Name: _____ ( ) Class: _____

WHITLEY SECONDARY SCHOOL

A Caring and Learning Community of Leaders

*Perseverance * Respect * Integrity * Discipline *Empathy*

PRELIMINARY EXAMINATION 2025

SUBJECT : PHYSICS PAPER 1 (6091/01)

LEVEL : Sec 4 G3

DATE : 2 September 2025

DURATION : 1 hr

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, Class and index number 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	
Total	**/ 40**

This document consists of **21** printed pages and **3** blank pages

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1 What is the correct order of magnitude for the diameter of an atom, the diameter of the Earth, and the diameter of a human hair?

	diameter of an atom	diameter of Earth	diameter of human hair
A	0.1 μm	10 Mm	100 μm
B	0.1 μm	10 Gm	10 μm
C	0.1 nm	10 Mm	100 μm
D	0.1 nm	10 Gm	10 μm

2 Which of the following lists of SI units contains only base units?

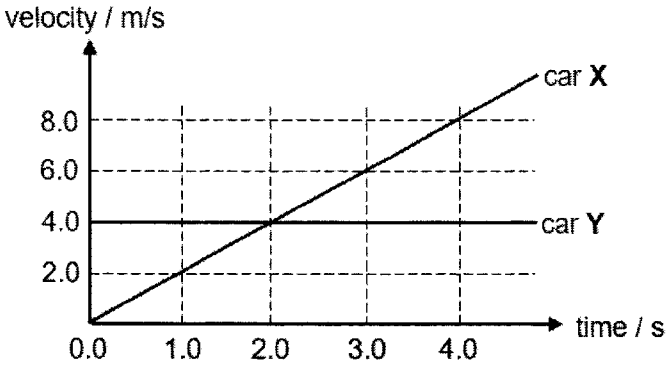
A ampere, kilogram, kelvin, metre, mole
B ampere, kilogram, metre, newton, ohm
C kelvin, mole, newton, second, volt
D kilogram, metre, mole, ohm, second

3 A car is travelling at a velocity of 2.0 m / s. It accelerates at 0.20 m / s^2 for 2.5 minutes. What is the final velocity of the car?

A 2.5 m / s
B 5.2 m / s
C 30 m / s
D 32 m / s

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4 The velocity-time graph of two cars is shown. Car **X** and car **Y** started off their journey from the same position when **t** = 0.0 s.



At what time will the two cars pass each other again?

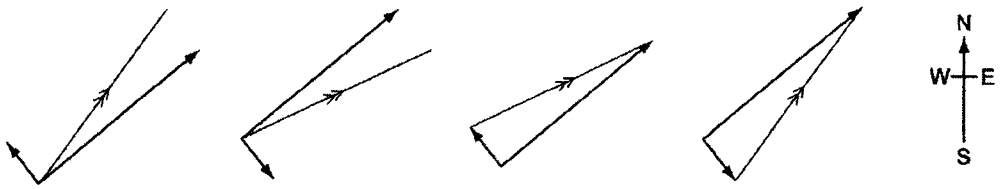
A 1.0 s
B 2.0 s
C 3.0 s
D 4.0 s

5 An aircraft heads north-east at 400 km / h.

The wind is blowing towards the north-west at 100 km / h.

Which vector diagram represents the correct way to obtain the resultant velocity of the aircraft?

A **B** **C** **D**



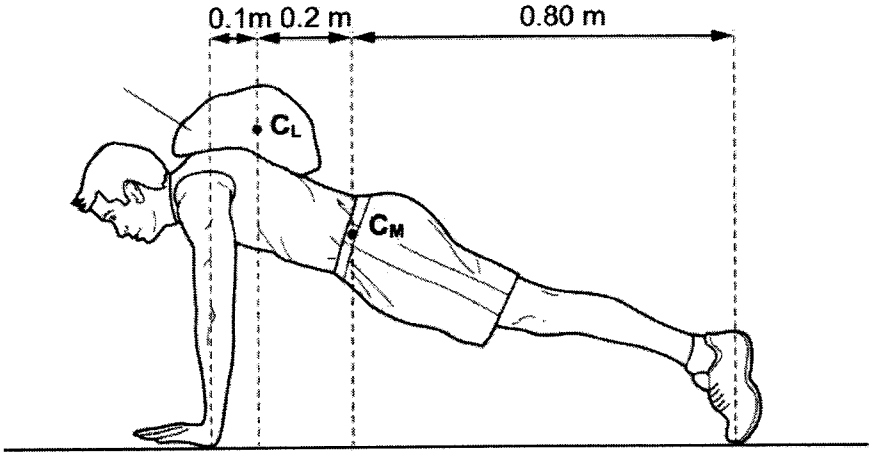
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6 Two boxes, P and Q, were pushed along a smooth surface from rest. The acceleration of box P is twice that of box Q. The mass of box Q is thrice of box P.

