Name:		Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Preliminary Examination
Secondary 4 (O-Level Programme)

PHYSICS **6091/01**

Paper 1 Multiple Choice **3 September 2025**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use paper clips, glue or correction fluid.
Write your name, index number and class on this paper and on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

For examiner's use only:

Total	/ 40

Overall	Marks	%
Paper 1	40	30%
Paper 2A	70	50%
Paper 2B	10	
Paper 3	40	20%

This document consists of **16** printed pages.

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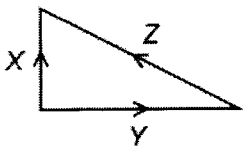
1 A student wishes to measure directly the circumference of a football.

Which is the most suitable instrument to use?

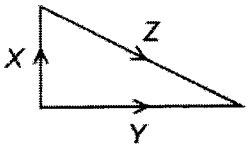
A a digital caliper
B a measuring tape
C a micrometer
D a ruler

2 Which vector diagram correctly shows the force *Z* as the resultant of forces *X* and *Y*?

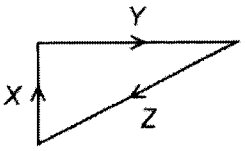
A



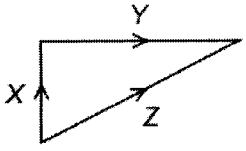
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C



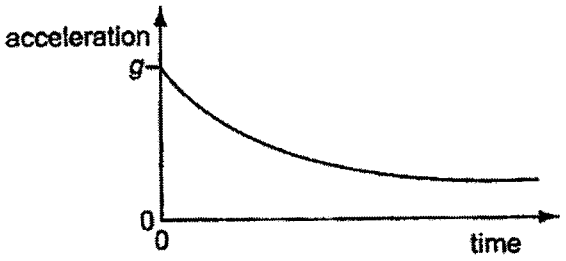
D



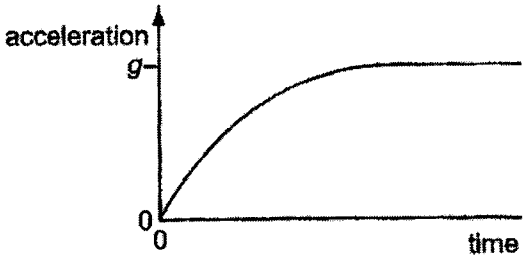
3 An object is dropped from a great height so that air resistance becomes significant.

Which graph shows how its acceleration varies with time?

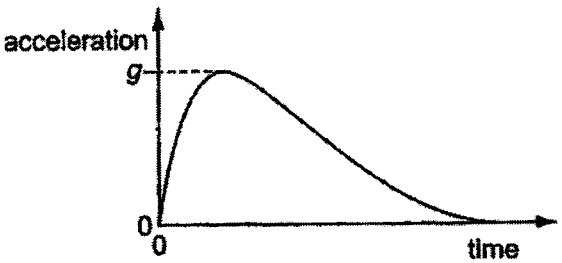
A



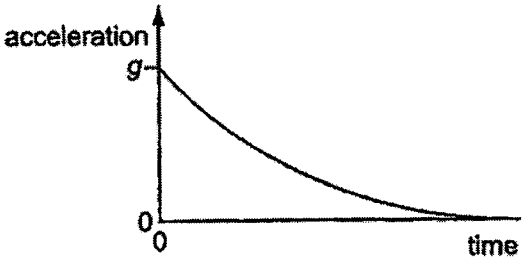
B



C

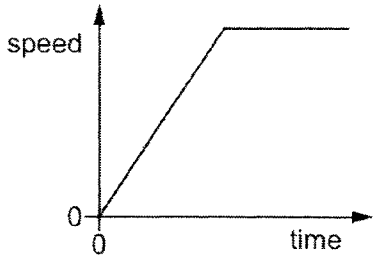


D



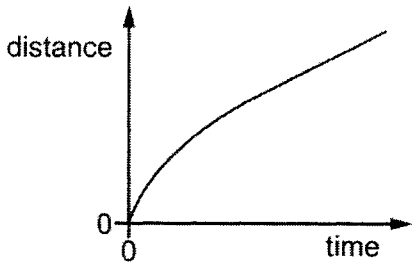
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4 A speed-time graph for the journey of a car is shown.

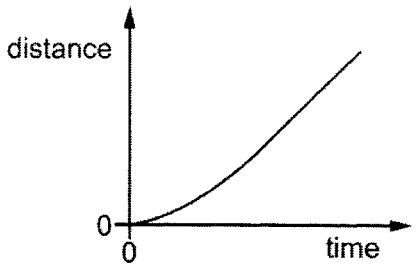


What is the distance-time graph for the journey?

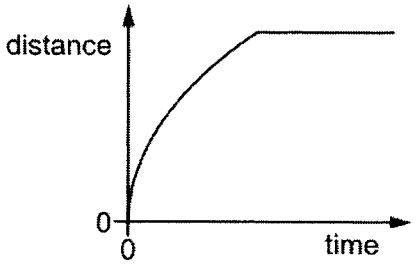
A



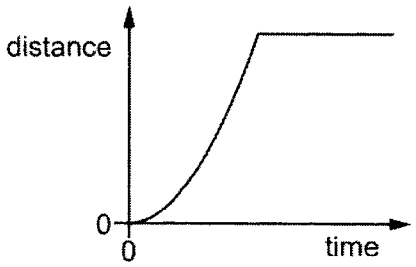
B



C

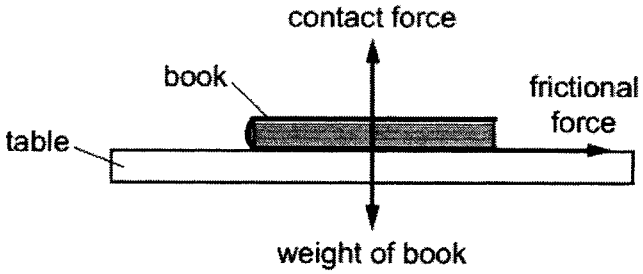


D



5 A train is travelling horizontally in a straight line. A book is on a table in the train.

The diagram shows all the forces acting on the book.



How is the train moving?

A accelerating to the left of the diagram.
B accelerating to the right of the diagram.
C moving at uniform speed to the left of the diagram.
D moving at uniform speed to the right of the diagram.

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6 A parachutist jumps off a plane. After 1.0 min, he opens the parachute and his velocity decreases at a decreasing rate.

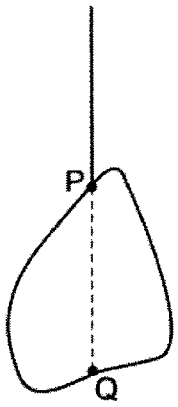
The following statements are possible explanations why the velocity of the parachutist decreases at a decreasing rate.

(I) As the velocity decreases, the air resistance acting on the parachute decreases.
(II) The air resistance is larger than the weight of the parachutist.
(III) The force of the parachute acting on the air increases.

Which of the above statements are correct explanations?

A (I) only
B (I) and (II) only
C (II) only
D (III) only

7 A thin, irregularly shaped metal plate is freely suspended from a point P and is in equilbrium, as shown. Point Q is vertically below P.

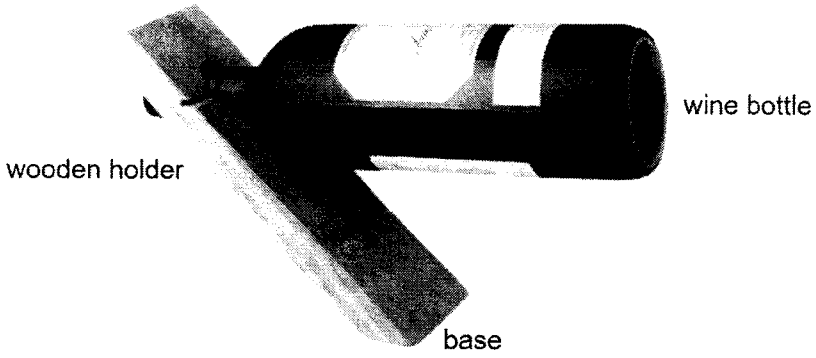


Where is the centre of gravity of the plate located?

A It is at P.
B It is at Q.
C It is exactly halfway between P and Q.
D Further investigation is needed to determine its position.

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8 The diagram below shows a wine bottle placed in a wooden holder. The bottle and the holder are in equilibrium.



Which of the following statements is true?

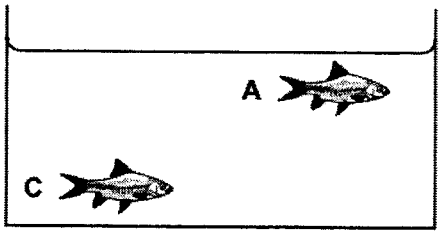
A The centre of gravity of the bottle is directly above the base of the wooden holder.
B The centre of gravity of the bottle and the centre of gravity of the wooden holder are at the same point.
C The centre of gravity of the wooden holder is directly above the base of the wooden holder.
D The combined centre of gravity of the bottle and the wooden holder is directly above the base of the wooden holder.

