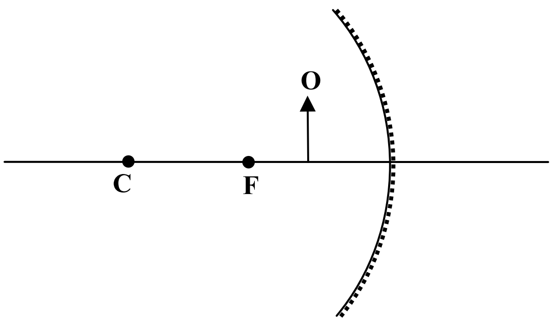
Why did the cannon recoil? (4)

Why will the cannon come to a stop in a shorter distance that the cannonball? (6)

(*b*) State the laws of reflection of light. (6)

How would you estimate the focal length of a concave mirror? (9)

The diagram shows an object **O** in front of a concave mirror, whose focus is at **F**.



Copy and complete the diagram to show the formation of the image of the object **O**. (9)

Give one use for a concave mirror. (4)

(*c*) The pitch of the sound emitted by the siren of a moving fire engine appears to change as it passes a stationary observer.

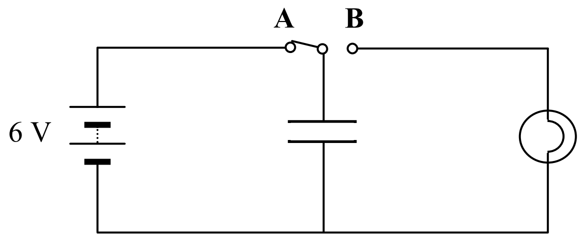
(i) Name this phenomenon. (6)

(ii) Explain, with the aid of a diagram, how this phenomenon occurs. (12)

(iii) Will the crew in the fire engine notice this phenomenon?
Give a reason for your answer. (4)

(iv) Give an application of this phenomenon. (6)

(*d*) A capacitor is connected to a switch, a battery and a bulb as shown in the diagram. When the switch is changed from position **A** to position **B**, the bulb lights briefly.



(i) What happens to the capacitor when the switch is in position **A**? (6)

(ii) Why does the bulb light when the switch is in position **B**? (6)

(iii) Why does the bulb light only briefly? (6)

(iv) The capacitor has a capacitance of 200 μF. Calculate its charge when connected to a 6 V battery. (6)

(v) Give a use for a capacitor. (4)

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Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2013

PHYSICS – ORDINARY LEVEL

MONDAY, 17 JUNE – MORNING, 9:30 TO 12:30

Answer **three** questions from **Section A** and **five** questions from **Section B**.

N.B. Relevant data are listed in the *Formulae and Tables* booklet, which is available from the Superintendent.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

---

1. You carried out an experiment to measure *g*, the acceleration due to gravity.

(i) Draw a labelled diagram of the apparatus you used. (12)

(ii) State the measurements you took during the experiment. (6)

(iii) Describe how you took these measurements. (9)

(iv) How did you calculate a value for *g* from your measurements? (9)

(v) Give one precaution that you took to get an accurate result. (4)

2. A student carried out an experiment to measure the specific latent heat of fusion of ice. The following is an extract from her report.

> "I first set up the apparatus for this experiment. I prepared the ice. I added the ice which was at 0 °C to the warm water. I found the mass of the ice. When all the ice was melted I took a temperature reading. I was then able to calculate the specific latent heat of fusion of ice."

(i) Draw a labelled diagram of the apparatus used in the experiment. (12)

(ii) How did the student prepare the ice for the experiment? (6)

(iii) How did the student know that the ice was at 0 °C? (3)

(iv) How did the student find the mass of the ice? (9)

(v) Why did the student use warm water in the experiment? (6)

(vi) What precaution did the student take when adding the ice to the water? (4)

3. An experiment to measure the refractive index of a substance was carried out by a student. When the apparatus had been set up the student made a series of measurements. The student repeated the experiment a number of times.

(i) Draw a labelled diagram of the apparatus that the student used in the experiment. (12)

(ii) What measurements did the student take? (12)

(iii) How were these measurements used to calculate the refractive index of the substance? (10)

(iv) Why did the student repeat the experiment? (6)

4. In an experiment to investigate the variation of the resistance R of a thermistor with temperature θ a student measured the resistance of a thermistor at different temperatures.

(i) Draw a labelled diagram of the apparatus used in the experiment. (12)

(ii) How did the student measure the resistance of the thermistor? (6)

The table shows the measurements recorded by the student.

θ/°C	10	20	30	40	50	60	70
R/Ω	1800	1200	750	400	190	90	40

(iii) Plot a graph on graph paper to show the relationship between resistance R of the thermistor and the temperature θ. (Put θ on the X-axis.) (12)

(iv) Use the graph to estimate the temperature of the thermistor when its resistance is 500 Ω. (4)

(v) What can you tell from the graph about the relationship between the resistance of a thermistor and its temperature? (6)

SECTION B (280 marks)

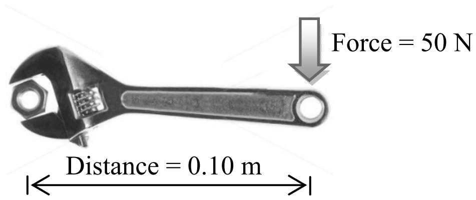
Answer **five** questions from this section.
Each question carries 56 marks.

---

5. Answer any **eight** of the following parts (*a*), (*b*), (*c*), etc.

(*a*) Give an example of (i) a vector quantity, (ii) a scalar quantity.

(*b*) The spanner shown in the diagram is used to turn a nut. Calculate the moment of the force applied by the spanner to the nut.



(*c*) Which of the following scientists is associated with the discovery of the structure of the atom?

Einstein **Rutherford** **Faraday** **Coulomb**

(*d*) What is meant by the threshold of hearing?

(*e*) How does light travel through an optical fibre?

(*f*) Give a common use for a convex lens.

(*g*) What colour is the wire that is connected to the fuse in a standard three-pin plug?

(*h*) Give a common use for a capacitor.

(*i*) What is the photoelectric effect?

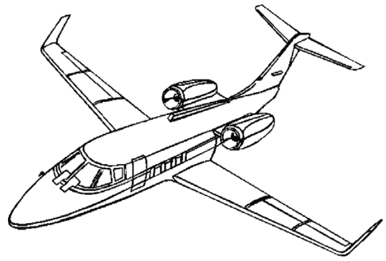
(*j*) Name one method for detecting radioactive particles.

(8 × 7)

6. Define (*a*) momentum, (*b*) force. (12)

State the principle of conservation of momentum.

Explain how the principle of conservation of momentum applies in the case of a jet engine moving an aircraft. (12)



A truck of mass 5000 kg is moving with a velocity 10 m s^{-1} when it collides with a stationary car with a mass of 1000 kg. The truck and the car then move off together.

(i) Calculate the momentum of the truck and the car before the collision. (6)

(ii) What is the momentum of the combined vehicles after the collision? (4)

(iii) Calculate the velocity of the combined vehicles after the collision. (6)

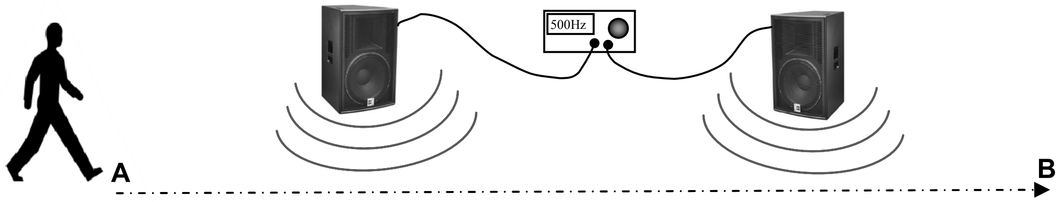
(iv) What is the momentum of the truck after the collision? (4)

(v) If the collision between the truck and the car takes 0.3 seconds, calculate the force exerted by the truck on the car. (6)

(vi) When the truck hits the back of the car the driver's airbag inflates. The airbag deflates when it is hit by the driver's head. Explain why the airbag reduces the risk of injury to the driver. (6)

7. (*a*) What is meant by the frequency of a wave?
Give the relationship between the frequency and the wavelength of a wave. (12)

The diagram shows a student walking in front of two loudspeakers along the path between **A** and **B**. A signal generator set at 500 Hz is connected to the loudspeakers.



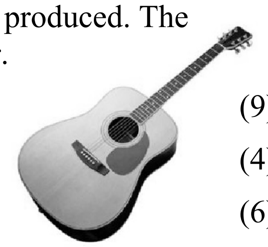
(i) What will the student notice as he moves from **A** to **B**? (6)

(ii) Name this phenomenon. (4)

(iii) Explain with the aid of a diagram how this phenomenon occurs. (9)

(iv) Why should this phenomenon be taken into account in the placing of speakers in theatres or auditoriums? (6)

(*b*) The note produced by a guitar string depends on the fundamental frequency of the string. The quality of the note depends on the number of overtones produced. The loudness of a note is increased by resonance in the body of a guitar.



(i) Explain the underlined terms. (9)

(ii) How can the note produced by a guitar string be changed? (4)

(iii) What is resonance? (6)

8. (*a*) An electric current is the flow of charge in a conductor when there is a potential difference between its ends.

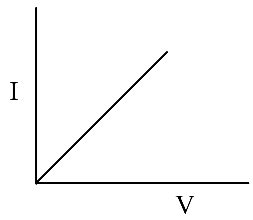
(i) Name the unit of current. (6)

(ii) Give an example of a conductor. (3)

(iii) Name a source of potential difference. (6)

(iv) What are the charge carriers in semiconductors? (8)

(v) What type of conductor does the I-V graph in the diagram represent? (6)



(*b*) A magnetic field exists about a current-carrying conductor.

(i) What is a magnetic field? (6)

(ii) Describe an experiment to show that a long straight wire carrying a current has a magnetic field. Sketch the magnetic field. (15)

(iii) Give an application of the magnetic field due to a current. (6)

9. When heat is transferred to or from an object the temperature of the object changes.

(i) What is heat? (6)

(ii) Name the three ways in which heat can be transferred. (9)

(iii) Describe an experiment to show how heat is transferred in a liquid. (9)

The water in an electric kettle is heated by the element and its handle is made from an insulating material.

(iv) How does the method of heat transfer in a liquid affect the positioning of the heating element in a kettle? (6)

(v) Why is the handle of a kettle made of an insulating material? (4)

(vi) Name an insulator suitable for use in the handle of a kettle. (4)

A kettle contains 1.3 kg of water with a specific heat capacity of 4200 J kg^{-1} K^{-1}. The temperature of the water rises from 10 °C to 80 °C during a three-minute period.

Calculate

(vii) the energy gained by the water (9)

(viii) the power rating of the kettle, assuming all of the electrical energy is used to heat the water. (9)

10. X-rays are used to diagnose and treat medical conditions. The image shows an X-ray photograph.

(i) What are X-rays? (6)

(ii) State a property of X-rays that makes them suitable for medical use. (6)

(iii) Give a use, other than medical, for X-rays. (6)

In an X-ray tube a beam of electrons is used to produce X-rays.

(iv) Draw a labelled diagram showing the main parts of an X-ray tube. (12)

(v) How are electrons produced in an X-ray tube? (6)

(vi) What is the purpose of the high voltage in an X-ray tube? (6)

(vii) What happens when the electrons hit the target in an X-ray tube? (6)

(viii) Name a suitable material for use as the target. (4)

(ix) Give one safety precaution required when using X-rays. (4)

11. Read this passage and answer the questions below.

The National Grid - Ireland's Transmission System

The control room of Ireland's national grid

The national grid system supplies electricity to customers. The grid consists of a network of high voltage transmission stations, power lines and cables delivering power to over 100 sub-stations all over Ireland. From these sub-stations power can be taken onwards on lower voltage lines to individual customers' premises.

The network includes approximately 6,000 km of overhead lines and underground cables. High voltages are used to avoid power losses which would otherwise occur when transferring power over long distances.

Power is generated by power plants throughout the country, utilising a variety of fuel or energy sources, including gas, oil, coal, peat, hydro-electricity, wind turbines and other sources such as biomass and landfill gas. All of the major power plants feed into the national grid.

At the sub-stations power is transferred from the grid, transformed into medium and low voltage electricity and is delivered to Ireland's 2.1 million domestic, commercial and industrial customers.

(Adapted from ***EIRGRID*** *AT A GLANCE*, Eirgrid information publication.)

(*a*) What are the key components of the national grid?

(*b*) Why are high voltages used to transmit power over the national grid?