Which of the following shows the correct relationship between force exerted on box P, F_P and force on box Q, F_Q?

A $F_P = (2/3)\, F_Q$
B $F_P = (3/2)\, F_Q$
C $F_P = 3\, F_Q$
D $F_P = 6\, F_Q$

7 An athlete with mass 80 kg trains by performing press-ups with a load on his back. The diagram shows the perpendicular distances involved. The centre of mass of the athlete is C_M and the centre of mass of the load he is carrying is C_L.

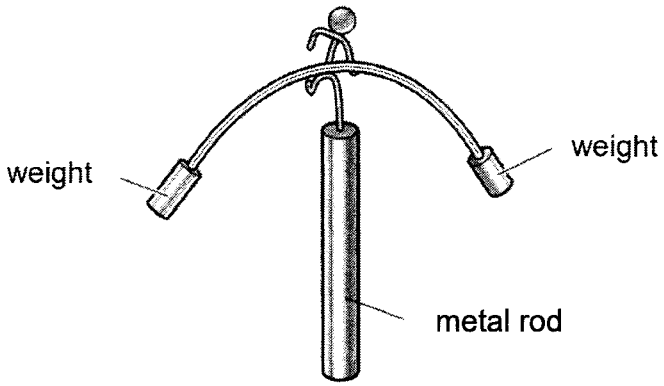


The mass of the load is 10 kg.
What is the upward force exerted on his two arms?

A 90 N
B 230 N
C 670 N
D 900 N

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8 A student makes a model toy which balances on the end of a metal rod.



Why are the weights needed?

A They increase the pressure on the rod.

B They increase the weight of the model.

C They lower the centre of gravity below the top of the rod.

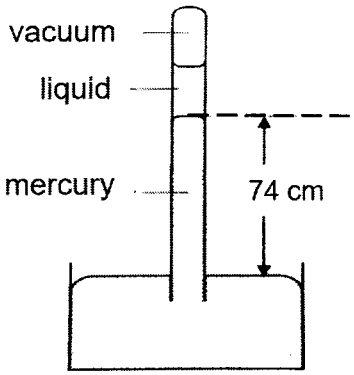
D They raise the centre of gravity above the top of the rod.

9 Which object will exert the greatest pressure on the ground?

	weight / N	contact area with ground / cm^2
A	50	100
B	280	150
C	9400	200
D	20000	600

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10 The diagram shows a mercury barometer. Some liquid less dense than mercury is found above the mercury column. The atmospheric pressure is 76 cm Hg, density of the liquid and mercury are 1200 kg / m^3 and 13600 kg / m^3 respectively.



What is the height of the liquid column?

A 0.02 cm

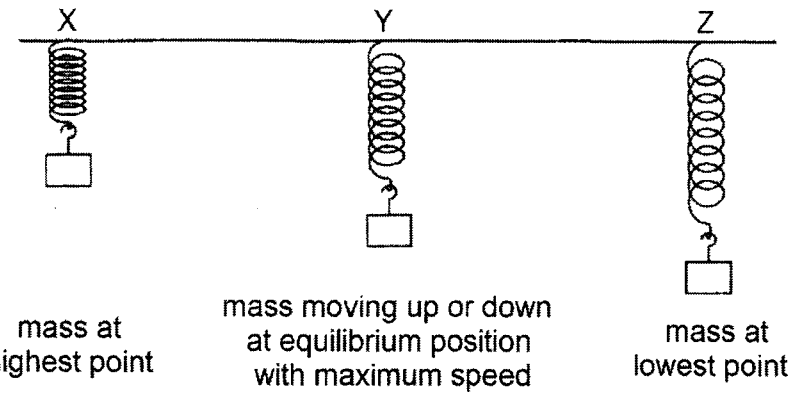
B 2.0 cm

C 22.7 cm

D 26.0 cm

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11 A spring fixed at one end, has a mass attached to the other end. The mass bounces up and down. It is shown in the diagram at three positions X, Y and Z.