9 Two identical fish tanks are filled with water to the same level.

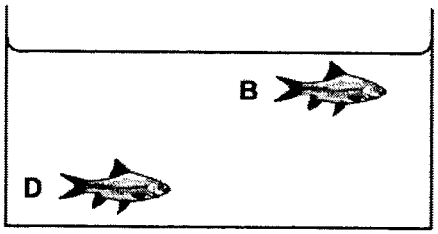
One tank contains fresh water. The other tank contains sea water.

Sea water is more dense than fresh water.

Which fish experiences the greatest pressure?



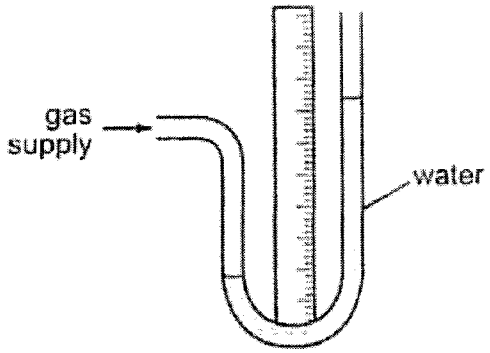
fresh water



sea water

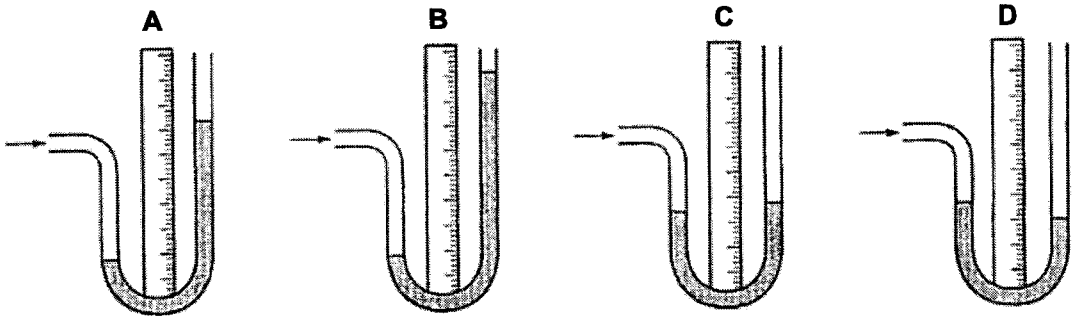
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10 A water manometer is connected to a gas supply. The diagram shows the water levels.

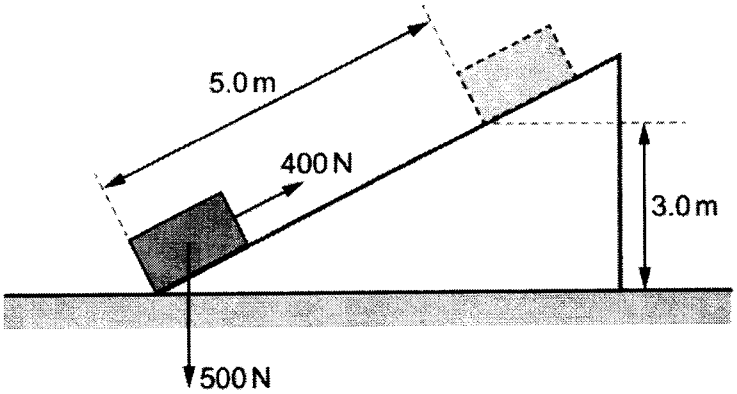


The water is replaced by mercury, which is more dense than water.

Which diagram shows the mercury levels when the manometer is connected to the same gas supply?



11 Work is done when a force of 400 N pulls a crate of weight 500 N at a constant speed along a ramp, as shown.



Part of the work done increases the gravitational potential energy E of the crate and the rest is work done W against friction.

What are the values of E and W?

	E / J	W / J
A	1500	500
B	1500	2000
C	2000	2500
D	3500	500

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12 A student calculates his power in running up a flight of stairs. He measures the vertical height of the stairs, the time taken to run up the stairs and his weight.

How does he calculate his power?

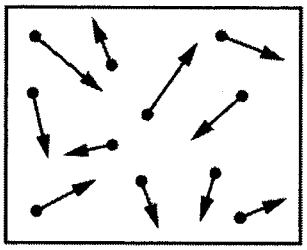
A height × time × weight
B (height × weight) / time
C (time × weight) / height
D weight / (height x time)

13 A student observes the Brownian motion of smoke particles in air with a microscope. He sees moving points of light.

Where do these points of light come from?

A air particles only moving randomly
B air particles only vibrating
C smoke particles only moving randomly
D smoke particles only vibrating

14 The diagram represents particles of a gas inside a closed container of constant volume.



The gas is heated.

What happens to the particles of the gas?

A They expand.
B They get closer together.
C They hit the container walls with less force.
D They move faster.

15 A cold solid is placed on top of a hot solid. Heat is transferred from the hot solid to the cold one.

What is the explanation for this?

A A hot solid expands, so its particles will move further apart.
B Energy is transferred from one particle to the next.
C Heat always rises.
D Molecules are free to move randomly through the solids.

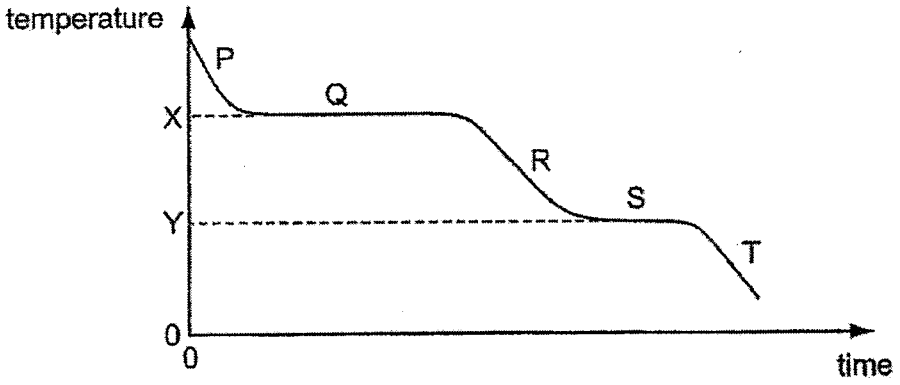
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16 Some hot water is sealed inside a metal can. The can is in a vacuum in outer space. The hot water slowly cools down.

How does the heat escape into space?

A conduction then convection
B conduction then radiation
C evaporation then convection
D evaporation then radiation

17 A vapour in a container is at a high temperature and loses heat to its surroundings. The graph shows how its temperature changes over the next few minutes.



Which feature of the graph indicates that the specific latent heat of vaporisation of the substance is greater than its specific latent heat of fusion?

A The gradient of the graph at P is greater than the gradient at R.
B The gradient of the graph at T is greater than the gradient at R.
C The length of the line Q is greater than the length of the line S.
D The value of X is greater than the value of Y.

18 Equal masses of copper and water are heated to the same temperature. As they cool down, the copper and the water lose heat at the same rate.

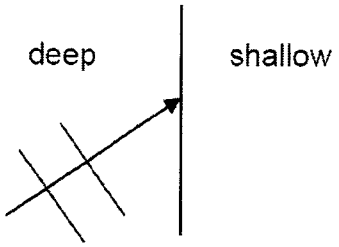
The temperature of the copper falls faster.

Why is this?

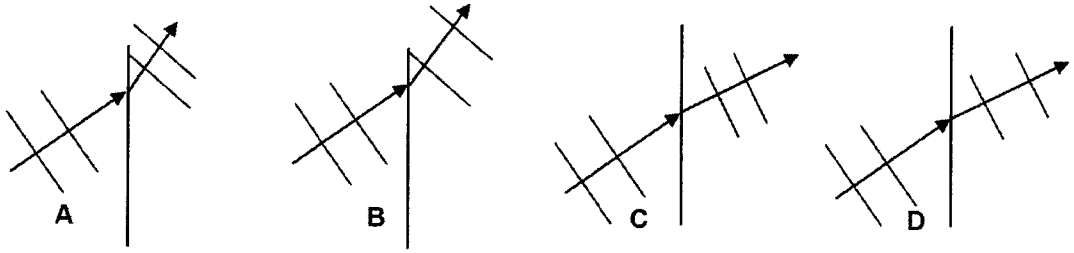
A Copper has a larger specific heat capacity.
B Copper has a larger specific latent heat.
C Copper has a smaller specific heat capacity.
D Copper has a smaller specific latent heat.

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19 The figure below shows straight parallel water waves travelling from the deep region to the shallow region in a ripple tank.

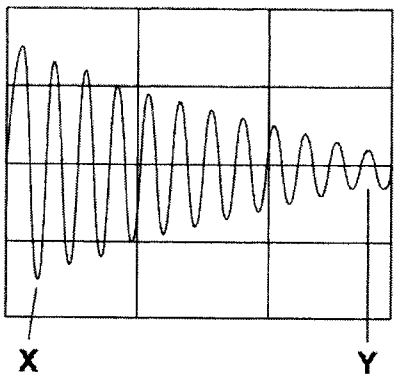


Which one of the following diagrams shows correctly the waves in the shallow region?



20 The diagram represents a sound wave, where the x-axis represents time.

The sound wave changes from X to Y.



Which statement about the sound wave is correct?

A The amplitude of the wave is increasing.
B The frequency of the wave is decreasing.
C The loudness of the sound is decreasing.
D The pitch of the sound is increasing.