(*c*) Why is the power supplied to domestic customers at lower voltages?

(*d*) Name two renewable and two non-renewable energy sources used to generate electricity.

(*e*) The national grid uses alternating current (a.c.) rather than direct current (d.c.). What is the difference between them?

(*f*) Name the device used to convert high voltages to lower voltages.

(*g*) Give the principle of operation of the device named in part (*f*).

(*h*) Name the unit of electrical energy that is used in the delivery of electricity to homes and businesses.

(8 × 7)

12. Answer any **two** of the following parts (*a*), (*b*), (*c*), (*d*).

(*a*) Define pressure. (6)

Describe an experiment to show that the atmosphere exerts pressure. (9)

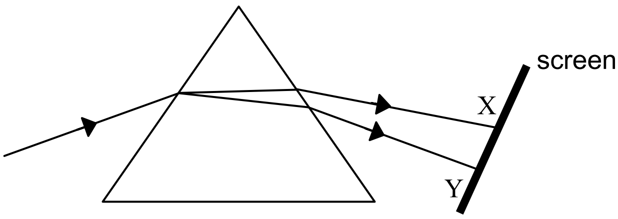
A diver swims upwards from a depth of 50 m to a depth of 20 m below the surface of the water.

Calculate the decrease in pressure on the diver as she swims upwards. (13)

(density of the water = 1000 kg m^{-3};

acceleration due to gravity, g = 9.8 m s^{-2})

(*b*) The diagram shows a beam of white light undergoing refraction and dispersion as it passes through a prism.



(i) What is meant by dispersion? (6)

(ii) What is observed on the screen between X and Y? (6)

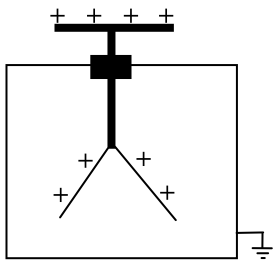
(iii) What information does dispersion give about the nature of white light? (4)

(iv) Give another method for the dispersion of light. (6)

(v) Give an everyday example of the dispersion of light. (6)

(*c*) State Coulomb's law of force between electric charges. (6)

The diagram shows a positively-charged electroscope.



(i) Give a use for an electroscope. (6)

(ii) How can an electroscope be given a positive charge? (6)

(iii) What is observed if you touch the cap of the electroscope with your finger? (4)

(iv) Explain why this happens. (6)

(*d*) Nuclear fission occurs in the reactor of a nuclear power station like the one shown in the photograph.

(i) What is nuclear fission? (6)

(ii) Name a fuel used in a nuclear reactor. (6)

(iii) How can the reaction in a nuclear reactor be controlled? (6)

(iv) How is the energy produced in a reactor used to generate electricity? (6)

(v) State a hazard of nuclear reactors. (4)

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Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2014

PHYSICS – ORDINARY LEVEL

MONDAY, 16 JUNE – MORNING, 9:30 TO 12:30

Answer **three** questions from **Section A** and **five** questions from **Section B**.

N.B. Relevant data are listed in the *Formulae and Tables* booklet, which is available from the Superintendent.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

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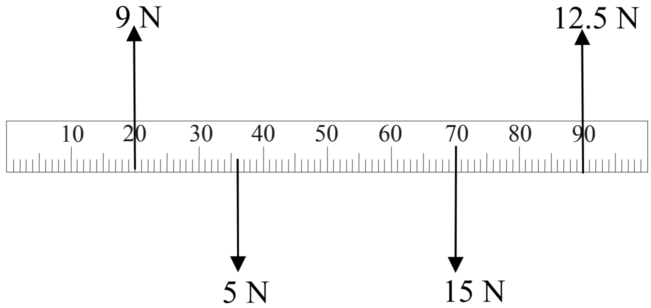
1. A student investigated the laws of equilibrium for a set of co-planar forces acting on a metre stick. The weight of the metre stick was 1.5 N and its centre of gravity was at the 50 cm mark. The student applied the forces shown to the metre stick until it was in equilibrium.



(*i*) How did the student measure the upward forces? (4)

(*ii*) Copy the diagram and show **all** the forces acting on the metre stick. (6)

(*iii*) (*a*) Find the total upward force acting on the metre stick.
(*b*) Find the total downward force acting on the metre stick.
(*c*) Explain how these values verify one of the laws of equilibrium. (15)

(*iv*) (*a*) Find the sum of the anticlockwise moments of the upward forces about the 0 mark.
(*b*) Find the sum of the clockwise moments of the downward forces about the 0 mark.
(*c*) Explain how these values verify the other law of equilibrium. (15)

2. A student carried out an experiment to measure the specific latent heat of fusion of ice. The following is an extract from her report.

> "I got ice which was at 0 °C and prepared it for my experiment by crushing and drying it. I added the ice to water in a calorimeter and waited for the ice to melt before taking more measurements. I used the measurements to calculate the specific latent heat of fusion of ice. I then repeated my experiment."

(*i*) Draw a labelled diagram of the apparatus used in this experiment. (12)

(*ii*) What measurements would the student have taken for this experiment? (12)

(*iii*) How was the ice crushed? (4)

(*iv*) Why was the ice crushed? (6)

(*v*) Why was the experiment repeated? (6)

3. An experiment was set up to investigate how the fundamental frequency of a stretched string varied with its length. The length, *l*, of the string and its fundamental frequency, *f*, were recorded. The procedure was repeated for different values of *f* and *l*.

(*i*) Draw a labelled diagram of the apparatus used in the experiment. (9)

(*ii*) Indicate on your diagram the length of the string that was measured. (6)

(*iii*) Describe how the string could have been set vibrating. (3)

(*iv*) How was the frequency determined? (6)

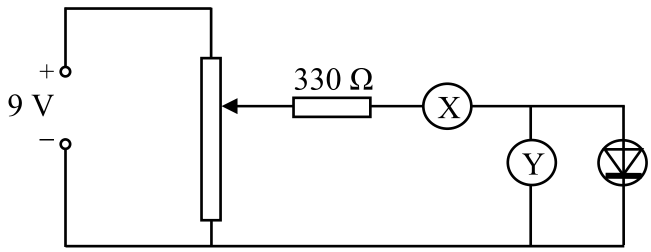
The following results were recorded during the experiment.

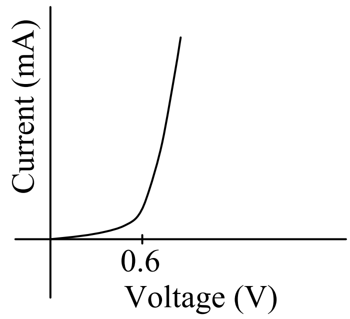
f (Hz)	256	288	320	341	384	480
l (m)	0.80	0.71	0.64	0.60	0.53	0.43
$1/l$ (m^{-1})		1.41				

(*v*) Copy and complete the table into your answer book. Draw a graph on graph paper of *f* on the *X*-axis against $1/l$ on the *Y*-axis. What conclusion can be drawn from your graph? (16)

4. A student carried out an experiment to investigate the variation of current, *I*, with voltage, *V*, for a semiconductor diode in forward bias and wrote the following report.

"I set up the circuit shown below for the experiment. During the experiment I varied the voltage and I recorded the current flowing at the different voltages and plotted a graph of my results, as shown below."





(*i*) How was the voltage changed in this experiment? (6)

(*ii*) What is the function of part X? (6)

(*iii*) What is the function of part Y? (6)

(*iv*) What does the graph tell you about conduction in a diode? (12)

(*v*) How would a student connect the diode in reverse bias? (6)

(*vi*) What is the function of the 330 Ω resistor? (4)

SECTION B (280 marks)

Answer **five** questions from this section.
Each question carries 56 marks.

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5. Answer any **eight** of the following parts (*a*), (*b*), (*c*), etc.

(*a*) A crane, powered by an electric motor, has a bucket that weighs 540 N when empty. The crane uses the bucket to lift 800 N of concrete up 75 m on a building site. Calculate the work done by the crane's motor.

(*b*) Which of the following are vector quantities and which are scalar quantities?

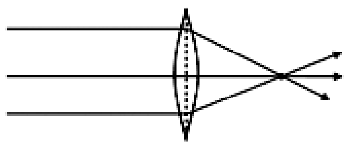
time **force** **mass** **velocity**

(*c*) Which of the following is used in the flash of a camera?

electroscope **hydrometer** **capacitor** **barometer**

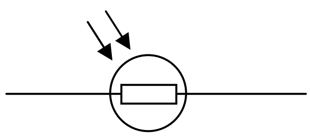
(*d*) What is the Doppler effect?

(*e*) Name the lens shown and give an application of it.



(*f*) What is meant by the *U*-value of a material?

(*g*) Name the component with the symbol shown in the diagram.



(*h*) Name a piece of laboratory equipment used to separate white light into its colours.

(*i*) How are X-rays produced?

(*j*) In the Sun, a mass of 4×10^9 kg is converted into energy every second.
Calculate the energy released each second.
(speed of light, $c = 3 \times 10^8$ m s^{-1})

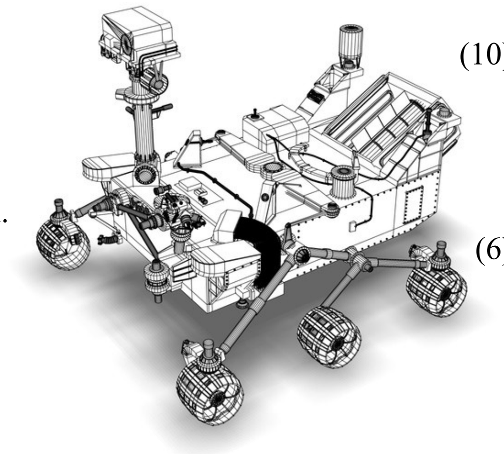
(8 × 7)

6. Sir Isaac Newton deduced that the weight of an object is due to the force of gravity.

Define force and give the unit of force.
State Newton's law of universal gravitation. (18)

Use the equation below, which is from page 56 of the *Formulae and Tables* booklet, to calculate, to one decimal place, the acceleration due to gravity on Mars. The radius of Mars is 3.4×10^6 m and the mass of Mars is 6.4×10^{23} kg.

$$g = \frac{GM}{d^2}$$ (10)



In August 2012 the *Curiosity* rover landed on Mars. The wheels of the rover are not as strong as the wheels that would be needed if the rover was to be used on Earth. Give a reason for this. (6)

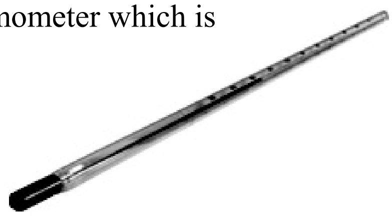
The *Curiosity* rover was built on Earth to travel on the surface of Mars. The rover has a mass of 899 kg.
Find

(*i*) the weight of *Curiosity* on Earth
(*ii*) the mass of *Curiosity* on Mars
(*iii*) the weight of *Curiosity* on Mars. (16)

The *Curiosity* rover communicates with Earth using radio waves, which are part of the electromagnetic spectrum. Name one other part of the electromagnetic spectrum. (6)

(acceleration due to gravity, $g = 9.8$ m s^{-2})

7. (*a*) The temperature of an object can be measured using a thermometer which is based on a suitable thermometric property.



(*i*) What is heat?
(*ii*) What is meant by temperature?
(*iii*) Give an example of a thermometric property.
(*iv*) The SI unit of temperature is the kelvin. Give another temperature scale.
(*v*) Express 310 K in the units of the scale you have named in part (*iv*). (30)

(*b*) The photograph shows an experiment to compare the heat transfer in different metals. A piece of wood is placed in a drop of wax at the end of each piece of metal and a heat source is used to heat the metals at the centre of the apparatus.

(*i*) How is heat transferred in metals?
(*ii*) Name the two other methods of heat transfer.
(*iii*) How can this experiment be used to find out which of the metals is best at allowing heat transfer?
(*iv*) State one way to make sure that this is a fair test. (26)

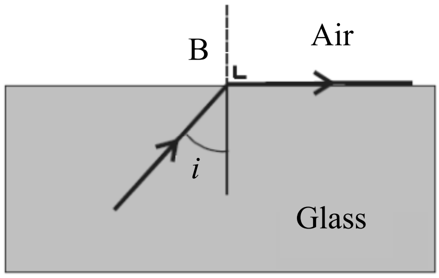
8. A ray of light can undergo both reflection and refraction.