Which row correctly describes the kinetic and gravitational potential stores for the mass and the elastic potential stores in the spring?

	kinetic store	gravitational potential store	elastic potential store
A	maximum for Y	maximum for X	maximum for Z
B	maximum for Y	minimum for Z	maximum for Y
C	zero for X	maximum for X	maximum for X
D	zero for Z	minimum for Z	zero for X

12 Which option correctly describes the mechanism by which energy is transferred to food in a microwave oven?

A electrically
B heating
C mechanically
D propagation of waves

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13 A gas placed in a container of fixed volume is heated.

What effect does this have on the gas?

A Both the pressure and temperature of the gas increase.
B Neither the pressure nor temperature of the gas increases.
C Only the pressure of the gas increases.
D Only the temperature of the gas increases.

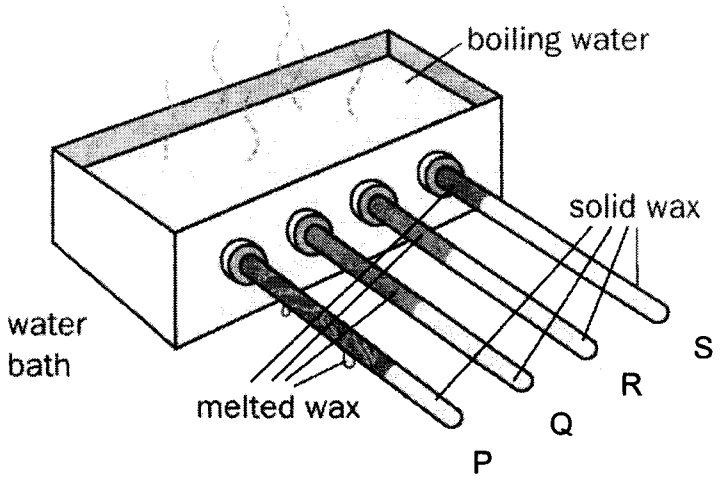
14 Results from a Brownian motion experiment involving smoke particles in air shows that heavy particles settle quickly. However, very small particles remain suspended for a long period of time.

Which of the following statements explain the behavior of very small particles?

A Air pressure has a greater effect on smaller particles.
B Random molecular bombardment by air molecules keeps the particles suspended.
C The Earth's gravitational field does not act on small particles.
D The small smoke particles have the same density as the air.

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15 A water bath is filled with boiling water. Four rods of different materials are coated with solid wax and placed in contact with the metal container holding the boiling water. At the end of the experiment, rod P had the most melted wax, while rod S had the least melted wax.



Which row best fits the likely materials of all 4 rods?

	rod P	rod Q	rod R	rod S
A	copper	glass	iron	wood
B	copper	iron	glass	wood
C	wood	glass	iron	copper
D	wood	iron	glass	copper

16 A person places his two feet on two separate surfaces, a woolen carpet and a marble tile. Both surfaces are initially at the same temperature.

Which statement best describes how the person will feel?

A Both surfaces feel the same since both are at the same temperature initially.

B The foot on the carpet feels warmer because the carpet transfers heat to the foot.

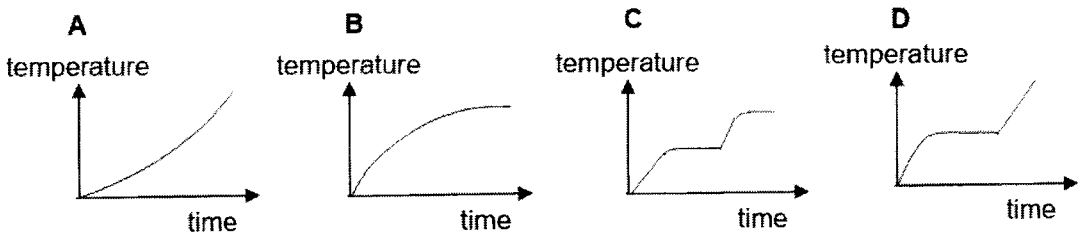
C The foot on the tile feels cooler because the tile transfers coldness to the foot.