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21 Which of the following does a remote controller emit?

A infra-red radiation
B microwave radiation
C ultrasound
D ultraviolet radiation

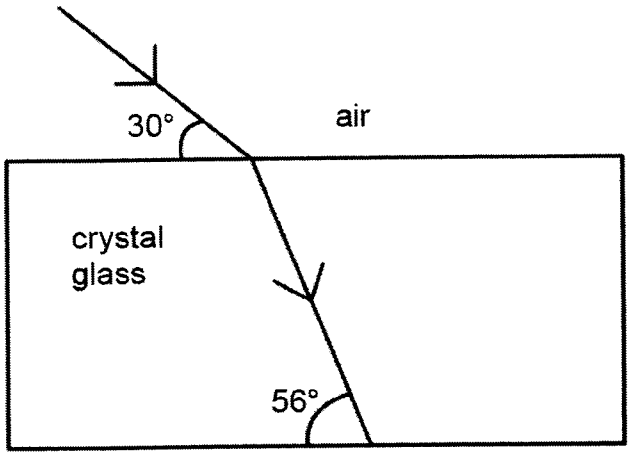
22 What is the speed of electromagnetic waves in a vacuum?

A 3.0×10^4 cm / s
B 3.0×10^5 km / s
C 3.0×10^6 cm / s
D 3.0×10^{11} km / s

23 What is the refractive index of a medium?

A the ratio of the speed of light in air to the speed of light in the medium
B the ratio of the speed of light in the medium to the speed of light in air
C the ratio of the speed of light in the medium to the speed of light in vacuum
D the ratio of the speed of light in vacuum to the speed of light in the medium

24 The figure below (not drawn to scale) shows a ray of light passing from air into a rectangular block made of crystal glass.



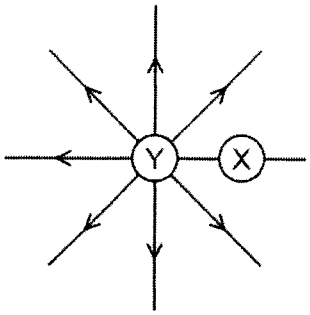
What is the critical angle of the crystal glass?

A 37° **B** 40° **C** 63° **D** 73°

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25 Object X is stationary and negatively charged. It experiences a force due to the field produced by object Y.

The arrows show the direction of the field produced by Y.



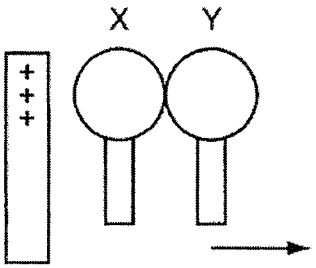
Which statement about the direction of the force on X is correct?

A It is towards the left because it is in an electric field.
B It is towards the right because it is in an electric field.
C It is towards the left because it is in a magnetic field.
D It is towards the right because it is in a magnetic field.

26 Two insulated, uncharged metal spheres X and Y are initially in contact.

While a positively-charged rod is near X, the spheres are moved apart.

After this action, X has a negative charge.



Which of the following describes the charge on Y?

A negative and smaller than the charge on X
B negative and the same size as the charge on X
C positive and smaller than the charge on X
D positive and the same size as the charge on X

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27 A battery is connected to a circuit. It is switched on for 1.0 minute. During that time, there is a current of 0.40 A in the circuit and the battery supplies 48 J of energy.

Which row gives the charge that passes and the electromotive force (e.m.f.) of the battery?

	charge that passes in 1.0 minute / C	e.m.f. of the battery / V
A	0.40	2.0
B	0.40	120
C	24	2.0
D	24	120

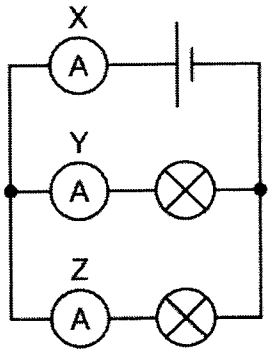
28 A resistor with resistance R is made from a length L of resistance wire with a cross-sectional area A.

A second resistor with resistance $2R$ is made from wire of the same material with a cross-sectional area of $A/4$.

What length of wire is needed for the second resistor?

A $L/2$ **B** L **C** $2L$ **D** $8L$

29 The circuit diagram shows two identical lamps connected in parallel to a cell. Three ammeters, X, Y and Z, are also connected in the circuit, as shown.

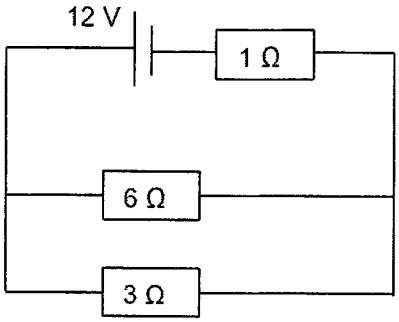


Which statement about the current in X is correct?

A It is equal to the current in Y and to the current in Z.
B It is less than either the current in Y or the current in Z.
C It is equal to the sum of the current in Y and the current in Z.
D It is equal to the difference between the current in Y and the current in Z.

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30 The circuit below consists of a 12 V d.c. supply and three resistors.



What is the potential difference across the 3 Ω resistor?

A 4.0 V
B 8.0 V
C 11.3 V
D 12.0 V

31 X and Y are lamps with filaments made from the same material. The filament of lamp X is thicker and shorter than that of lamp Y.

When individually connected to the mains and switched on, which is the brighter lamp and which lamp has the larger resistance?

	brighter lamp	larger resistance
A	X	X
B	X	Y
C	Y	X
D	Y	Y

32 An electric cooker is rated 2.5 kW, 250 V.

What is the correct fuse rating, and where should it be connected to a 125 V supply?

A 8 A fuse connected to live wire
B 8 A fuse connected to neutral wire
C 23 A fuse connected to live wire
D 23 A fuse connected to neutral wire

33 It costs $0.30 for 1 kWh of energy transferred electrically to a household.

How much will it cost to run a 60 W lamp for 10 hours?

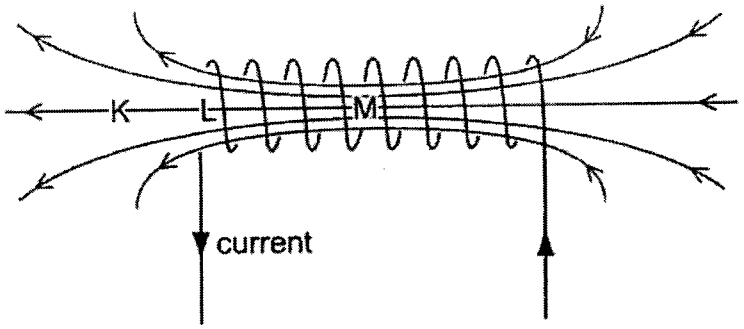
A $0.05 **B** $0.18 **C** $3.00 **D** $18.00

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34 Which statement about magnetism is correct?

A A magnet attracts small pieces of aluminium.
B Steel makes a better permanent magnet than iron does.
C There is no limit to the magnetic strength of a magnet made from a steel bar.
D Two like poles always attract one another.

35 The diagram shows the magnetic field pattern due to a current in a solenoid.

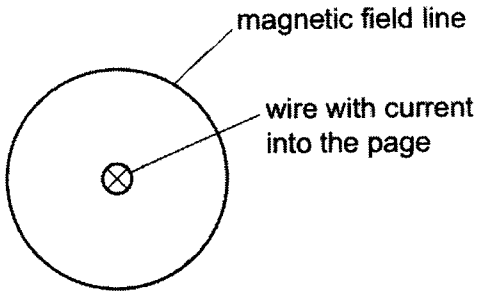


Which statement is correct?

A The strength of the field is greater at K than it is at L.
B The strength of the field is greater at M than it is at L.
C The strength of the field is greater at K than it is at M.
D The strength of the field is greater at L than it is at M.

36 There is an electric current in a straight wire in the direction into the page. This produces a magnetic field around the wire.

All the field lines are circles but only one field line is shown.

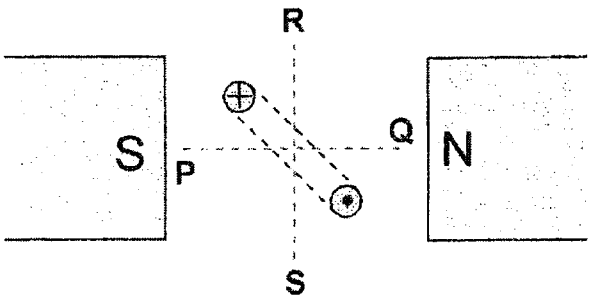


Which row describes the magnetic field?

	direction of field lines	spacing of field lines
A	anti-clockwise	equally spaced over the whole field
B	anti-clockwise	more widely spaced further from the wire
C	clockwise	equally spaced over the whole field
D	clockwise	more widely spaced further from the wire

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37 The diagram below shows the plan view of a current-carrying rectangular coil placed in a uniform magnetic field. The coil is free to rotate, and the direction of the current in the coil is constant.