(*i*) Explain what is meant by reflection of light. (6)

(*ii*) State the laws of reflection of light. (9)

(*iii*) Give an application of reflection of light. (5)

(*iv*) Describe an experiment to demonstrate one of the laws of reflection of light. (12)



The diagram shows a ray of light travelling from glass to air. The ray of light undergoes refraction at B.

(*v*) Explain what is meant by refraction of light. (6)

(*vi*) What special name is given to the angle of incidence, *i*, when the effect shown in the diagram occurs? (6)

In the diagram the value of the angle *i* is 38°.

(*vii*) Calculate the value of the refractive index of the glass. (6)

(*viii*) Draw a diagram to show what happens to the ray of light when the angle of incidence is increased to 40°. (6)

9. A magnetic field exists around a current-carrying conductor.

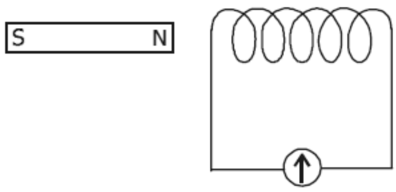
(*i*) What is a magnetic field? (6)

(*ii*) How does a compass indicate the direction of a magnetic field? (6)

(*iii*) Describe an experiment to show that there is a magnetic field around a current-carrying conductor and sketch the field lines around the conductor. (12)

(*iv*) Sketch the magnetic field around a bar magnet. (6)

A coil of wire is connected as shown in the diagram to a galvanometer. A bar magnet is placed near the coil.



(*v*) What is observed when the magnet is moved towards the coil? (6)

(*vi*) What is observed when the magnet is stationary? (6)

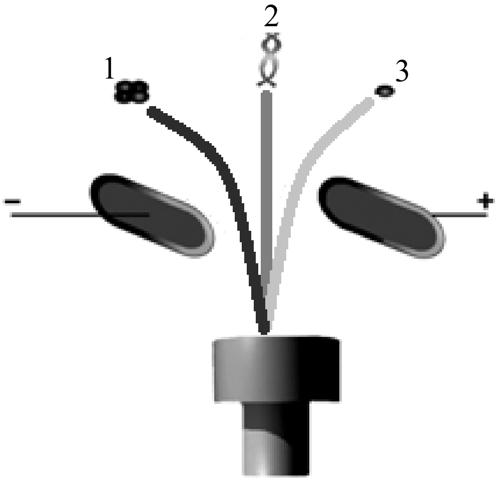
(*vii*) Explain these observations. (9)

(*viii*) How would increasing the speed of movement of the magnet alter the observations? (5)

10. (*i*) What is meant by radioactivity? (6)

In an experiment, the radiation from a radioactive source is passed through an electric field, as shown in the diagram.

(*ii*) What does this experiment indicate about radiation? (6)



State which type of radiation (1, 2 or 3)

(*iii*) is unaffected by electric fields

(*iv*) is positively charged

(*v*) is negatively charged.

(*vi*) Give the name of radiation types 1, 2 and 3, in that order. (18)

Nuclear fission occurs in a nuclear power station such as the one shown in the photograph.

(*vii*) Name a suitable fuel for nuclear fission. (6)

(*viii*) Explain the role of neutrons in nuclear fission. (6)

(*ix*) Explain how the control rods can control the rate of fission, or stop the reaction completely. (6)

(*x*) Iodine–131 is a product of nuclear fission. The half-life of iodine–131 is 8 days. What fraction of iodine–131 remains after 24 days? (8)

11. Read this passage and answer the questions below.

Lightning is one of the most deadly natural phenomena known to man. Lightning begins with the water cycle. To understand the water cycle we must first understand the principles of *evaporation* and *condensation*.

Evaporation is the process by which a liquid absorbs heat and changes to a gas. When a liquid is heated its molecules move around faster. Some of the molecules may move quickly enough to break away from the surface of the liquid and carry heat away in the form of a gas. Once free the gas begins to rise into the atmosphere due to *convection*.

Condensation is the process by which a gas loses heat and turns into a liquid. As the gas rises higher, the temperature of the surrounding air drops. Eventually the gas cools and turns back into a liquid. Earth's gravitational pull then causes the liquid to fall back down to the earth, thereby completing the cycle.

In an electrical storm, the storm clouds become charged due to convection in the cloud. The upper portion of the cloud becomes positively charged and the lower portion becomes negatively charged. The cloud's strong electric field creates a conductive path between the cloud and the earth's surface. This allows a current to flow which we see as the 'spark' of lightning.

The lightning causes air to heat up and expand rapidly, creating a sound wave that travels through the surrounding air. Sound travels much slower than light, so we see the flash before we hear the thunder.

(Adapted from '*howstuffworks.com*')

(*a*) Explain the term *evaporation*.

(*b*) What effect does the addition of heat have on the molecules of a liquid?

(*c*) What happens to the temperature of a gas rising through the atmosphere?

(*d*) What part does gravity play in the water cycle?

(*e*) Explain the term *convection*.

(*f*) What helps create the conductive path needed for lightning to occur?

(*g*) Name an instrument used in the laboratory to study static electricity.

(*h*) Why do we see the flash of lightning before we hear the thunder?

(8 × 7)

12. Answer any **two** of the following parts (*a*), (*b*), (*c*), (*d*).

(*a*) Explain the distinction between speed and velocity. (6)

A bus leaves a bus stop and accelerates from rest at 0.5 m s^{-2} to reach a speed of 15 m s^{-1}. It then maintains this speed for 100 seconds. When it approaches the next stop, the driver applies the brakes uniformly to bring the bus to a stop in 20 seconds.

Calculate

(*i*) the time it took the bus to reach its top speed

(*ii*) the distance it travelled while at its top speed

(*iii*) the acceleration required to bring the bus to a stop. (15)

Sketch a velocity-time graph of the bus journey. (7)

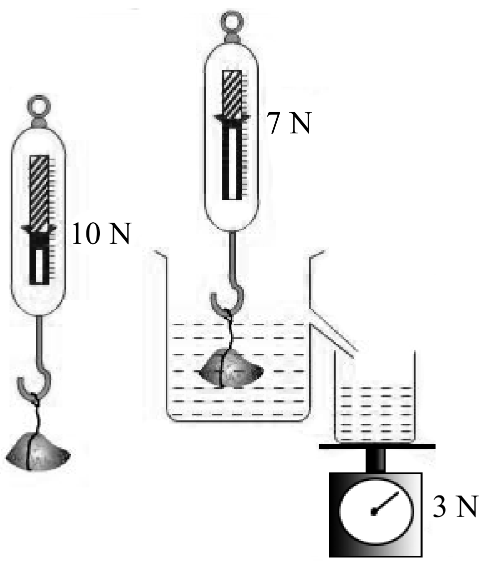
(*b*) State the unit of pressure.

Describe an experiment to demonstrate that the atmosphere exerts pressure. (14)

State Archimedes' principle.

The diagram shows the reading on a newton balance for an object suspended in air and in a liquid.

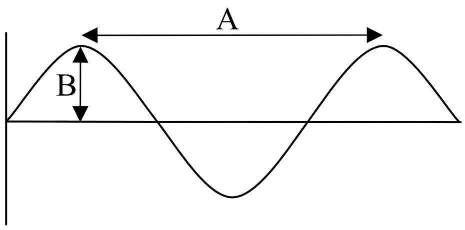
The weight of the liquid displaced is also shown on a balance.



(*i*) What is the upthrust (buoyancy force) on the object caused by the liquid?

(*ii*) Will the object float in the liquid if released?
Explain your answer. (14)

(*c*) The diagram shows a transverse wave.



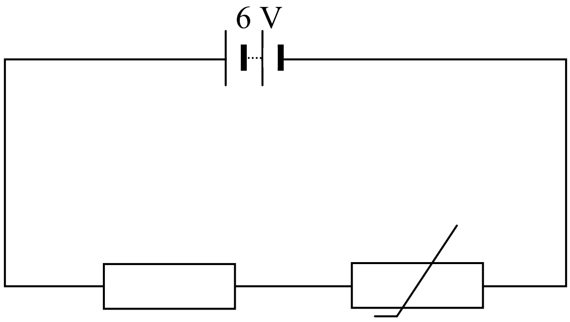
(*i*) Name the distances labelled A and B. (10)

(*ii*) 20 waves pass a fixed point every second. What is the frequency of the wave? (6)

(*iii*) Calculate the velocity of the wave if distance A = 1.5 m. (6)

(*iv*) Transverse waves can be polarised. Name a type of wave that cannot be polarised. (6)

(*d*) The circuit diagram shows a resistor and a thermistor connected in series with a 6 V battery. At a certain temperature the resistance of the thermistor is 450 Ω.



(*i*) State Ohm's law. (6)

(*ii*) What is the total resistance of the circuit? (4)

(*iii*) What is the current in the circuit? (6)

(*iv*) What is the potential difference across the 50 Ω resistor? (6)

(*v*) What would happen to the resistance of the circuit if the temperature were increased? (6)

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2015. M35

Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2015

PHYSICS – ORDINARY LEVEL

MONDAY, 15 JUNE – MORNING, 9:30 TO 12:30

Answer **three** questions from **Section A** and **five** questions from **Section B**.

Relevant data are listed in the *Formulae and Tables* booklet, which is available from the Superintendent.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

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1. A student carried out an experiment to investigate the relationship between force and acceleration by applying a force to a body and measuring the resulting acceleration. The table shows measurements recorded during the experiment.

Force (N)	0.5	1.0	1.5	2.0	2.5	3.0	3.5
Acceleration (m s^{-2})	0.1	0.2	0.3	0.4	0.5	0.6	0.7

(*i*) Draw a labelled diagram of the apparatus used in the experiment. (9)
(*ii*) State what measurements were taken during the experiment. (9)
(*iii*) How were the effects of friction reduced in this experiment? (6)
(*iv*) Plot a graph, on graph paper, of the acceleration against the force. (12)
(*v*) What does your graph tell you about the relationship between the acceleration of the body and the force applied to it? (4)

2. During an experiment to measure the specific latent heat of vaporisation of water, cold water was placed in an insulated copper calorimeter. Dry steam was passed into the water, causing the temperature of the calorimeter and water to rise. The following are some of the measurements that were recorded.

Mass of calorimeter + water... 90.7 g
Mass of calorimeter + water + steam .... 92.3 g

(*i*) Draw a labelled diagram of the apparatus used in the experiment. (9)
(*ii*) How was the steam dried? (6)
(*iii*) What other measurements should be taken during this experiment? (9)
(*iv*) Calculate the mass of steam used. (3)
(*v*) Calculate the latent heat released when the steam condensed. (9)
(*vi*) State one safety precaution required for this experiment. (4)

(specific latent heat of vaporisation of water = 2.3×10^6 J kg^{-1})

3. In an experiment to measure the focal length of a concave mirror, a student placed an object in front of the mirror so that a real image was formed. The student repeated the experiment by placing the object at different positions.

The table shows the data recorded by the student.

u (cm)	20	25	30	60
v (cm)	60	38	30	19.5

(*i*) Draw a labelled diagram showing the arrangement of the apparatus used. (12)

(*ii*) How was the position of the image located? (6)

(*iii*) Show the distances u and v on your diagram. (6)

(*iv*) Calculate the value of f, the focal length of the mirror. (12)

(*v*) Why did the student repeat the experiment? (4)

4. In an experiment to find the resistivity of the material of a wire, a student took a sample of the wire and measured its length l, diameter d, and resistance R.

(*i*) Describe how the student found the resistance of the wire. (6)

(*ii*) What instrument did the student use to measure the diameter of the wire? (6)

The table shows the measurements recorded by the student.

R (Ω)	30		
l (cm)	80		
d (mm)	0.21	0.26	0.22

(*iii*) Use the data to calculate the cross-sectional area of the wire. (12)

(*iv*) Find the resistivity of the material in the wire. (10)

(*v*) State two precautions which should be taken in order to obtain an accurate result. (6)

SECTION B (280 marks)

Answer **five** questions from this section.
Each question carries 56 marks.

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5. Answer any **eight** of the following parts, (*a*), (*b*), (*c*), etc.

(*a*) State Newton's law of universal gravitation.

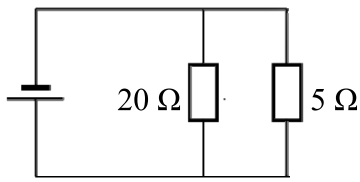
(*b*) A small stone is thrown straight up from the ground with an initial speed of 20 m s^{-1}. Calculate the height it has reached after two seconds.
(acceleration due to gravity, g = 9.8 m s^{-2})

(*c*) From the list below, identify (*i*) the scientist associated with the law of refraction of light and (*ii*) the scientist associated with the laws of electromagnetic induction.