D The foot on the carpet feels warmer because the rate of heat transfer is slower through the wool.

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17 A container of water is heated at a constant rate in an insulated container till half of it vaporizes.

Which of the following graphs shows how the temperature changes during this time?



18 Which of the following is **not** a difference between boiling and evaporation?

A Evaporation is a slow process but boiling is a fast process.

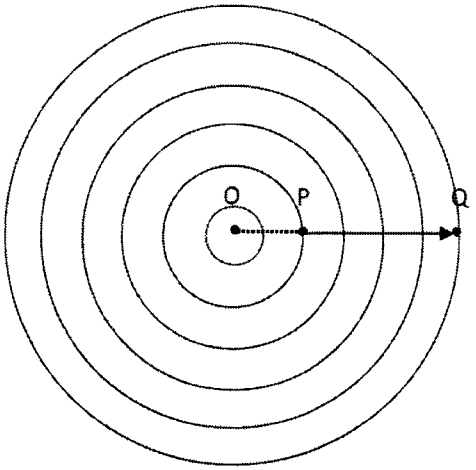
B Evaporation occurs from 0 °C to 100 °C but boiling takes place only at the boiling point.

C During evaporation, there is a change in state and temperature while boiling involves a change in state only.

D Evaporation does not require an external thermal energy source while boiling requires.

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19 The figure shows circular wavefronts travelling from a point source O.



If the time taken for a wavefront to travel from point P to Q is 12.0 s and the wavelength of the wave is 200 cm, what is the speed of the wave?

A 0.67 m / s
B 1.0 m / s
C 17 m / s
D 67 m / s

20 In which of the following scenarios will sound **not** be heard?

A A bell ringing in air.
B A drum being played in an open field.
C A tuning fork vibrating inside a vacuum chamber.
D An alarm clock ringing inside a box with small openings.

21 The wavelength of an ultraviolet ray is approximately 1×10^{-7} m.
What is the approximate wavelength of X-rays?

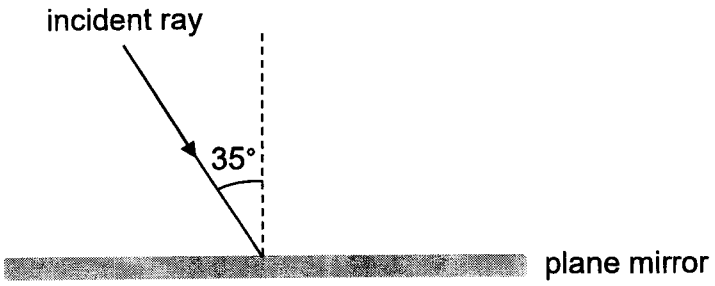
A 1×10^{-10} m
B 1×10^{-7} m
C 1×10^{-5} m
D 1×10^{-2} m

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22 Which electromagnetic wave can cause structural damage to living cells and tissue?

A infra-red radiation
B microwaves
C radio waves
D ultraviolet radiation

23 A ray of light strikes a plane mirror at an angle of incidence of 35°. The mirror is then rotated 10° clockwise while the incident ray remains fixed.

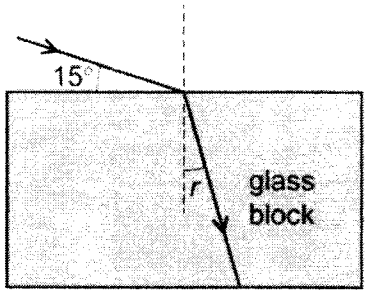


What is the angle between the new reflected ray and the original reflected ray?