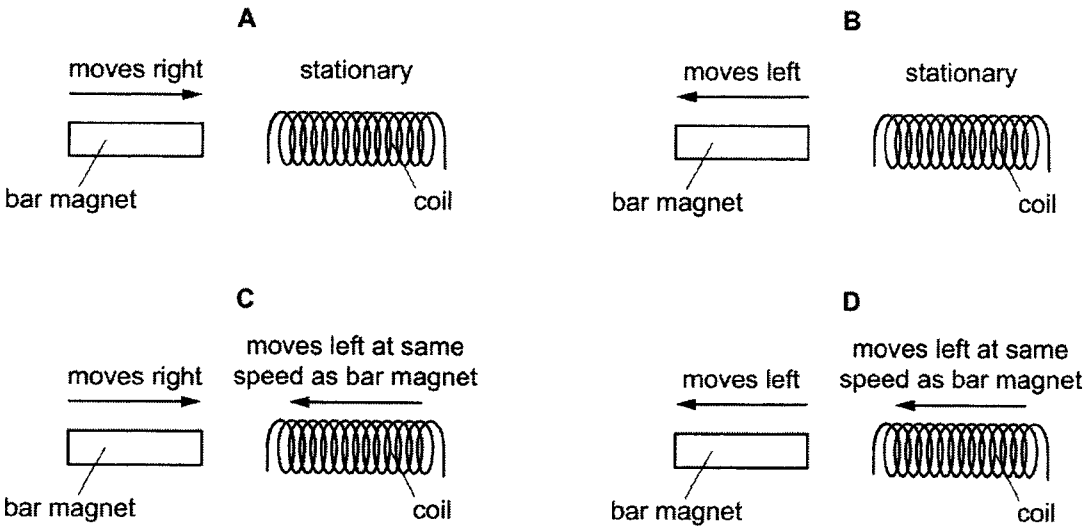


Which of the following correctly describes the motion of the coil?

A It rotates anti-clockwise and stops.
B It rotates anti-clockwise continuously.
C It rotates clockwise and stops.
D It rotates clockwise continuously.

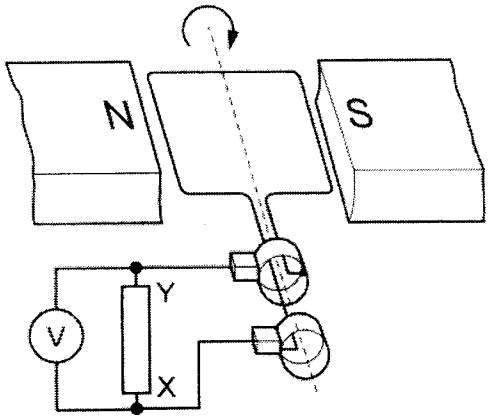
38 The diagram shows a bar magnet and a coil of wire. The bar magnet is moved at the same speed in each experiment.

In which situation is the largest electromotive force (e.m.f.) induced?

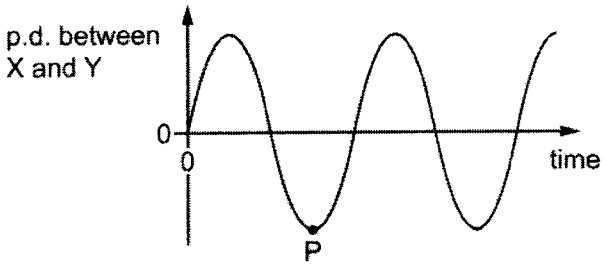


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39 The diagram shows an a.c. generator.

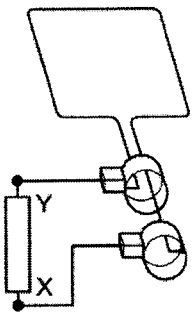


The graph shows the potential difference (p.d.) between points X and Y plotted against time. A positive value of p.d. indicates that X is at a higher potential than Y.

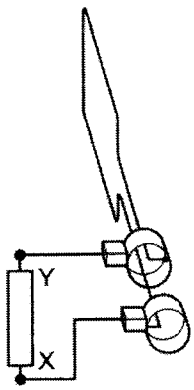


Which diagram shows the position of the coil at point P on the graph?

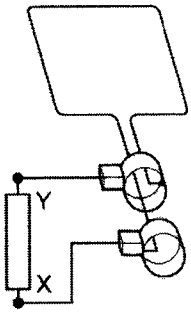
A



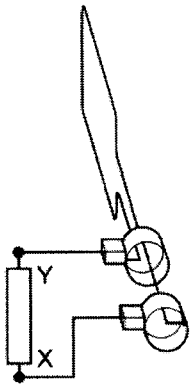
B



C



D



40 The uranium atom $^{238}_{92}U$ emits an α-particle to become thorium, which then emits a β-particle to become protactinium.

What is the atomic number of protactinium?

A 89
B 90
C 91
D 93

END OF PAPER

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Paper 2A	☐ s.f. ☐ formula	70

Name:		Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Preliminary Examination
Secondary 4 (O-Level Programme)

PHYSICS

6091/02

Paper 2 Structured and Free Response

29 August 2025
1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black link.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided.

Section B
Answer **one** question.
Write your answers in the spaces provided.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

The number of marks is given in brackets [ ] at the end of each question or part question.

For examiner's use only:

Section A	/ 70
Section B	/ 10
Total	**/ 80**

Overall	Marks	%
Paper 1	40	30%
Paper 2A	70	50%
Paper 2B	10	
Paper 3	40	20%

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Section A

Answer **all** the questions in this section.

1 A ball is released from rest above the ground. Fig. 1.1 shows the variation with time of the velocity of the ball.

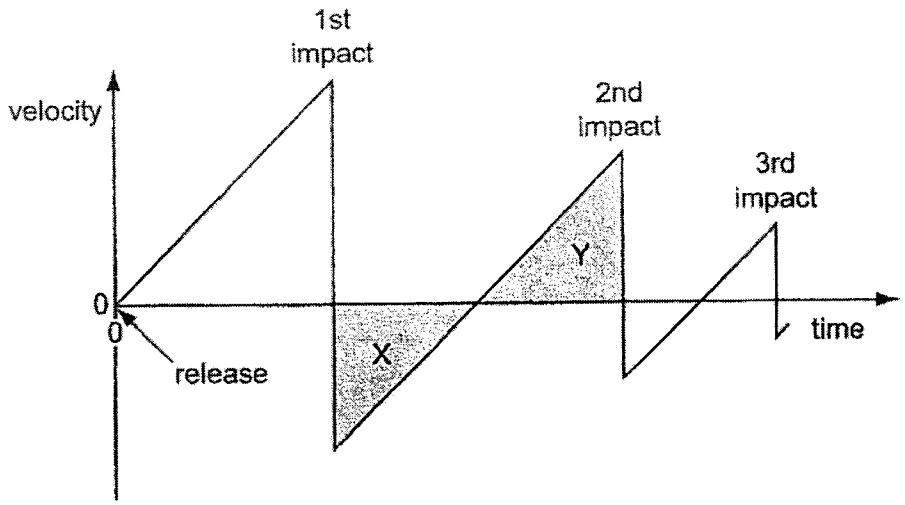


Fig. 1.1

(a) **(i)** State the gradient of the graph (with units) from $t = 0$ s to the time of the ball's first impact with the ground.

.....[1]

(ii) Describe the motion of the ball from $t = 0$ s to the time the ball reaches its maximum height after its **first** impact with the ground.

.....

.....

.....

.....[2]

(iii) Explain why areas X and Y are equal.

.....

.....[1]

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(b) The ball is subsequently released from rest the same distance above the ground, but with significant air resistance. The ball does **not** reach its terminal velocity during its motion.

(i) Sketch, on Fig. 1.1, the variation of the velocity of the ball with time from $t = 0$ s to the time of the ball's **first** impact with the ground.

[1]

(ii) Explain, in terms of forces acting, why the velocity of the ball varies as sketched in **(b)(i)**.

.....

.....

..... [2]

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2 Fig. 2.1 shows the position of a person's teeth (comprising incisors and molars), and his masseter muscle used to move the lower jawbone.

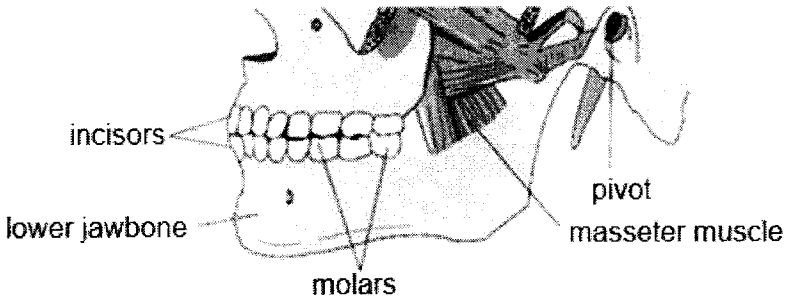


Fig. 2.1

Fig. 2.2 shows a simplified model of the lower jawbone of negligible mass. The model consists of two straight parts of length 7.0 cm and 4.0 cm, making an angle of 50° to each other. During one particular bite of a piece of food, a downward force of 45 N is applied on the incisors at the front of the lower jawbone, while an upward muscle force *F* is exerted by the masseter muscle at the back of the lower jawbone.