Faraday   Snell   Joule   Archimedes

(*d*) A glass block has a critical angle of 42°. Calculate the refractive index of the glass used in the block.

(*e*) Calculate the effective resistance of the resistors shown in this circuit diagram.



(*f*) State Boyle's law.

(*g*) State one use of the device shown on the right.

(*h*) Name an electronic component that has a p-n junction.

(*i*) What is the purpose of a transformer in a mobile phone charger?

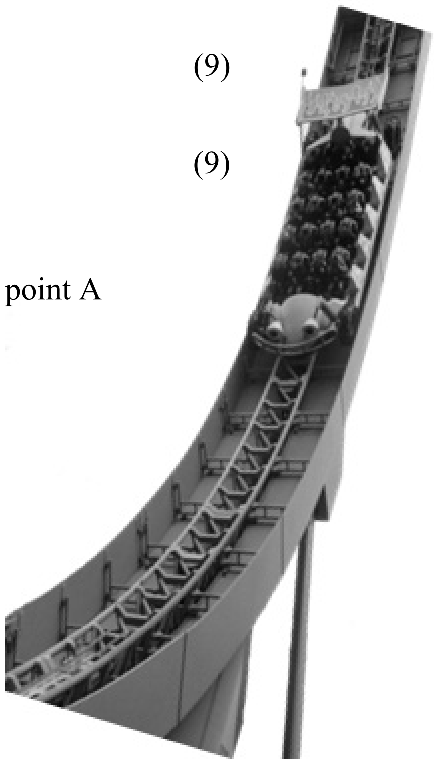
(*j*) What is meant by the *half-life* of a radioactive substance?

(8 × 7)

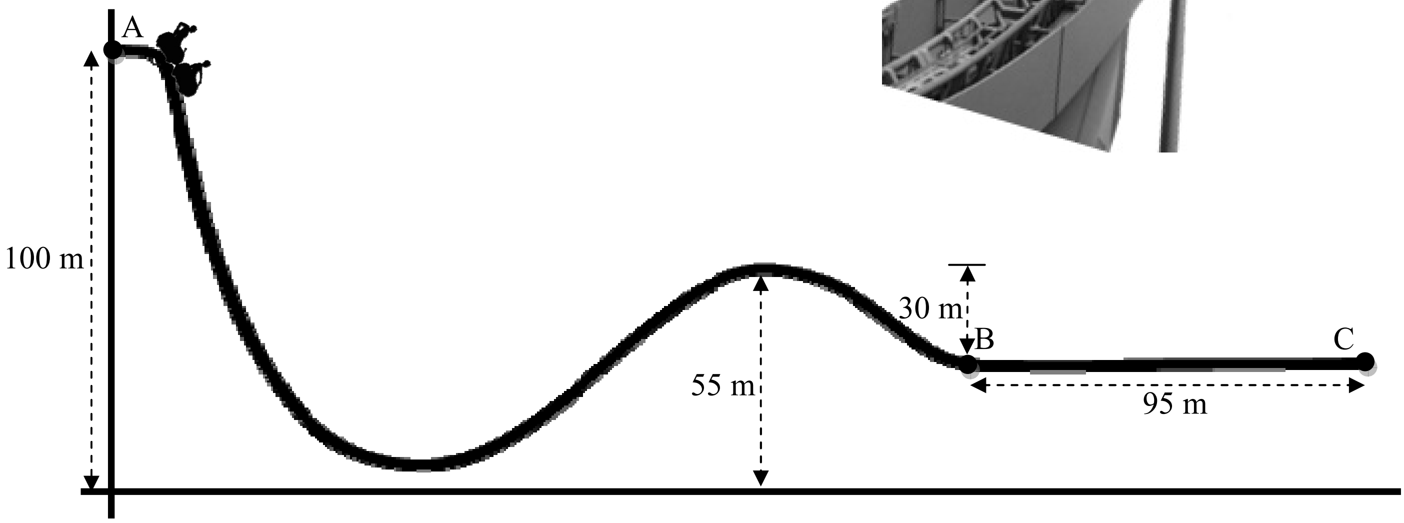
6. Define (*i*) potential energy and (*ii*) kinetic energy. (9)

State the principle of conservation of energy.

Explain how the principle applies to a roller-coaster. (9)



A roller-coaster car of mass 850 kg is released from rest at point A of the track, as shown in the diagram.



(*i*) Calculate the difference in height between point A and point B. (5)

(*ii*) Calculate the change in the potential energy of the car between A and B. (6)

(*iii*) Write down the kinetic energy of the car at point B, assuming there is no friction and no air resistance. Calculate its velocity at point B. (12)

The brakes are applied at point B and the car comes to a stop at point C.

(*iv*) Calculate the deceleration of the car between B and C.

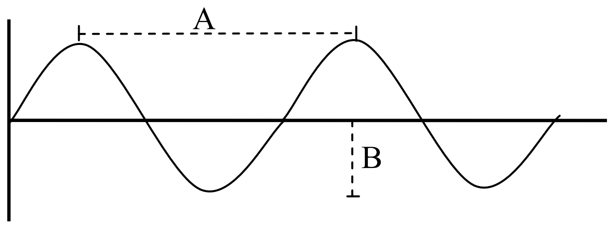
(*v*) Calculate the average force required to bring the car to a stop. (15)

(acceleration due to gravity, $g = 9.8$ m s^{-2})

7. Explain the term *resonance*. (6)

Describe a laboratory experiment to demonstrate resonance. (14)

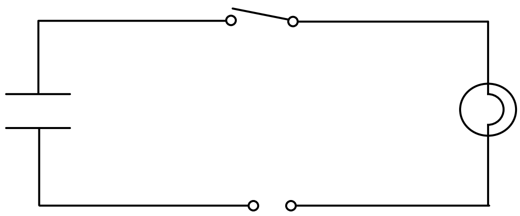
The diagram shows a waveform.



(*i*) What is length A called? (3)
(*ii*) What is length B called? (3)
(*iii*) What is meant by the frequency of a wave? (6)
(*iv*) List three characteristics of a musical note. (9)
(*v*) What is meant by the term *natural frequency of an object*? (6)
(*vi*) The natural frequency of a stretched string is 250 Hz.
Calculate the wavelength of the sound wave produced. (9)

(speed of sound in air = 340 m s^{-1})

8. Define capacitance. Name the unit of capacitance. (9)



12 V a.c.

The diagram above shows a circuit with a bulb, switch, capacitor and a 12 V a.c. power supply.

(*i*) What is observed when the switch is closed? (6)
(*ii*) What would be observed if a 12 V d.c. supply were used instead of the a.c. supply? (6)
(*iii*) What do these observations tell us about capacitors? (6)
(*iv*) The capacitor has a charge of 0.8 C when connected to the 12 V d.c. supply.
Calculate its capacitance. (9)

Describe an experiment to show that energy is stored in a charged capacitor. (12)

The photographs show a radio and a camera flash. Each of these devices makes use of a property of capacitors. Name the property used in each case. (8)

9. Distinguish between heat and temperature. (9)

The diagram shows a kettle which is filled with 500 g of water which is initially at a temperature of 20 °C.

The heating element of the kettle has a power rating of 0.8 kW. We assume all the heat is transferred to the water.

(*i*) Find the energy required to raise the temperature of the water to 100 °C. (12)

(*ii*) What is the energy supplied by the element per second? (6)

(*iii*) How long will it take the kettle to heat the water to 100 °C? (6)

(*iv*) Why are handles of kettles often made of plastic? (6)

(*v*) How is the heat transferred throughout the liquid in the kettle? (6)

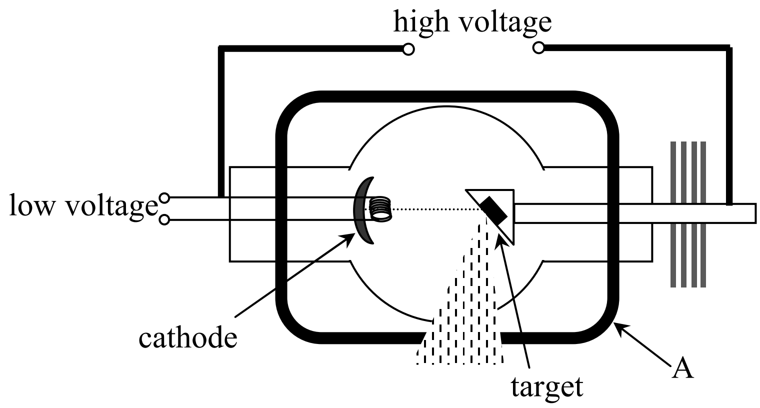
(*vi*) Why is the heating element of a kettle made of metal? (6)

(*vii*) The heat source for a kettle is placed at the bottom. Suggest why this is the case. (5)

(specific heat capacity of water = 4180 J kg^{-1} K^{-1})

10. X-rays are produced when a beam of high speed electrons collides with a target in an X-ray tube, as shown below.

What are X-rays? State two properties of X-rays. (12)



(*i*) What process occurs at the cathode? (6)

(*ii*) Name a substance commonly used as the target. (6)

(*iii*) State the function of the part marked A. (6)

(*iv*) State one use of X-rays. (5)

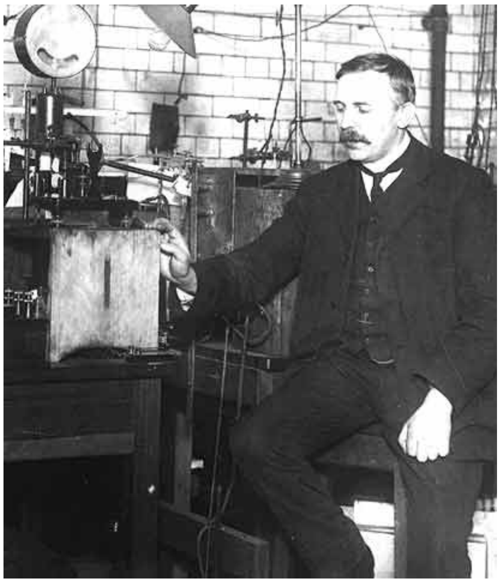
A cathode ray tube, like the one used in the cathode ray oscilloscope, also uses a beam of high speed electrons.

(*v*) Draw a sketch of a cathode ray tube suitable for use in an oscilloscope. (12)

(*vi*) Why is a vacuum needed in both the X-ray tube and the cathode ray tube? (6)

(*vii*) State one use of a cathode ray oscilloscope. (3)

11. Read the following passage and answer the accompanying questions.



Ernest Rutherford (1871–1937, Nobel Prize 1908) was a brilliant student from New Zealand who, thanks to a grant, moved to the glorious Cavendish Laboratory in Cambridge, full of hopes and ambitions. Later in his life he became a physics professor at the University of Manchester.

One day in 1909, in Manchester, he suggested to his collaborator Hans Geiger and to his student Ernest Marsden that they study the deflection of the so-called alpha-particles. These are positively charged helium ions produced by a radioactive source of radium bromide. This deflection occurs when the alpha-particles pass through a thin film of gold. Experiments of this kind had already been performed, and it had been observed that the alpha-particles are only slightly deflected when they cross the film.

The novelty of Rutherford's suggestion was that he asked his collaborators to check if any alpha-particle bounced back instead of going through the film. Why should a thin metal film reflect heavy high-speed bullets, like the alpha-particles produced by a radioactive source? Geiger and Marsden made their measurement and ran back breathlessly to Rutherford. They had observed that some alpha-particles were indeed bouncing back.

In Rutherford's words: "It was quite the most incredible event that has ever happened to me in my life". He had looked inside the atom and the image he saw was very different from what physicists had expected. A central nucleus, much smaller than the actual size of the atom, holds the entire positive charge and practically all the atomic mass. The rest is just a cloud of light electrons, carrying all the negative charge.

(Adapted from *A Zeptospace Odyssey*, Gian Francesco Giudice, Oxford University Press, 2010)

(*a*) What are alpha-particles?

(*b*) Name a source of alpha-particles.

(*c*) What material was used as the target in the experiment?

(*d*) How did Geiger and Marsden detect the alpha-particles?

(*e*) What was the surprising result they observed?

(*f*) What force caused the deflection of the alpha-particles?

(*g*) Outline what the Geiger-Marsden experiment revealed about the structure of the atom.

(*h*) For what invention is Hans Geiger most famous?

(8 × 7)

12. Answer any **two** of the following parts, (*a*), (*b*), (*c*), (*d*).

(*a*) A bicycle can be steered by applying a pair of equal but opposite forces to the handlebars, which act as a lever.