A 10°
B 20°
C 35°
D 45°

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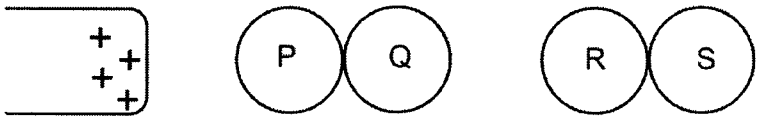
24 Light in air strikes the top surface of a glass block at an angle of 15° as shown. The refractive index of glass is 1.5.



What is the angle of refraction *r*?

A 10°
B 23°
C 40°
D 50°

25 P, Q, R and S are identical insulated neutral metal spheres. They are arranged as shown.



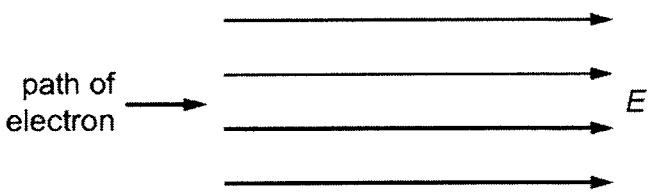
A positively-charged bar is brought near to P. Only sphere S is earthed momentarily.

What would the charge on spheres R and S be after the bar is removed?

	R	S
A	negative	neutral
B	negative	negative
C	neutral	neutral
D	positive	positive

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26 An electron enters a region of space where there is a uniform electric field *E* as shown.



Initially, the electron is moving parallel to, and in the direction of, the electric field.

What is the subsequent path and change of speed of the electron caused by the electric field?

	path of electron	speed of electron
A	curved	decreases
B	curved	increases
C	linear	decreases
D	linear	increases

27 A typical lightning strike occurs when there is a potential difference of 50 MV between the clouds and the ground. When the lightning strikes, it transfers 800 MJ of energy.

What is the number of electrons that travels through the lightning strike? (charge of an electron = 1.6×10^{-19} C)

A 1.6×10^{1}

B 4.0×10^{17}

C 1.0×10^{20}

D 3.1×10^{26}

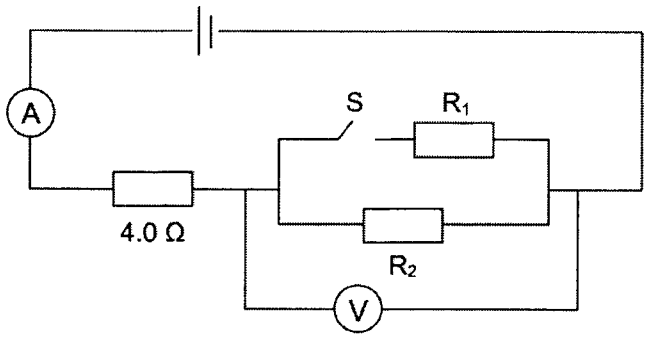
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28 The resistance of a cylindrical wire X of length 1.0 m and cross-sectional area of 1.0×10^{-6} m^2 is 0.5 Ω. A second wire Y is made from the same material. It has a length of 2.0 m and a cross-sectional area of 0.50×10^{-6} m^2.

What is the resistance of Y?

A 0.25 Ω
B 0.5 Ω
C 1.0 Ω
D 2.0 Ω

29 Two resistors, R_1 and R_2 are connected in parallel in a circuit as shown in the diagram.
When switch S is open, the ammeter reads 1.0 A and the voltmeter reads 8.0 V.
When the switch S is closed, the ammeter reads 1.5 A and the voltmeter reads 6.0 V

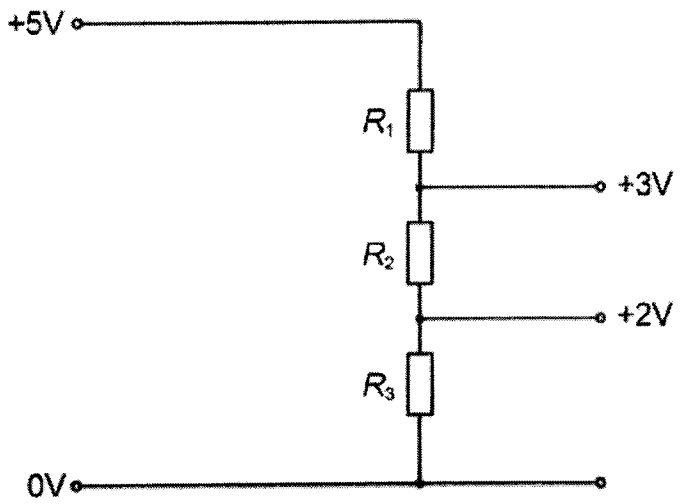


What are the resistances of R_1 and R_2?