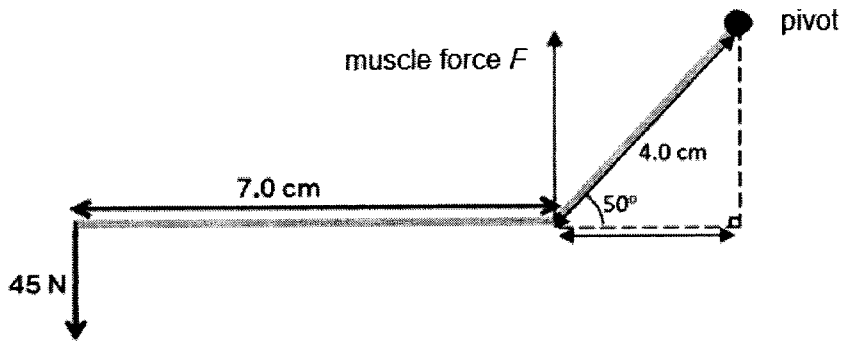


Fig. 2.2

(a) The lower jawbone is in equilibrium.

Determine the magnitude of the muscle force *F* applied by the masseter muscle.

magnitude of muscle force *F* = _____ [2]

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(b) Hence, determine the magnitude and direction of the force applied on the pivot.

magnitude of force on pivot = _____

direction = _____ [2]

(c) Suggest, for the same moment created by the jawbone, why the molars used for crushing hard food are found at the back, rather than the front of the jaw.

_____

_____

_____

_____ [2]

(d) Incisors are sharper than molars. Using concepts of pressure, suggest why incisors are used for cutting meat rather than molars for the same force exerted by incisors and molars.

_____

_____

_____ [2]

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3 A hot steel rod is cooled by plunging it into cold water, as shown in Fig. 3.1.

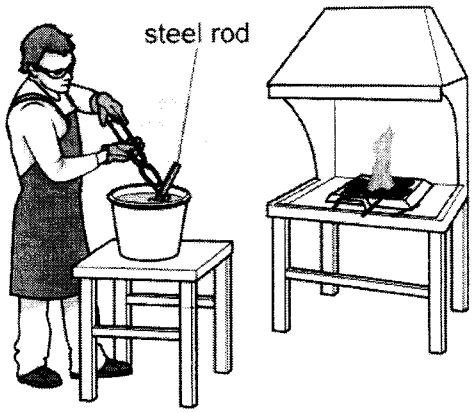


Fig. 3.1

(a) The steel rod has a mass of 2.0 kg and is initially at a temperature of 500 °C. It cools to 50 °C when placed in the water.

The specific heat capacity of steel is 460 J / (kg °C).

(i) State what is meant by *specific heat capacity*.

.....

.....

..... [2]

(ii) Calculate the energy transferred by heating from the steel rod to the water as it cools to 50 °C. Assume no energy is transferred to the surrounding air during this process.

energy transferred = ... [2]

(b) When the water and the steel rod are at a temperature of 50 °C, energy is subsequently transferred from the water to the air above it by a convection current.

Describe how the convection current is produced in the air.

.....

.....

.....

..... [3]

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4 Fig. 4.1 is a full-scale diagram that represents a sound wave of frequency 5.1 kHz in air. Sound waves are longitudinal waves.

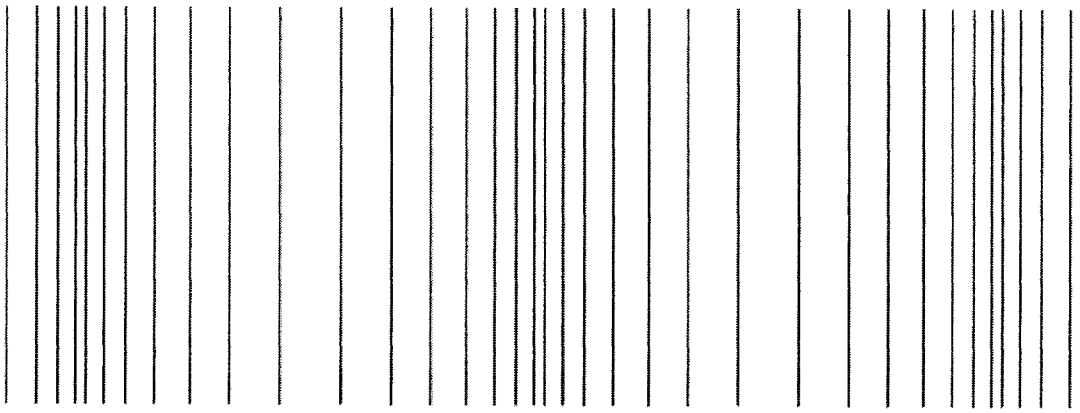


Fig. 4.1

(a) State what is meant by a *longitudinal wave.*

.....

..... [1]

(b) **(i)** On Fig. 4.1, mark accurately with a cross, the position of one centre of compression labelled with the letter **C,** and of one centre of rarefaction labelled with the letter **R.**

[2]

(ii) Using the full-scale diagram, measure the wavelength of this sound wave.

wavelength = ... [1]

(iii) Calculate the speed of sound in air.

speed of sound = ... [2]

(c) Both sound and light are waves.

Sound travels faster in glass than in air, but light travels faster in air than in glass.

Explain why this is so.

.....

.....

.....

..... [2]

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5 **(a)** The list below contains three components of the electromagnetic (EM) spectrum.

infra-red radiation **gamma rays** **visible light**

(i) Arrange the components in order of increasing wavelength.

.....[1]

(ii) State two properties that these components have in common.

.....

.....[2]

(b) Satellites are used in the transmission of television signals, as shown in Fig. 5.1.

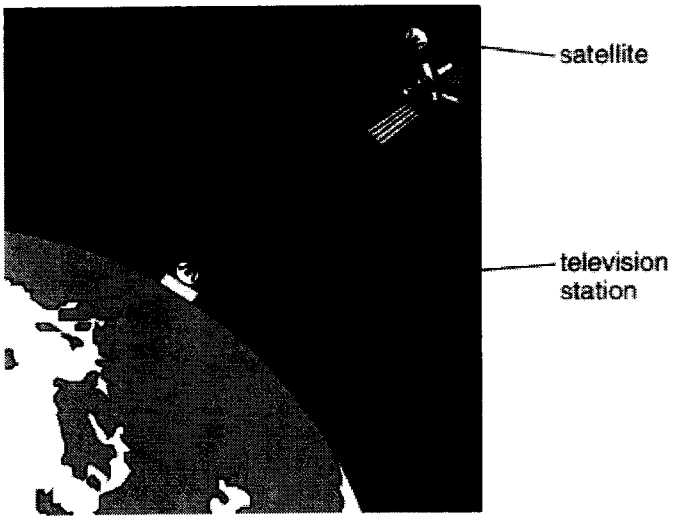


Fig. 5.1

(i) State which component of the EM spectrum is used to transmit the television signal to the satellite.

.....[1]

(ii) State another component of the EM spectrum that is also used to transmit television signals, but without using satellites.

.....[1]

(iii) Suggest one advantage of using a satellite to transmit television signals.

.....

.....[1]

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6 An object is placed 4.5 cm in front of a thin converging lens of unknown focal length as shown in Fig. 6.1. The image formed is the same size as the object and on the opposite side of the lens from the object.

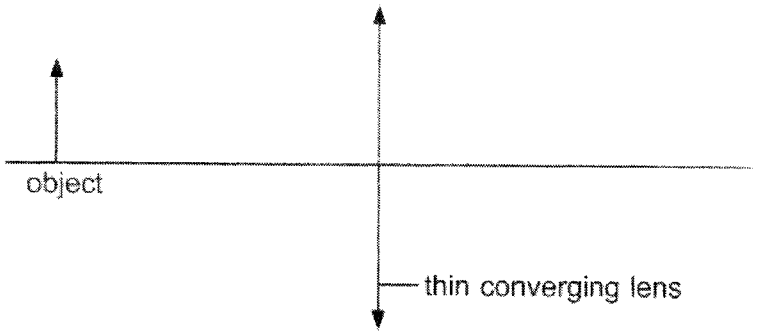


Fig. 6.1

(a) State what is meant by *focal length*.

.....

..... [1]

(b) On Fig. 6.1, draw a ray diagram to determine the focal length of the lens. Show any necessary working below.

focal length = ... [3]

(c) Describe how one of the characteristics of the image changes during the following adjustments to the position of the object:

(i) the object distance is decreased from 4.5 cm to 4.0 cm.

.....

..... [1]

(ii) the object distance is decreased from 2.0 cm to 1.0 cm.

.....

..... [1]

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7 A teacher carries out an experiment on radioactivity using the apparatus as shown in Fig. 7.1.

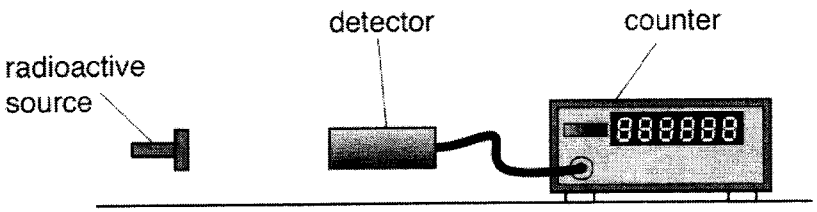


Fig. 7.1 (not to scale)

The count rate is a measurement of the count per minute.