(*i*) What is meant by the term *lever*? (6)

(*ii*) What is the name given to the turning effect of a force? (6)

(*iii*) What is the name given to a pair of equal but opposite forces? (6)

A cyclist's hands are placed 40 cm apart on the ends of the handlebars.

To turn the bicycle, he applies a force of 20 N through each hand.

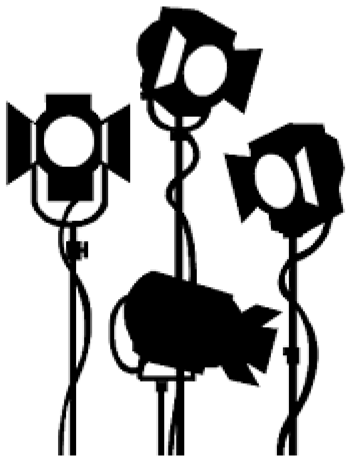
Calculate the turning effect of the force. (10)

(*b*) What is meant by dispersion of light? (6)

What does dispersion of light indicate about the nature of white light? (6)

Name two laboratory techniques that can be used to cause dispersion of light. (6)

Describe one example of dispersion of light occurring in nature. (4)



The diagram shows stage lighting similar to that found in most theatres.
Only red, green and blue lights are needed to create all the colours needed on stage.
Explain why this is so. (6)

(*c*) Define resistance. What is the unit of resistance? (9)

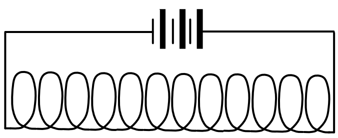
Describe an experiment to demonstrate the heating effect of an electric current. (9)

Electrical conduction in different materials is due to the movement of charge carriers.

State the charge carriers that are responsible for conduction in each of the following.

(*i*) gases
(*ii*) semiconductors
(*iii*) metals
(*iv*) solutions (10)

(*d*) A solenoid (long coil of wire) is connected to a battery as shown.



(*i*) Copy the diagram into your answer book and draw the magnetic field in and around the solenoid. (6)

(*ii*) Explain the term *electromagnetic induction*. (6)

A magnet and a solenoid can together be used to produce electricity.

Describe, with the aid of a diagram, how this can be done. (16)

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2016. M35

Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2016

PHYSICS – ORDINARY LEVEL

MONDAY, 20 JUNE – MORNING, 9:30 TO 12:30

Answer **three** questions from **Section A** and **five** questions from **Section B**.

Relevant data are listed in the *Formulae and Tables* booklet, which is available from the Superintendent.

SECTION A (120 marks)

Answer **three** questions from this section.
Each question carries 40 marks.

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1. A student carried out an experiment to verify the principle of conservation of momentum.

During the experiment, the student took measurements to find mass and velocity.

(*i*) Draw a labelled diagram of the arrangement of the apparatus used in this experiment. (12)

(*ii*) How was mass measured? (6)

(*iii*) What measurements were taken to calculate velocity?
How were these measurements used to calculate velocity? (9)

(*iv*) How did the student determine the momentum? (6)

(*v*) How did the student verify the principle of conservation of momentum? (7)

2. An experiment was set up to determine the refractive index of a material.

(*i*) Draw a labelled diagram of the arrangement of the apparatus used in this experiment. (12)

(*ii*) Indicate on your diagram the measurements that were taken. (9)

(*iii*) What instrument was used to take these measurements? (6)

(*iv*) How was the refractive index calculated? (7)

(*v*) Why should the experiment be repeated? (6)

3. A student carried out a laboratory experiment to find the speed of sound in air.

(*i*) Draw a labelled diagram of the arrangement of the apparatus used in this experiment. (12)

(*ii*) How did the student find the frequency of the sound wave used? (6)

(*iii*) What other measurements did the student take? (9)

(*iv*) How did the student calculate the speed of sound in air? (9)

(*v*) State one precaution which the student might have taken to get an accurate result. (4)

4. In an experiment to verify Joule's law, a heating coil was placed in a fixed mass of water.

A current I was allowed to flow through the coil for a fixed length of time and the rise in temperature, $\Delta\theta$, was recorded.

This was repeated for different values of I.

The table below shows the data recorded.

(*i*) Draw a labelled diagram of the arrangement of the apparatus used in this experiment. (12)

(*ii*) How was the current changed during the experiment? (4)

(*iii*) Copy the table below and complete it in your answerbook. (6)

I (A)	1.0	1.5	2.0	2.5	3.0	3.5	4.0
I^2 (A^2)		2.25					
$\Delta\theta$ (°C)	2.3	4.9	8.8	13.0	20.2	26.0	35.2

(*iv*) Using the data in the completed table, draw a graph on graph paper of $\Delta\theta$ against I^2. (12)

(*v*) Explain how your graph verifies Joule's law. (6)

SECTION B (280 marks)

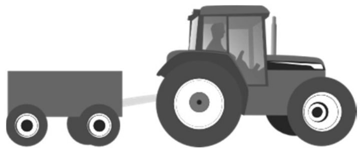
Answer **five** questions from this section.
Each question carries 56 marks.

---

5. Answer any **eight** of the following parts, (*a*), (*b*), (*c*), etc.

(*a*) State the principle of Archimedes.

(*b*) A tractor applies a force of 500 N to pull a trailer a distance of 3 km. Calculate the work done by the tractor.



(*c*) Choose from the list below the instrument used to measure (*i*) pressure, and (*ii*) energy.

opisometer **barometer** **hydrometer** **joulemeter**

(*d*) State two uses for a concave mirror.

(*e*) Conduction is one method of heat transfer. Name the other two methods.

(*f*) What is the function of a lightning conductor?

(*g*) There are 150 turns in the primary coil of a transformer and 3000 turns in the secondary coil. Calculate the output voltage when 12 V a.c. is connected across the primary coil.

(*h*) State one common use of the electroscope.

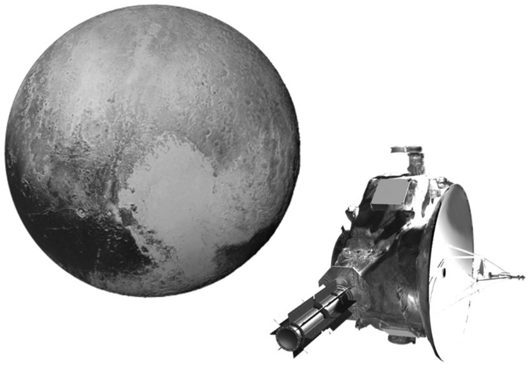
(*i*) What is the photoelectric effect?

(*j*) What are alpha-particles?

(8 × 7)

6. Define the term force and state the unit of force. (9)

Force is a vector quantity. Name another example of a vector quantity. (6)



The *New Horizons* spacecraft visited the minor planet Pluto in 2015.

Newton's law of universal gravitation is used to calculate the force between two bodies, for example Pluto and the *New Horizons* spacecraft.

State the factors which affect the size of the gravitational force between two bodies. (9)

Pluto has a mass of 1.3×10^{22} kg and a radius of 1186 km. Use the equation below, which is taken from page 56 of the *Formulae and Tables* booklet, to calculate g, the acceleration due to gravity on the surface of Pluto. (12)

$$g = \frac{GM}{d^2}$$

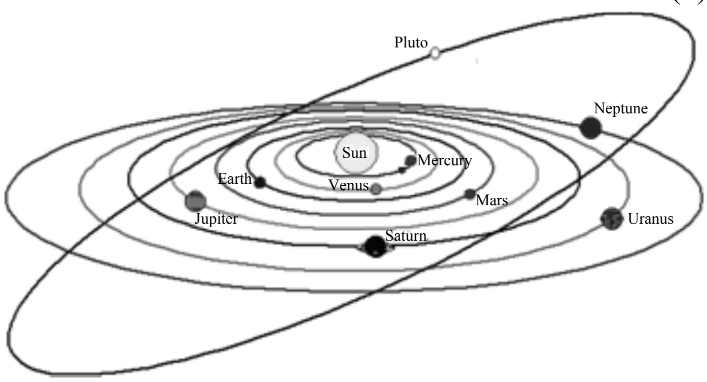
The mass of the *New Horizons* spacecraft is 450 kg. Calculate the weight it would have on the surface of Pluto.

The closest the spacecraft got to Pluto was 11000 km from the surface of the planet. Would you expect its weight at this position to be greater or less than it would be at the surface? Explain your answer. (12)

The Earth is surrounded by a layer of air, called its atmosphere, which exerts a pressure on the surface of the planet. Explain why Pluto's atmosphere exerts a very low pressure on its surface. (3)

The *New Horizons* spacecraft used a radioactive isotope to generate electricity, instead of the solar panels used on most spacecraft.

Suggest a reason why solar panels were unsuitable in this case. (5)



7. Sound and light travel as waves. Sound travels as a longitudinal wave whereas light travels as a transverse wave.

Explain the underlined terms. (8)

Describe a laboratory experiment which demonstrates that sound requires a medium to travel through. (12)

Total internal reflection is the basis of operation of optical fibres.

(*i*) With the aid of a labelled diagram, explain how total internal reflection occurs. (9)

(*ii*) State two uses of optical fibres. (6)

(*iii*) The refractive index of a material in an optical fibre is 1.44. Calculate the minimum angle at which light can strike the sides of the fibre and still be transmitted through the fibre. (9)

The picture shows a sound-level meter, which is used to measure sound intensity level.

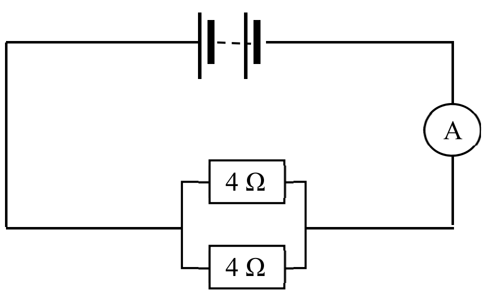
(*iv*) What is the unit of sound intensity level? (6)

(*v*) Why might a sound-level meter be used in a workplace? (6)

8. Define *voltage* and *resistance*. (9)

Name an instrument used to measure each of these quantities. (6)

Name a source of voltage. (6)



The diagram above shows a circuit with a 12 V d.c. power supply, an ammeter, and two 4 Ω resistors connected in parallel.

Calculate

(*i*) the total resistance of the circuit

(*ii*) the current flowing through the ammeter

(*iii*) the current flowing through each resistor. (21)

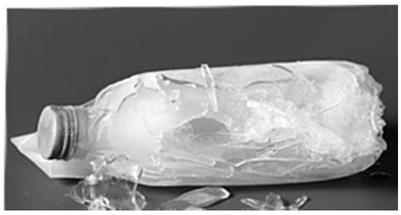
One effect of an electric current is the heating effect. Name the two other effects of an electric current. Describe an experiment to demonstrate one of these two effects. (14)

9. What is meant by *latent heat*? (6)

Name an instrument used to measure temperature. (3)

A glass bottle is filled with 0.75 kg of water at a temperature of 20 °C. The bottle is then placed in a freezer, which freezes the water and cools it to −15 °C.

Calculate the energy removed from the water to



(*i*) reduce its temperature to 0 °C

(*ii*) convert the water at 0 °C to ice at 0 °C

(*iii*) to cool the ice at 0 °C to ice at −15 °C. (24)

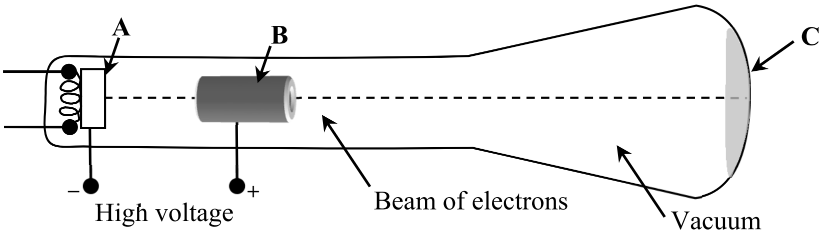
specific heat capacity of water	$= 4200 \, J \, kg^{-1} \, K^{-1}$
specific latent heat of fusion of water	$= 3.3 \times 10^5 \, J \, kg^{-1}$
specific heat capacity of ice	$= 2200 \, J \, kg^{-1} \, K^{-1}$

The power rating of the freezer is 300 W. How long will it take for the freezer to remove 9000 J of energy from the water? (5)

As the water freezes, the glass bottle cracks and shatters.
Explain why this occurs. (6)

The freezer is an example of a heat pump. Outline the operation of a heat pump. (12)

10. X-ray tubes and cathode ray tubes are practical applications of thermionic emission. Thermionic emission causes the emission of electrons, which are sub-atomic particles.