	R_1 / Ω	R_2 / Ω
A	4.0	4.0
B	4.0	8.0
C	8.0	4.0
D	8.0	8.0

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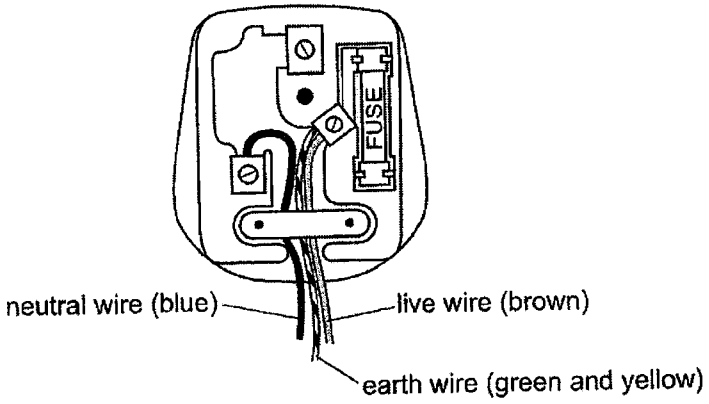
30 A potential divider is used to give outputs of 2V and 3V from a 5V source, as shown.



What are possible values for the resistances R_1 , R_2 and R_3?

	R_1 / kΩ	R_2 / kΩ	R_3 / kΩ
A	2	1	5
B	3	2	2
C	4	2	4
D	4	6	10

31 The plug of an electrical appliance is incorrectly wired, as shown.



What is the effect of using the plug wired this way?

A The appliance catches fire.

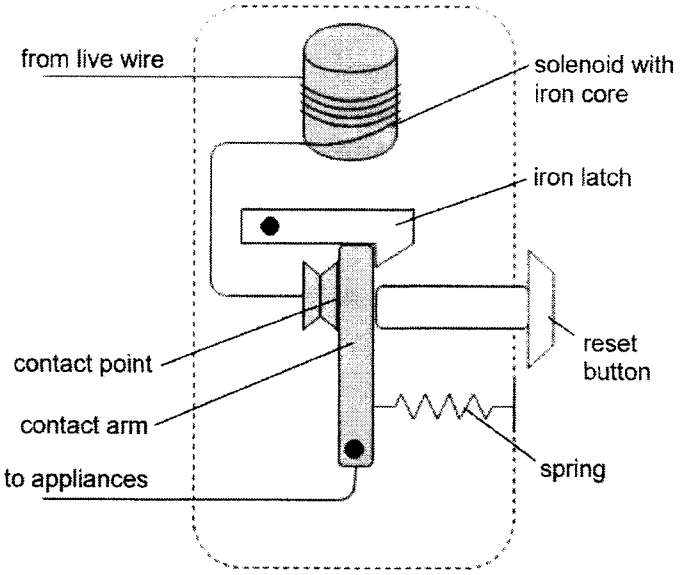
B The appliance does not work.

C The fuse in the plug blows.

D The metal case of the appliance becomes live.

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32 A diagram of a circuit breaker is shown below.



Which of the following modifications will cause the circuit breaker to trip at a lower current limit?

A Decrease the distance between the solenoid and the iron latch.