(a) **(i)** State the name of one type of radiation detector.

.....[1]

(ii) State one safety precaution the teacher must take when using a radioactive source.

.....

.....[1]

(b) **(i)** State what is meant by *background radiation*.

.....

.....[1]

(ii) The teacher measures the count rate due to the source.

Describe how the count rate is corrected for the background radiation.

.....

.....

.....[2]

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(c) The count rate is recorded for various distances d between the source and the detector. Fig. 7.2 shows a graph of the results obtained.

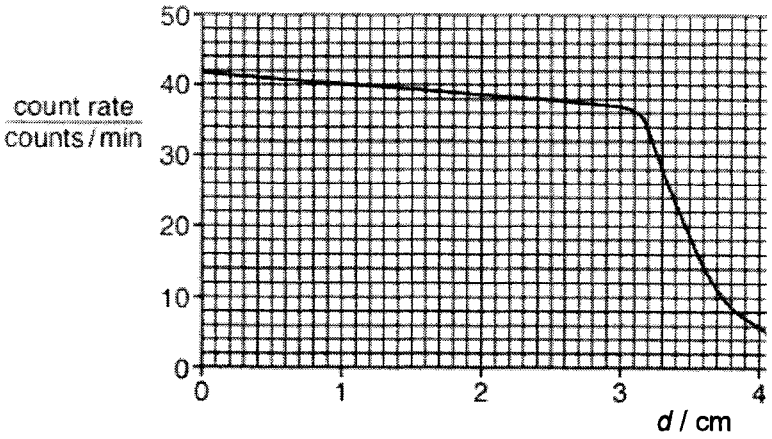


Fig. 7.2

(i) The background radiation is 2 counts / min.

On Fig. 7.2, sketch a graph of the corrected count rate for distances d up to 4.0 cm.

[1]

(ii) State and explain the type of radiation emitted by the radioactive source.

.....

..... [2]

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8 At night, a bright floodlight is used to illuminate a building. The floodlight is a metal filament lamp. It is connected in series with a variable resistor, a 240 V alternating current (a.c.) power supply, a switch and a fuse.

When the floodlight is first switched on, the resistance of the variable resistor is at its maximum value. In the following few minutes, the variable resistor is adjusted so that its resistance decreases slowly to zero. This causes the brightness of the floodlight to increase until it reaches a maximum. At maximum brightness, the current in the floodlight is 12 A.

(a) Draw a circuit diagram with the correct circuit symbols to show the connections between the a.c. power supply, variable resistor, floodlight, switch and fuse.

[2]

(b) Show that the resistance of the floodlight at maximum brightness is 20 Ω.

[1]

(c) State and explain what happens to the resistance of the floodlight as its brightness increases.

[2]

(d) The fuse is removed and the insulation of the live and neutral wires are both damaged. The circuit remains closed.

During an inspection when the switch is still closed, an electrical engineer accidentally causes the exposed live wire and the exposed neutral wire to be in contact in the plug.

State and explain a possible hazard in this scenario.

[2]

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(e) At night, there is less light surrounding the building.

An electrical engineer suggested directly replacing the variable resistor with a light-dependent resistor, so that the floodlight becomes brighter at night compared to in the day.

Explain, using potential divider concept, why the electrical engineer's suggestion is not feasible.

.....

.....

.....

..... [3]

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9 Motors and generators are important components of modern electrical systems that help to transfer energy between different stores.

(a) Fig. 9.1 shows a rider on an electric scooter.

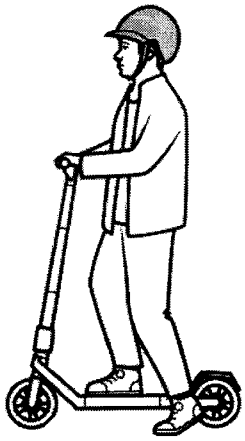


Fig. 9.1

The scooter contains a battery and a motor to drive the back wheel.

Describe how energy is transferred from the chemical potential store of the battery through the motor to the kinetic store of the scooter.

.....

.....

..... [2]

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(b) Fig. 9.2 shows a typical a.c. generator.

A resistor of resistance 10 Ω is connected across the output terminals. It can be assumed that the resistances of the coil, the slip rings and carbon brushes are negligible.

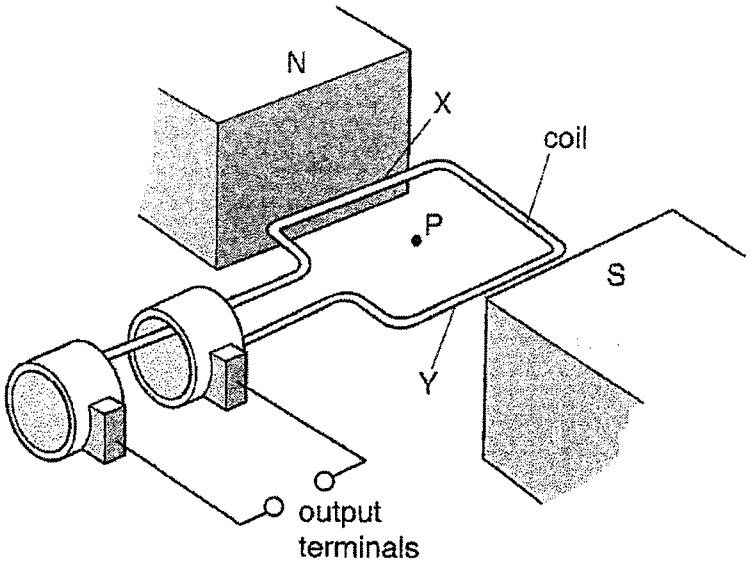


Fig. 9.2

Table 9.1 shows the relationship between the number of revolutions per second of the coil, the maximum induced electromotive force (e.m.f.) V_{max} in the coil and the maximum current I_{max} in the coil.

Table 9.1

number of revolutions per second of coil	V_{max} / V	I_{max} / A
1 000	12	1.15
2 000	24	2.30
3 000	36	3.45

(i) State the relationship between the number of revolutions per second of the coil and V_{max}.

_____

_____ [1]

(ii) Explain the relationship stated in **(i)**.

_____

_____

_____ [2]

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(iii) Explain why the values of I_{max} in Table 9.1 are smaller than the theoretical values of induced current, calculated using V_{max} / R, where R is the resistance of the resistor (10 Ω).

.....

.....

.....

..... [2]

(iv) Describe the difference between the function of a split-ring commutator in a d.c. motor and the function of the slip rings in an a.c. generator.

.....

.....

.....

..... [2]

(v) Fig. 9.3 shows how the output voltage V of the generator varies with time when there are 1 000 revolutions per second of the coil.

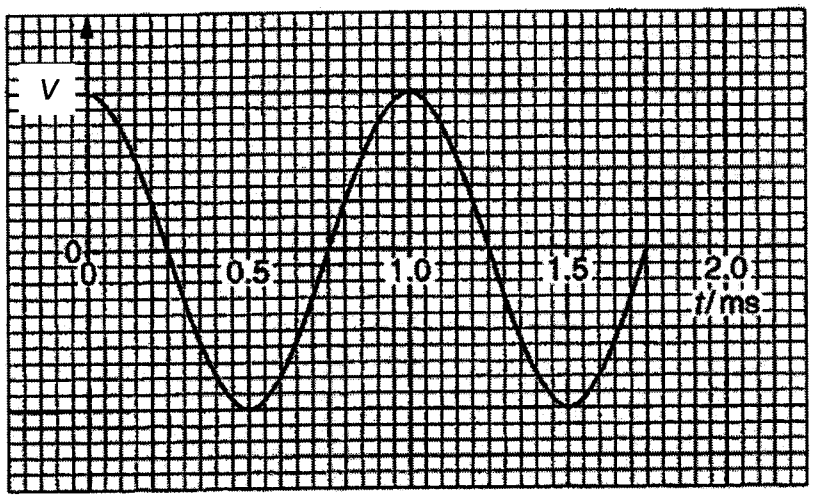


Fig. 9.3

The slip rings in Fig. 9.2 are replaced by a split-ring commutator.

On Fig. 9.3, sketch the variation of the output voltage of the generator with time due to this replacement.

[1]

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Paper 2B	☐ s.f. ☐ formula	/10

Name:		Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Preliminary Examination
Secondary 4 (O-Level Programme)

PHYSICS

6091/02

Paper 2 Structured and Free Response

29 August 2025

1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

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Section B

Answer only **one** of the two questions.

10 Fig. 10.1 shows a section through a very old bicycle tyre that is made of solid rubber.

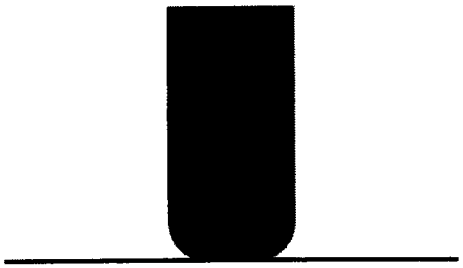


Fig. 10.1

(a) The solid rubber tyre exerts a pressure on the ground.

(i) Define *pressure*.

.....

..... [1]

(ii) The mass of the bicycle and rider is 60 kg and the total area of the tyres in contact with the road is 2.4×10^{-3} m^2. The gravitational field strength is 10 N / kg.