The diagram shows a simple cathode ray tube, which produces a beam of electrons by thermionic emission.

(*i*) State two properties of the electron. Name another sub-atomic particle. (9)

(*ii*) Name the parts labelled **A**, **B**, and **C** in the diagram. (9)

(*iii*) State the function of any two of these parts. (9)

(*iv*) How could the beam of electrons be deflected? (6)

(*v*) Why is it important to have a vacuum inside a cathode ray tube? (6)

(*vi*) State one use of a cathode ray tube. (3)

Electrons are produced by thermionic emission in an X-ray tube also.

Draw a sketch of an X-ray tube. (11)

Why are lead aprons often worn when using an X-ray tube? (3)

11. Read this passage and answer the questions below.

Experimentum crucis

Once he returned to Cambridge from the country in 1667, Newton began to gain honours with startling rapidity and became the second holder of the Lucasian Professorship in Mathematics, a position later held by Stephen Hawking. This new job obliged Newton to give occasional lectures but he was also able to spend much more time on experiments.

To isolate a single colour (or at least what the eye sees as a colour – a spectrum in fact consists of an innumerable range of colours, each blending into the next), he put a card with a hole in it next to a prism, only letting through a narrow band of light. Not only did he confirm his view that when this beam was passed through a second prism no different colours were produced – red light remained red, blue remained blue and so on – he discovered that red coloured light was bent much less by the prism than blue light. The degree of bending, the refraction, varied as he moved through the different colours.

He later referred to this discovery as the *experimentum crucis*, the crucial experiment, emphasising its significance as a turning point in the understanding of the nature of light. He had found something fundamental and new - that light was made up of colours that were distinct entities, impossible to change from one into the other, each bent differently by a prism. For good measure, his experiment explained why a prism worked at all. When a beam of light hit an ordinary block of glass there was no rainbow produced. As the light passed from air to glass it was true that the blue light would bend further than the red, splitting it out, but when it reached the far side of the block it would move back the other way an equal amount and the result would be to recombine the colours. The prism's triangular faces meant that the two opportunities to bend - towards the vertical of the first face and away from the vertical of the second - both resulted in movement in the same direction. The colours remained separate.

(Adapted from *Light Years - The Extraordinary Story of Mankind's Fascination with Light*, Brian Clegg, Icon Books, 2015)

(*a*) What word is used to describe the bending of light by a prism?

(*b*) What does the spectrum of light consist of?

(*c*) Which colour of light is bent the most?

(*d*) Draw a diagram to show how a spectrum can be produced using a prism.

(*e*) What was the significance of Newton's experiment?

(*f*) Without using a prism, how else can a spectrum be produced?

(*g*) Why is a spectrum not produced by an ordinary block of glass?

(*h*) Name another field of physics for which Newton is famous.

(8 × 7)

12. Answer any **two** of the following parts, (*a*), (*b*), (*c*), (*d*).

(*a*) Define *kinetic energy* and *potential energy*. (6)

Students carried out an experiment to investigate how to protect a falling egg from breaking.

They observed the results when an egg of mass 52 g was dropped from a height of 2 m, when protected and unprotected.

(*i*) Calculate the potential energy of the egg before it was dropped. (6)

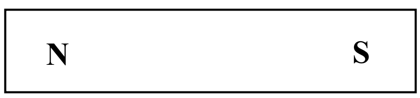
(*ii*) Calculate the velocity of the egg as it hit the ground. (6)

Suggest how the egg could be protected from breaking when it hits the ground. (6)

State one everyday application of the principal behind the protection of the egg. (4)

(*acceleration due to gravity, g = 9.8 m s*$^{-2}$)

(*b*) The diagram shows a bar magnet.



(*i*) Copy the diagram and show on it the magnetic field lines around the magnet. (6)

(*ii*) Describe an experiment to plot the magnetic field lines around the magnet. (12)

(*iii*) Name a metal that is attracted to a magnet. (4)

(*iv*) State two practical uses of a magnet. (6)

(*c*) A ring circuit is used in domestic wiring.

(*i*) State one advantage of using of a ring circuit when wiring a house. (6)

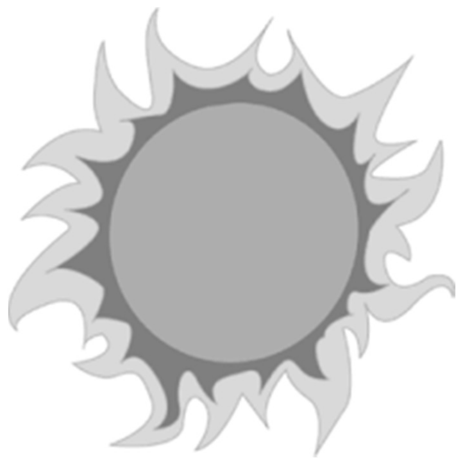
(*ii*) *Earthing* is a safety measure included in domestic circuits.

What is meant by earthing? How does earthing contribute to safety? (9)

(*iii*) Name one other safety device used in domestic wiring. (4)

(*iv*) In a standard domestic three-pin plug, the live wire is covered in brown plastic. Name the other two wires and state the colour associated with each of them. (9)

(*d*) *Nuclear fusion* is the source of the Sun's energy.



(*i*) What is meant by nuclear fusion? (6)

(*ii*) Name the other type of nuclear reaction used in nuclear power stations. (6)

(*iii*) State one advantage and one disadvantage of each of these sources of nuclear energy. (12)

(*iv*) Name the scientist whose equation $E = mc^2$ explained why a large amount of energy is available from a small mass of fuel in nuclear reactions. (4)

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2017. M35

Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2017

PHYSICS – ORDINARY LEVEL

MONDAY, 19 JUNE – MORNING, 9:30 TO 12:30

Answer **three** questions from **Section A** and **five** questions from **Section B**.

Relevant data are listed in the *Formulae and Tables* booklet, which is available from the Superintendent.

SECTION A (120 MARKS)

Answer **three** questions from this section.
Each question carries 40 marks.

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1. An experiment was set up to measure *g*, the acceleration due to gravity.

(*i*) Draw a labelled diagram of the apparatus used in this experiment. (12)

(*ii*) What measurements were taken to calculate *g*?

How were these measurements taken? (12)

(*iii*) How were these measurements used to calculate *g*? (9)

(*iv*) State two precautions which the student might have taken to get an accurate result. (7)

2. An experiment was set up to measure the specific heat capacity of a substance.

(*i*) Draw a labelled diagram of the apparatus used in this experiment. (12)

(*ii*) What measurements were taken during this experiment? (9)

(*iii*) How was the mass of the substance determined? (6)

(*iv*) How was the specific heat capacity of the substance determined? (9)

(*v*) State one precaution which the student might have taken to get an accurate result. (4)

3. An experiment was set up to measure the focal length of a concave mirror.
The table shows the data recorded during the experiment.

u (cm)	15	25	45
v (cm)	30	17	13

(*i*) Draw a labelled diagram of the apparatus used in this experiment. (12)

(*ii*) How did the observer know that the apparatus was correctly arranged to record the data? (6)

(*iii*) Indicate on your diagram the measurements that were taken. (6)

(*iv*) Calculate the value of the focal length *f* of the mirror, using the data above. (12)

(*v*) Why might it be an advantage to use a darkened room when carrying out this experiment? (4)

4. An experiment was set up to investigate the variation of the resistance *R* of a metallic conductor with its temperature θ.

(*i*) Draw a labelled diagram of the apparatus used in this experiment. (12)

(*ii*) How was the value of the resistance of the metallic conductor measured? (6)

The table shows the measurements obtained during the experiment.

θ (°C)	0	15	30	40	60	80	100
R (Ω)	19.6	20.6	21.6	22.2	23.5	24.8	26.1

(*iii*) Using the data in the table draw a graph, on graph paper, to show the variation of the resistance of the metallic conductor with temperature. (12)

(*iv*) What does the graph tell you about the relationship between the resistance of a metallic conductor and its temperature? (6)

(*v*) Use your graph to find the temperature of the metallic conductor when it has a resistance of 22.8 Ω. (4)

SECTION B (280 MARKS)

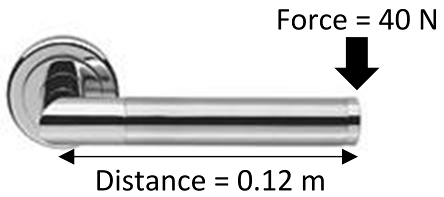
Answer **five** questions from this section.
Each question carries 56 marks.

---

5. Answer any **eight** of the following parts (*a*), (*b*), (*c*), etc.

(*a*) Name an example of (*i*) a vector quantity and (*ii*) a scalar quantity.

(*b*) A door handle is used to open a door.
Calculate the moment of the force applied in the diagram.



(*c*) Choose from the list below the instrument used to measure (*i*) electrical current and (*ii*) length.

ammeter **protractor** **metre stick** **barometer**

(*d*) Conduction is one method of heat transfer. Name the other two methods.

(*e*) Name the instrument shown. 

(*f*) State one common use for a convex lens.

(*g*) Resonance can cause a wine glass to shatter. What is resonance? 

(*h*) Name one source of voltage.

(*i*) What sub-atomic particle is released by the photoelectric effect?

(*j*) Name one method of detecting radiation.

(8 × 7)

6. A fairground sling-shot is shown below. Springs attached to the pod are used to store a form of potential energy. When the pod and springs are released, this potential energy is used to exert a force which gives the pod an upward acceleration. At the pod's highest point, the occupants experience apparent weightlessness for a short time, before gravity causes the pod to fall back towards the ground.

(*i*) Explain the underlined terms. (18)

(*ii*) What form of energy does the pod have due to its motion? (6)

(*iii*) What form of energy does the pod have at its highest point? (6)

(*iv*) Why do the occupants experience apparent weightlessness at the pod's highest point? (3)

The mass of the pod is 400 kg.

It reaches a maximum height of 50 m above its point of release.

(*v*) Calculate the potential energy stored in the springs before the pod is released. (6)

(*vi*) Draw a diagram to show the forces acting on the pod when it is released. (6)

(*vii*) Calculate the momentum of the pod when it has a speed of 8 m s^{-1}. (6)

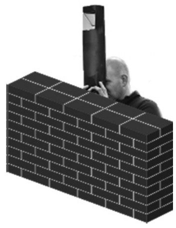
(*viii*) State one energy loss that might prevent the pod from reaching its maximum height. (5)

(*acceleration due to gravity, g = 9.8 m s^{-2}*)

7. A ray of light can undergo both reflection and refraction.

(*i*) What is meant by reflection of light? (6)

(*ii*) State the laws of reflection. (9)



The periscope, like the one in the diagram, is an application of the reflection of light that allows a person to see over objects.

(*iii*) Draw a diagram to show how a periscope works. (9)

The diagram shows the word AMBULANCE written so that a driver can read it correctly in a car mirror.

(*iv*) Explain why the driver can read the word correctly in the mirror. (6)

Total internal reflection of light occurs in optical fibres which are used to transmit information.

(*v*) Draw a labelled diagram to show how total internal reflection occurs. (9)

(*vi*) Draw a labelled diagram to show how an optical fibre transmits light along its length. (9)

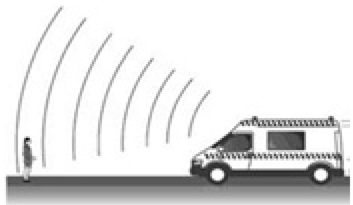
(*vii*) An optical fibre cable has a refractive index of 1.5.
Calculate the angle at which total internal reflection occurs. (8)

8. Frequency and wavelength are properties associated with waves.

(*i*) What is meant by the frequency of a wave? (6)

(*ii*) State the relationship between the frequency of a wave and its wavelength. (6)

The diagram shows a person standing near an ambulance as it approaches with its siren on. As the ambulance passes, the person observes a change in the frequency of the siren.



(*iii*) What name is given to this effect? (6)

(*iv*) Explain, with the aid of a labelled diagram, how this phenomenon occurs. (12)

(*v*) Name one practical application of this phenomenon. (5)

(*vi*) An electrical storm is seen before it is heard. What does this indicate about the difference between sound waves and light waves? (6)

(*vii*) State one other difference between sound waves and light waves. (6)

When timing a 100 m sprint, a person stands at the finishing line and starts the stopwatch when he hears the starting gun fired at the starting line.

(*viii*) Calculate the difference in time the runner would receive if the stopwatch was started at *exactly* the same time as the starting gun was fired, i.e. without any delay caused by the time taken for the sound to travel 100 m. (9)

(*speed of sound in air = 330 m* s^{-1})

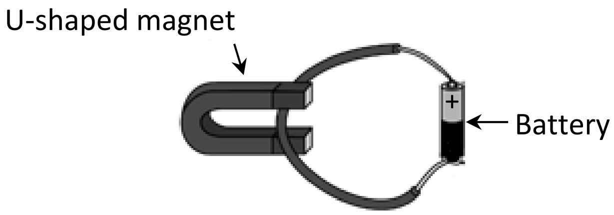
9. Magnetic fields can be detected near a magnet or a current-carrying conductor.

(*i*) What is a magnetic field? (6)

(*ii*) State one example of a good conductor and one example of a good insulator. (6)

(*iii*) Name the unit of voltage. (6)

The diagram below shows a wire placed between the poles of a U-shaped magnet.

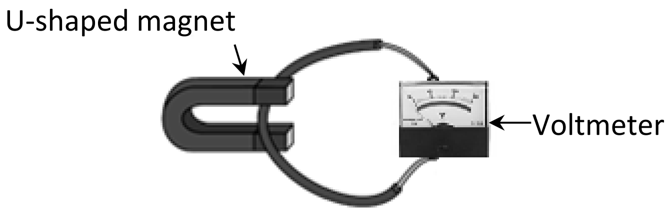


(*iv*) What happens to the wire when current flows through it? (6)

(*v*) What happens when the direction of the current is reversed? (6)

(*vi*) Name one device based on this effect. (6)

The wire is then disconnected from the battery and connected to a sensitive voltmeter.



(*vii*) What is observed on the voltmeter when neither the wire nor the magnet move? (4)

(*viii*) What is observed on the voltmeter when either the wire or the magnet is moved? (4)

(*ix*) Name a scientist whose law is associated with this phenomenon? (6)

(*x*) Magnetism is one effect associated with an electric current.
Name one other effect. (6)

10. Radiation is released when radioactive elements decay.

(*i*) Name three types of radiation. (9)

(*ii*) Which type of radiation has no charge? (3)

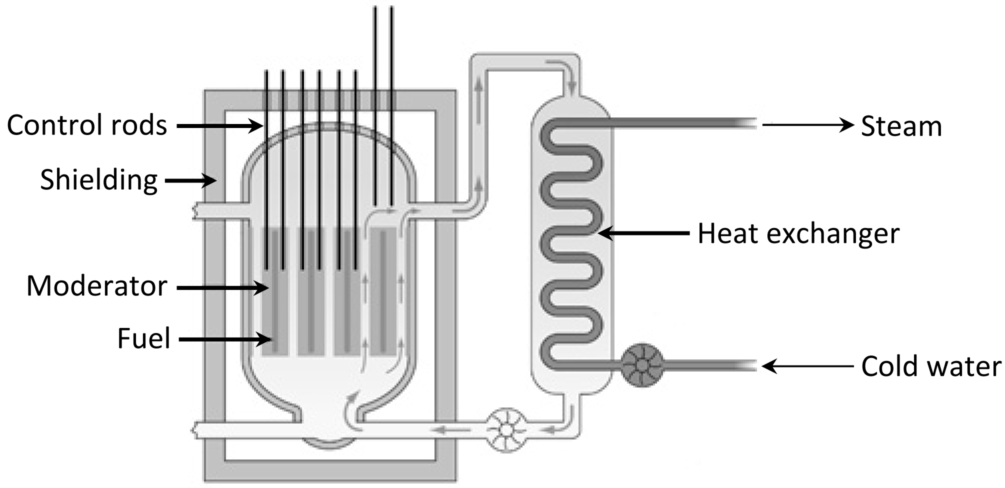
(*iii*) Which type of radiation is the least penetrating? (3)

(*iv*) Which type of radiation is not deflected by magnetic fields? (3)

(*v*) State one danger associated with nuclear radiation. (6)

(*vi*) State one precaution that should be taken when handling radioactive substances. (3)

Radioactive fuels are used to generate power in a nuclear fission reactor like the one shown in the diagram.



(*vii*) What is nuclear fission? (6)

(*viii*) Name a fuel used in nuclear reactors. (5)

(*ix*) State the function of (*a*) the control rods and (*b*) the shielding in a reactor. (12)

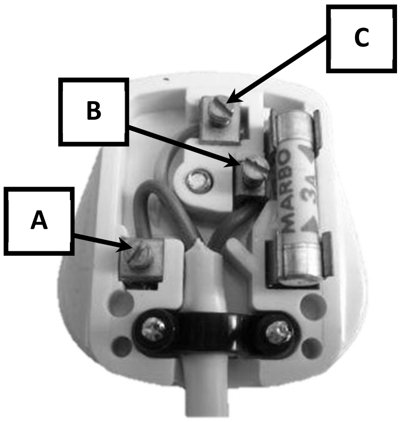
(*x*) What is the purpose of the heat exchanger? (6)

11. Read the following passage and answer the questions below.

The Electricity Connection to your Home

The electricity connection to your home is an a.c. supply and comes through ESB Networks' main fuse and meter. The ordinary fuses or miniature circuit breakers in the distribution board respond to overloaded circuits by 'blowing' and switching off the flow of electricity in the circuit. Additional protection against electric shock or fire is provided by a Residual Current Device, RCD. In simple terms, an RCD detects an abnormal flow of electricity out of a circuit when, for instance, a cable is damaged or a fault develops in an appliance allowing electricity to 'leak' out. The RCD responds instantaneously to such 'leakage' and disconnects the supply from the circuit. All RCDs have a test button to check that the mechanism is working properly.

Making the Connection – Plugs and Cable Colours



Almost all new electric appliances now come complete with a fitted 13 A 3-pin plug. The first thing to know is the colour code for connecting the cables to the appropriate pin/terminal in the plug. When you connect each wire to the appropriate terminal, it is most important that no loose strands of wire are exposed and that all the screw connections are fully tightened. You should also leave a little extra slack on the green/yellow wire within the plug in order to avoid strain on this vital connection. The ordinary 13 A plug suits most of the commonly used 'non-fixed' appliances in the home – heaters, washing machines, dryers, microwave ovens, tools, entertainment equipment, etc. Appliances with a higher loading should be permanently connected to their own circuit through a switch. The most vulnerable parts of many appliances are the connecting flex and the plug. Most electrical accidents associated with electric appliances are caused either by damaged flexes or wrongly-wired plugs. For your own safety, keep electric appliances well maintained and don't abuse them.

(Adapted from *The Safe Use of Electricity in the Home*, ESB Networks)

(*a*) What is the function of the electricity meter?

(*b*) What is meant by the term a.c.?

(*c*) Name three safety devices found in domestic circuits.

(*d*) What is the cause of most accidents associated with electrical appliances?

(*e*) What is the function of the test button on an RCD?

(*f*) Name the pins labelled **A**, **B** and **C** in the diagram.

(*g*) State one precaution that should be taken when wiring a plug.

(*h*) What is the maximum power that an appliance with a 13 A plug can use when connected to a 220 V supply?

(8 × 7)

12. Answer any **two** of the following parts (*a*), (*b*), (*c*), (*d*).

(*a*) Define (*i*) velocity and (*ii*) friction. (9)

A car started from rest and accelerated at 0.4 m s^{-2} to reach a top speed of 28 m s^{-1}. It maintained this speed for 200 seconds.

When the car approached its destination, the driver applied the brakes uniformly to bring it to a stop in 30 s.

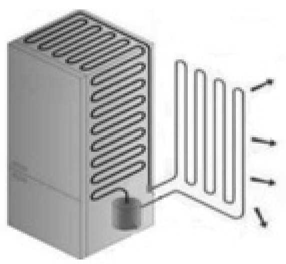
(*iii*) Draw a diagram indicating the main forces acting on the car when it was accelerating. (6)

(*iv*) Calculate how long it took the car to reach its top speed. (6)

(*v*) Sketch the velocity-time graph for the journey. (7)

(*b*) The <u>heat pump</u> in a fridge uses a fluid with a high <u>specific latent heat</u>.

(*i*) Explain the underlined terms. (12)



A fridge lowers the temperature of 2 kg of water from 30 °C to 5 °C in 840 s.

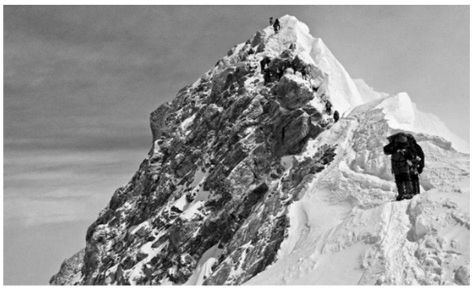
Calculate

(*ii*) the energy removed from the water (12)

(*iii*) the power of the fridge. (4)

(*specific heat capacity of water = 4200 J kg^{-1} K^{-1}*)

(*c*) Mountain climbers encounter large changes in atmospheric pressure.



(*i*) Define pressure and state its unit. (10)

(*ii*) Describe an experiment to demonstrate that the atmosphere exerts pressure. (9)

A weather balloon is released to test the weather at the height of Mount Everest, where atmospheric pressure is only 3.0×10^4 Pa.

The balloon has a volume of 2 litres when it is released from sea level.

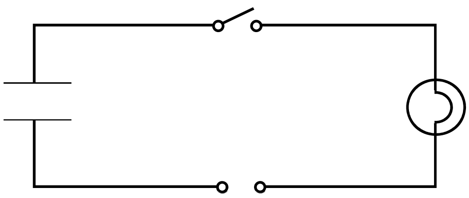
(*iii*) Calculate the volume of the balloon when it reaches the height of Mount Everest. (9)

(*atmospheric pressure at sea level = 10.1×10^4 Pa*)

(*d*) (*i*) State Coulomb's law of force between electric charges. (6)

A capacitor can be used to store electric charge.

A discharged capacitor with a capacitance of 6×10^{-2} F is connected in a circuit with a bulb, a switch and a 12 V d.c. power supply as shown.



(*ii*) What is observed when the switch is closed? (6)

(*iii*) What would be observed if a 12 V a.c. power supply had been used instead? (4)

(*iv*) Calculate the charge stored on the capacitor when it is connected to the 12 V d.c. power supply. (9)

(*v*) State one application of a capacitor. (3)

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Coimisiún na Scrúduithe Stáit

State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2018

PHYSICS – ORDINARY LEVEL

WEDNESDAY, 20 JUNE – MORNING, 9:30 TO 12:30

Answer **three** questions from **Section A** and **five** questions from **Section B**.

Relevant data are listed in the *Formulae and Tables* booklet, which is available from the Superintendent.

SECTION A (120 MARKS)

Answer **three** questions from this section.

Each question carries 40 marks.

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1. An experiment was set up to verify Boyle's law.

(*i*) Draw a labelled diagram of the apparatus used in this experiment. (12)

The table shows the measurements obtained during the experiment.

V (cm^3)	2	3	4	5	6	9
p (kPa)	535	350	270	215	180	120
$1/V$ (cm^{-3})			0.25			

(*ii*) How were the pressure and volume measured? (9)

(*iii*) Copy and complete the table. (6)

(*iv*) Explain how the data can be used to verify Boyle's law. (6)

(*v*) State two precautions which the student might have taken to improve the accuracy of this experiment. (7)

2. An experiment was set up to establish the calibration curve of a thermometer.

(*i*) Draw a labelled diagram of the apparatus used in this experiment. (12)

(*ii*) What measurements were taken during this experiment? (9)

The table shows the data recorded during the experiment.

Temperature (°C)	0	20	40	60	80	100
Value of thermometric property	10	25	60	100	160	200

(*iii*) Use the data in the table to draw a graph, on graph paper, to establish the calibration curve. Put temperature on the horizontal (X) axis. (12)

(*iv*) Use your graph to determine the temperature when the value of the thermometric property is 75. (7)

3. An experiment was set up to investigate how the fundamental frequency of a stretched string varied with its length.

The length *l* and the frequency *f* of the string were recorded.

(*i*) Draw a labelled diagram of the apparatus used in this experiment. (12)

(*ii*) Indicate on your diagram the length of the string that was measured. (6)

(*iii*) Describe how the string was set vibrating. (6)

(*iv*) How was the frequency of the string determined? (7)

(*v*) Sketch a graph to show the relationship between *l* and *f* that you would expect to obtain. (9)

4. An experiment was set up to find the resistivity of the material of a wire.

(*i*) Draw a labelled diagram of the apparatus used in this experiment. (12)

(*ii*) What measurements were taken during this experiment? (12)

(*iii*) How were these measurements used to calculate the resistivity? (9)

(*iv*) State two precautions which the student might have taken to improve the accuracy of this experiment. (7)

SECTION B (280 MARKS)

Answer **five** questions from this section.