Calculate the pressure exerted on the road. Show all necessary working.

pressure = ... [3]

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(b) Fig. 10.2 shows a modern tyre that contains air.

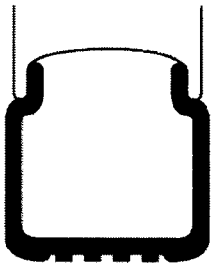


Fig. 10.2

(i) Describe and explain the difference between the motion of the rubber molecules in the old tyre in Fig. 10.1 and the air molecules in Fig. 10.2.

.....

.....

.....

.....

..... [3]

(ii) On a hot day, the temperature of the modern tyre increases.

State and explain, using ideas about molecules, what happens to the pressure in the tyre.

.....

.....

.....

..... [3]

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11 Electric fields and magnetic fields can be useful or dangerous, depending on the context in which they exert influence on objects.

(a) Fig. 11.1 shows two pieces of soft iron in the magnetic field of a strong permanent magnet.

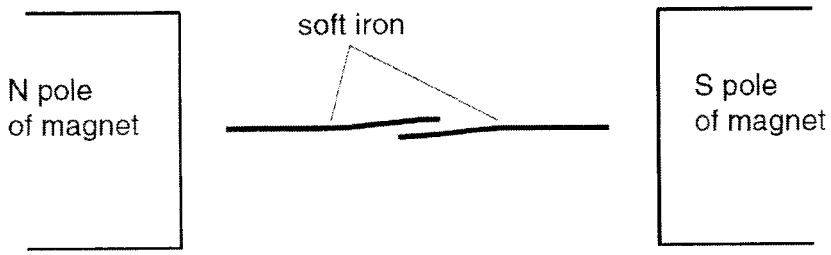


Fig. 11.1

The pieces of soft iron become magnetised.

(i) On Fig. 11.1, mark the magnetic poles produced at each end of both pieces of soft iron.

[1]

(ii) Fig. 11.2 shows a reed switch.

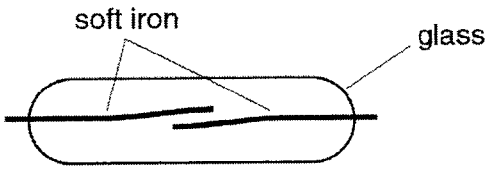


Fig. 11.2

The reed switch is placed between the poles of the strong permanent magnet.

State and explain what happens.

.....

.....

..... [2]

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(iii) Fig. 11.3 shows two separate electrical circuits.

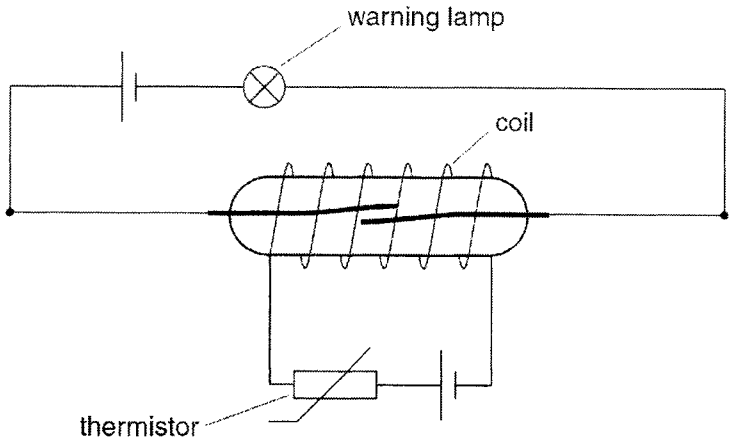


Fig. 11.3

One circuit consists of a reed switch, a cell and a warning lamp. The other circuit consists of a thermistor, another cell, and a coil wound round the reed switch. The thermistor is at the same temperature as the air around it.

1. State what happens to the thermistor when the temperature of the air rises.

.....[1]

2. Explain why the warning lamp lights up when the air temperature rises.

.....

.....

.....

.....[2]

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(b) Electrostatic charges can be placed on objects by friction.

(i) State the name of the charged particle that is transferred from one object to another in this process.

_____ [1]

(ii) Fig. 11.4 shows petrol being pumped into a can. Electrostatic charges build up on the petrol and the pipe.

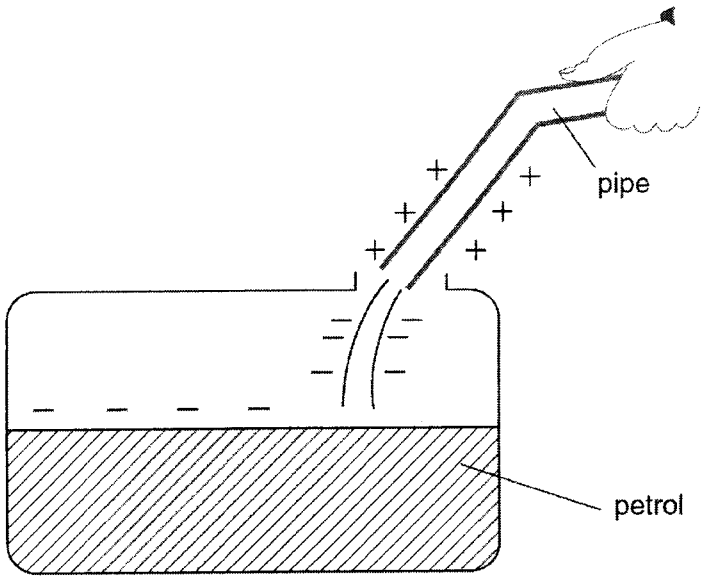


Fig. 11.4

1. Explain why this is dangerous.

_____

_____

_____

_____ [2]

2. State what can be done to stop the electrostatic charge building up in this way.

_____

_____ [1]

--- END OF PAPER ---

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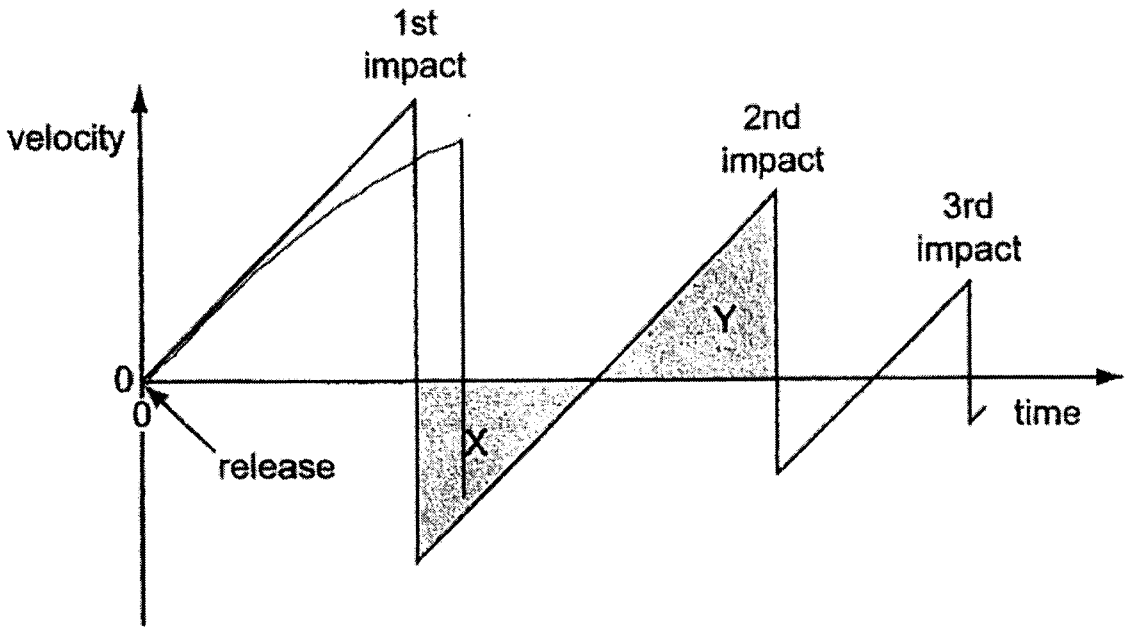
2025 CHS SEC 4 PHYSICS PRELIMINARY EXAMINATION

2025 CHS Physics Prelim Paper 1

Qn		Qn		Qn		Qn		Qn	
1	B	2	D	3	D	4	B	5	B
6	B	7	D	8	D	9	D	10	C
11	A	12	B	13	C	14	D	15	B
16	B	17	C	18	C	19	C	20	C
21	A	22	B	23	D	24	B	25	A
26	D	27	C	28	A	29	C	30	B
31	B	32	A	33	B	34	B	35	B
36	D	37	C	38	C	39	C	40	C

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2025 CHS Physics Prelim Paper 2 Section A

S/N	Mark Scheme
1ai	• 10 m/s^2 [A1]
1aii	• ball moves (downwards) with speed increasing at a constant rate (or with a constant acceleration) [B1] • moves upwards (or changes direction) with speed decreasing at a constant rate (or with a constant deceleration) until it is instantaneously stationary. [B1]
1aiii	• Distance travelled (vertically) upwards (after first impact with ground) is the same as distance travelled (vertically) downwards (before second impact with ground / after reaching maximum height) [A1]
1bi	same gradient at t = 0 **and** decreasing gradient (cannot be zero) **and** longer time for first impact with ground **and** smaller maximum velocity before first impact with ground **and** velocity becomes zero. [A1] 
1bii	• Air resistance increases with speed **and** is in opposite direction to weight. [M1] • Resultant force decreases, and hence acceleration decreases (or speed increases at a decreasing rate). [A1]