Each question carries 56 marks.

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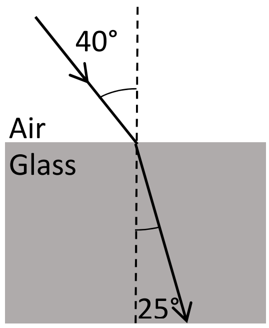
5. Answer any **eight** of the following parts (*a*), (*b*), (*c*), etc.

(*a*) State Newton's first law of motion.

(*b*) Calculate the refractive index of the glass block shown in the diagram.



(*c*) Choose from the list below the instrument used to measure (*i*) energy and (*ii*) resistance.

barometer **joulemeter** **lens** **ohmmeter**

(*d*) State one use for a semiconductor diode.

(*e*) State one use for the instrument shown.

(*f*) Define capacitance.

(*g*) State two characteristics of a musical note.

(*h*) Sketch the magnetic field around a bar magnet.

(*i*) Name two sources of ionising radiation.

(*j*) State one application of the photoelectric effect.

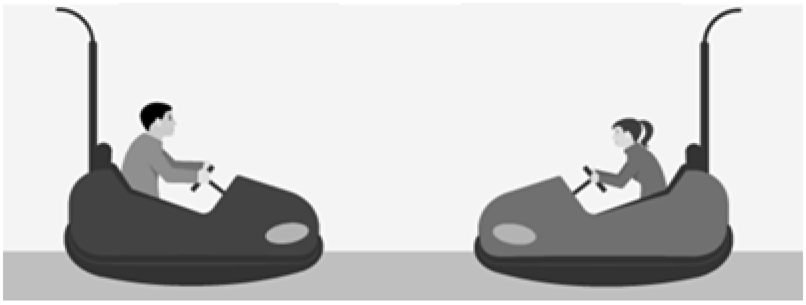
(8 × 7)

6. Define (*i*) momentum and (*ii*) kinetic energy. (12)

The cannon recoils when a cannon ball is shot from it.

Use the principle of conservation of momentum to explain why the cannon recoils. (6)

Bumper car A of mass 500 kg is moving with a speed of 6 m s^{-1} when it collides with stationary bumper car B of mass 300 kg. After the collision the cars move together.



(*i*) Calculate the momentum of each car before the collision. (9)

(*ii*) What is the momentum of the combined cars after the collision? (6)

(*iii*) Calculate the speed of the two cars after the collision. (6)

(*iv*) Calculate the kinetic energy of each car before the collision. (9)

(*v*) Calculate the kinetic energy of the cars after the collision. (5)

(*vi*) What conclusion can be drawn from the change in kinetic energy that happens during the collision? (3)

7. The temperature of an object can be measured using a thermometer.

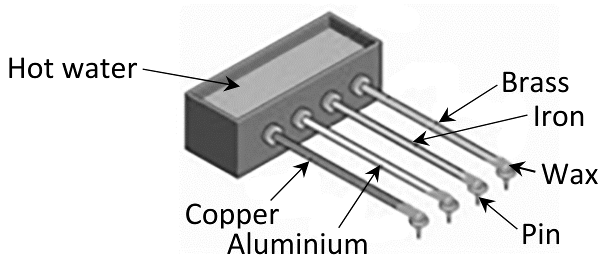
(*i*) What is heat? (6)

(*ii*) What is meant by the temperature of an object? (6)

(*iii*) What is the unit of temperature on the SI scale? (6)

(*iv*) Express 20 °C in the units you have named in part (*iii*). (6)

The diagram shows an apparatus used to compare heat transfer in different metals.



(*v*) Name the method by which heat is transferred in metals. (6)

(v*i*) Name the two other methods of heat transfer. (6)

(*vii*) How can this experiment be used to find out which metal is the best at allowing heat transfer? (6)

(*viii*) State two ways of making sure that this investigation is fair. (8)

(*ix*) Metals are good conductors. Name a good insulator. (6)

8. <u>Diffraction</u> and <u>interference</u> are properties associated with waves.

(*i*) Explain the underlined terms. (12)

(*ii*) Describe an experiment to demonstrate the wave nature of light. (12)

The photograph shows a liquid crystal display (LCD) monitor, which may require a polaroid panel to allow the image on the screen to be seen clearly.

(*iii*) What is meant by polarisation? (6)

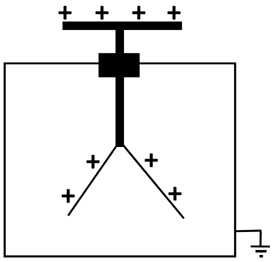
(*iv*) Describe an experiment to demonstrate the polarisation of light. (12)

Monitors of the kind shown use only three colours to form any image.

(*v*) What three colours are used? (9)

(*vi*) Describe how these colours can be used to create any image. (5)

9. (*a*) The diagram shows a positively charged gold leaf electroscope.



(*i*) State Coulomb's law of force between charges. (6)

(*ii*) State one use of an electroscope. (3)

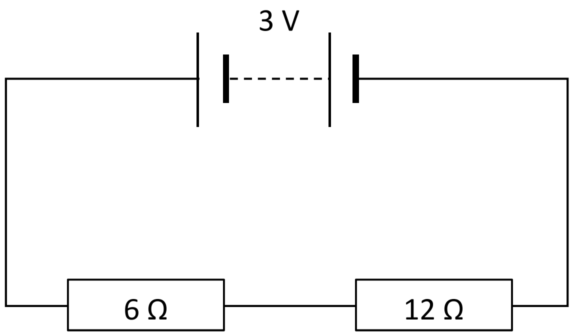
(*iii*) How can an electroscope be given a positive charge? (6)

(*iv*) What is observed when the cap of a charged electroscope is earthed? (3)

(*v*) Explain this observation. (6)

(*vi*) How could the cap of the electroscope be earthed? (4)

(*b*) The circuit diagram shows two resistors connected in series with a 3 V battery.



(*i*) State Ohm's law. (6)

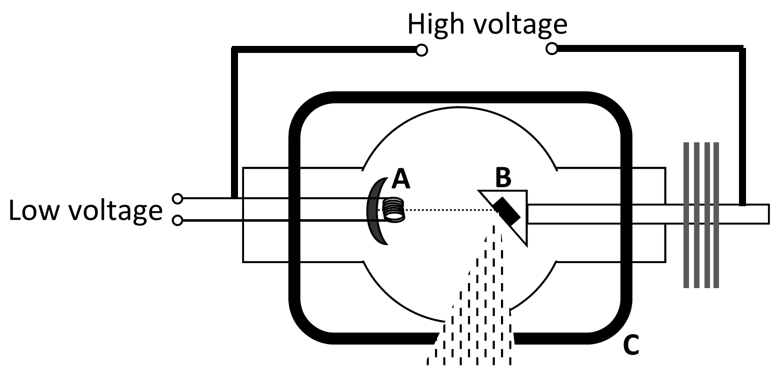
(*ii*) Calculate the total resistance of the circuit. (6)

(*iii*) Calculate the current in the circuit. (6)

(*iv*) Calculate the potential difference across the 6 Ω resistor. (6)

(*v*) Name an instrument used to measure potential difference. (4)

10. X-rays are produced when a beam of high speed electrons collides with a target in a tube like the one shown.



(*i*) What are X-rays? State two properties of X-rays. (12)

(*ii*) What process occurs at part **A**? (6)

(*iii*) Name a substance used in part **B**. (4)

(*iv*) State the function of part **C**. (6)

(*v*) State one use of X-rays. (4)

(*vi*) Why is a vacuum needed inside an X-ray tube? (6)

(*vii*) Name another device that uses a beam of high speed electrons. (6)

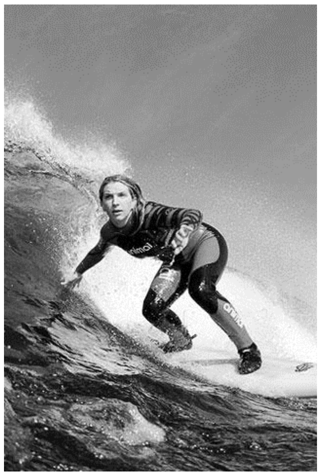
(*viii*) State one use for the device you have named in part (*vii*). (6)

(*ix*) State one difference between X-rays and gamma-rays. (6)

11. Read the following passage and answer the questions below.

The Physics of Surfing

Many people are surprised to learn that there is a lot of physics involved in riding a wave. Consider the principle of the wave itself: the energy of offshore storms is transmitted in ocean waves. As the ocean waves move into shallow water they slow down, the wavelength decreases and the wave height (amplitude) increases until the wave becomes unstable and breaks.



A vital physical principle behind surfing is Archimedes' principle, which keeps the board floating and allows the surfer to ride the wave. Archimedes' principle states that *when a body is floating in a fluid it displaces its own weight of the fluid*. The buoyancy (upthrust) counterbalances the weight of both the surfboard and the surfer and prevents both from sinking. Since the weight of the surfer is distributed evenly by the surfboard and is counterbalanced by the board's buoyancy, the surfer can stand on the top of the water.

The weight of the surfer on the board produces a force that is straight down. At the same time, buoyancy produces a force that acts on the board. This force, together with forces due to the wave, pushes the surfer forward. The sum of these forces results in a forward force that propels the surfer in the same direction as the wave.

Adapted from *http://illumin.usc.edu/index/article/193/the-engineering-behind-surfing/* (University of Southern California)

(*a*) What physical quantity is transmitted in a wave?

(*b*) Why do waves break close to the shore?

(*c*) Draw a diagram to show the main features of a wave.

(*d*) State Archimedes' principle.

(*e*) What is meant by the term buoyancy (upthrust)?

(*f*) How does buoyancy help the surfer to stay afloat?

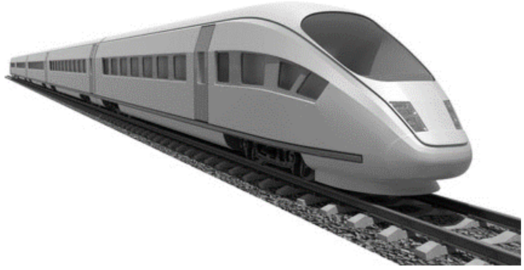
(*g*) Draw a labelled diagram to show the forces acting on a floating object.

(*h*) Explain how the stance of the surfer shown helps her to balance.

(8 × 7)

12. Answer any **two** of the following parts (*a*), (*b*), (*c*), (*d*).

(*a*) Define (*i*) velocity and (*ii*) acceleration. (10)



A train left a station and accelerated from rest at 0.4 m s^{-2} to reach its top speed of 55 m s^{-1}. The train then travelled for 300 seconds at this speed.

(*iii*) Calculate how long it took the train to reach its top speed. (6)

(*iv*) How far did the train travel while at its top speed? (6)

(*v*) Draw a velocity-time graph of the train's journey. (6)

(*b*) Sunlight is made up of visible light of different colours as well as many types of invisible radiation.

(*i*) How could you show the different colours present in visible light? (9)

(*ii*) UV radiation is also present in sunlight.
What do the letters U and V stand for? (6)

(*iii*) Compare the wavelength of UV radiation to the wavelength of infra-red (IR) radiation. (3)

(*iv*) Describe how to detect UV radiation. (6)

(*v*) State one use of UV radiation. (4)

(*c*) The diagram shows a water boiler which is filled with 0.7 kg of water which is initially at 20 °C. The boiler has a power rating of 3 kW.

(*i*) Calculate the energy needed to raise the temperature of the water from 20 °C to 90 °C. (12)

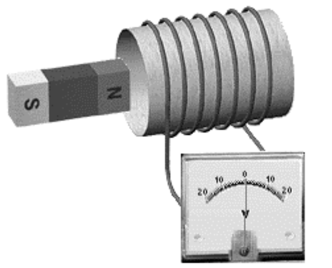
(*ii*) How many joules of energy are supplied per second by the boiler? (4)

(*iii*) Calculate how long it will take the boiler to heat the water to 90 °C. (6)

(*iv*) Where should the manufacturer place the heating element of the boiler? Explain your answer. (6)

(specific heat capacity of water = 4200 J kg^{-1} K^{-1})

(*d*) (*i*) What is electromagnetic induction? (6)



(*ii*) Explain how you would use a magnet and a coil, as shown above, to produce electricity. (6)

(*iii*) How would you know that electricity is being produced? (6)

(*iv*) How could you increase the magnitude of the electricity produced? (6)

(*v*) The apparatus in the diagram can be used to produce a.c. electricity. What is meant by a.c.? (4)

There is no examination material on this page.