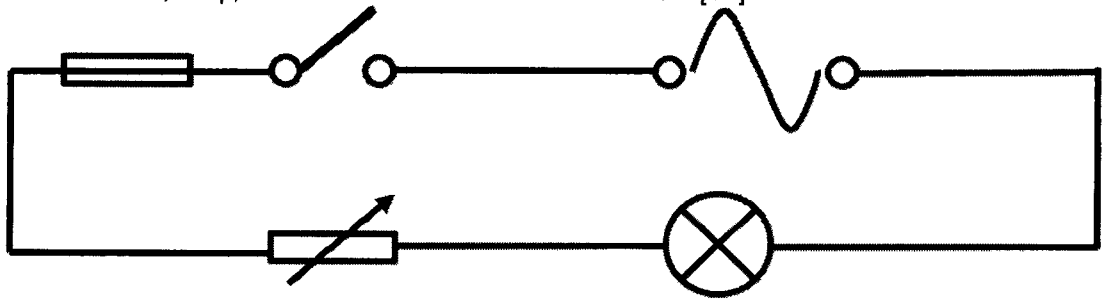
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S/N	Mark Scheme
2a	By principle of moments, Taking moments about pivot, [formula] Sum of clockwise moments = sum of anti-clockwise moments [formula] $M = F \times d$ [formula] $F \times 4.0 \cos 50^\circ = 45 \times (7.0 + 4.0 \cos 50^\circ)$ [B1] $F = 168$ N (3 s.f.) [B1]
2b	By Newton's First Law, Sum of downward forces = sum of upward forces Force on pivot + 45 = 168 Force on pivot = 123 N [B1] Direction = downwards [B1]
2c	• At the back, molars apply a force on the food whose line of action has a shorter perpendicular distance to the pivot. [B1] • For the same moment created by *F*, force by molar teeth on (hard) food is larger. [B1]
2d	• Incisors have a smaller surface area of contact (with the meat) than molars. [B1] • (For the same force exerted,) incisors exert a larger pressure to be able to cut meat. [B1]
3ai	• change of internal energy (of a material) per unit mass [B1] • for each unit change in temperature [B1]
3aii	$E = mc\Delta\theta$ [formula] $= 2.0 \times 460 \times (500 - 50)$ [B1] $= 4.14 \times 10^5$ J (3 s.f.) [B1]
3b	• air (above the water) expands on heating [B1] • density of hot air less (than cold air) and hot air rises [B1] • cold air (being denser) falls (and cycle repeats) [B1]
4a	a wave that travels in a direction parallel to the direction of vibration (or oscillation) of particles [B1]
4bi	**C** in correct position i.e. gap 4, 18 or 32 [B1] **R** in correct position i.e. gap 11 or 25 [B1]
4bii	6.4 cm [B1]
4biii	$v = f\lambda$ $= 5\,100 \times 0.064$ (using answer in 4bii converted to m) [B1] $= 326$ m / s [B1]
4c	• (Sound travels faster in glass than in air) because glass particles are closer together and collide more easily with one another than air particles. [B1] • (Light travels faster in air than glass) because air is optically less dense than glass [B1]

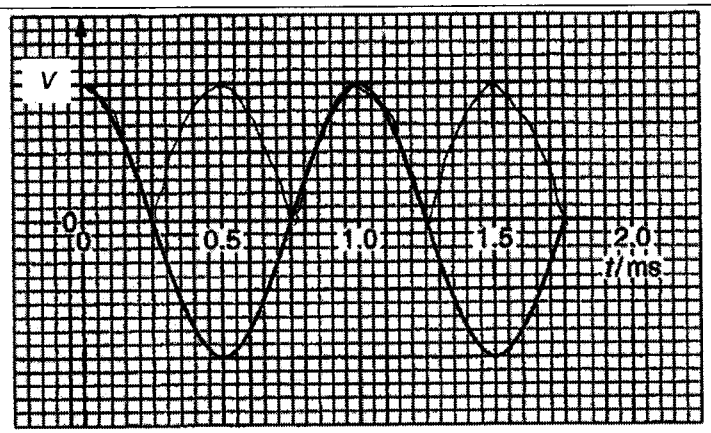
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S/N	Mark Scheme
5ai	gamma rays, visible light, infra-red radiation [B1]
5aii	• can travel in space/vacuum **or** no medium needed • same (high) speed (in air) **or** travel at speed of light • transverse (stated **or** explained) • transfer/transmit energy • (oscillating) magnetic **and** electric fields/waves • reflection/refraction
5bi	microwaves [B1]
5bii	radio waves [B1]
5biii	• cover a large area over the horizon / larger coverage of events around the world • unaffected by tall buildings/hills / no obstructions • higher quality of signal
6a	distance between optical centre and principal focus of lens [B1]
6b	• correct location of real image [B1] • correct incident and refracted rays [B1 for both] • focal length = 2.1 – 2.4 cm [B1]
6ci	• image becomes larger **or** magnified **or** further from lens [B1]
6cii	image becomes smaller **or** closer to object/lens. [B1]
7ai	Geiger-Muller tube/counter/detector [B1]
7aii	• keep distance (away from source) by using tongs [B1] • **or** use lead-lined box to store radioactive source • **or** use source for short time • **or** wear lead-lined clothing and gloves
7bi	Radiation when there is no source that is deliberately introduced [B1] **or** naturally occurring (radiation) **or** always present
7bii	• measure count rate with no source [B1] • subtract from (measured) count (rate for same time) [B1]
7ci	• graph is 2 cpm lower for d = 0 to 4.0 cm [B1]
7cii	alpha (particles/radiation) [B1] count rate decreases when they travel in air [B1]

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S/N	Mark Scheme
8a	• correct symbols for a.c. power supply, variable resistor, lamp, switch and fuse [B1] • variable resistor, lamp, switch and fuse are connected in series [B1] 
8b	R = V / I = 240 / 12 [B1 for formula and substitution] = 20 Ω
8c	• when current increases, temperature increases (due to decrease in resistance of variable resistor) [B1] • resistance increases [B1]
8d	• possible overheating leading to electrical fire [B1] • short circuit due to negligible resistance (alternative path) of bare copper wire (compared to floodlight and variable resistor), leading to surge in current [B1]
8e	• When light intensity decreases (at night), resistance of LDR increases. [B1] • resistance of floodlight takes up a smaller proportion of total resistance (compared to day) [B1] • potential difference across floodlight decreases (making it less bright). [B1]
9a	• energy transferred electrically / through electric current [B1] • energy (then) transferred mechanically due to work done by motor on (back) wheel [B1]
9bi	V_{max} is directly proportional to the number of revolutions per second of the coil. [B1]
9bii	• as number of revolutions per second increases (or decreases), rate of change of magnetic flux linking the coil (and the magnet) increases (or decreases). [B1] • by Faraday's Law, magnitude of (maximum) induced e.m.f. increases. [B1]
9biii	• magnetic field of induced current interacts with that of (permanent) magnet to produce a force on sides of coil. [B1] • oppositely directed to the force used to rotate the coil, reducing rate of change of magnetic flux (linking the coil) and hence values of maximum current. [B1]
9biv	• split-ring commutator reverses the direction of current in the coil every time it passes the vertical position so that force(s) acting on side(s) of coil ensure that it always turns in the same direction. [B1] • slip rings ensure that coil is not entangled / induced current is transferred to external circuit (or resistor) / induced current is alternating. [B1]

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S/N	Mark Scheme
9bv	 [B1 for correct shape]

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S/N	Mark Scheme
10ai	force (acting) per unit area [B1]
10aii	p = F / A = mg / A [B1 for both formulae] = (60 x 10) / 0.0024 [B1] = 250 kPa [B1]
10bi	• rubber molecules (in old tyre) are (constantly and randomly) vibrating about fixed positions [B1] • air molecules (in modern tyre) are moving constantly and randomly (at high speeds) [B1] • strong(er) attractive forces between rubber molecules than in air molecules (or vice versa) [B1]
10bii	• (when temperature increases) air molecules move faster and collide more frequently and forcefully with (inner walls of) tyre [B1] • larger force (by air molecules) per unit area on (inner walls of) tyre [B1] • pressure (in tyre) increases [B1]
11ai	• left soft iron: S on left and N on right • right soft iron: S on left and N on right [B1 for all correct]
11aii	• unlike poles attract (or N pole of left soft iron is attracted to S pole of right soft iron). [B1] • both soft irons come into contact / move towards one another. [B1]
11aiii(1)	resistance of thermistor decreases [B1]
11aiii(2)	• current in coil increases, causing magnetic field of coil to be stronger [B1] • reed switch closes (or soft irons come into contact) (causing current to flow through lamp) [B1]
11bi	electron [B1]
11bii(1)	• opposite charge between pipe and petrol can cause a spark (or discharge path) [B1] • spark can ignite petrol (vapour) causing a fire or explosion. [B1]
11bii(2)	• grounding or earthing the can / connecting a metal chain from the can to ground [B1]

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