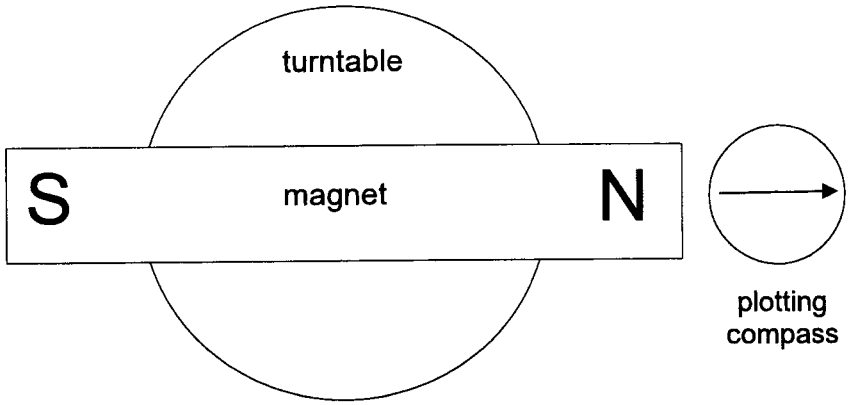
B Decrease the number of turns of coil in the solenoid.

C Increase the mass of the iron latch.

D Remove the iron core.

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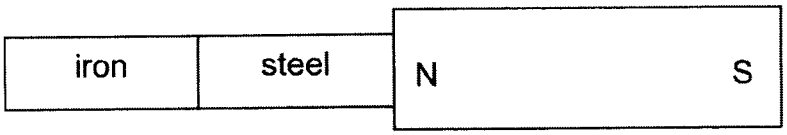
33 The figure shows a bar magnet resting on a turntable. A plotting compass is placed in front of the magnet as shown.



What will happen to the needle of the plotting compass when the turntable rotates in a clockwise direction?

A It does not move.
B It rotates anticlockwise.
C It rotates clockwise.
D It oscillates.

34 A steel bar and an iron bar are attracted to a magnet as shown.

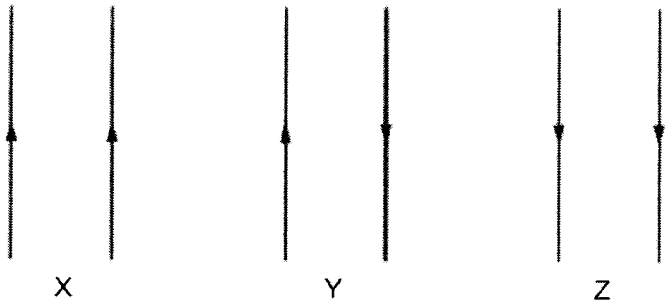


What will happen when the magnet is removed?

A Both steel and iron bars lose their magnetism.
B The iron bar retains its magnetism and steel bar loses its magnetism.
C The steel and iron bars remain attracted to each other.
D The steel and iron bars repel each other.

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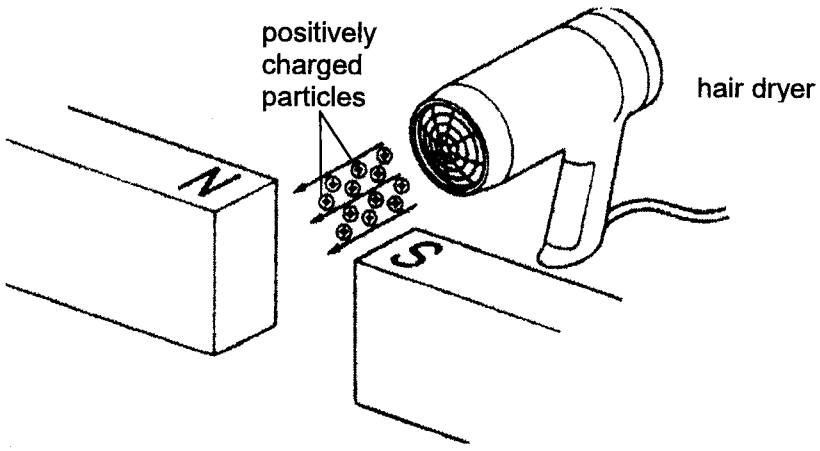
35 Three pairs of current-carrying parallel wires X, Y and Z are shown in the diagram.



Which row shows the force between the two wires for pairs X, Y, and Z?

	X	Y	Z
A	attraction	attraction	attraction
B	attraction	repulsion	attraction
C	repulsion	attraction	repulsion
D	repulsion	repulsion	repulsion

36 Hot air from a hair dryer contains many positively-charged particles. The hot air is directed between the poles of a strong magnet as shown in the diagram below.



How would the particles move as they pass through the strong magnet?

A The particles move downwards.

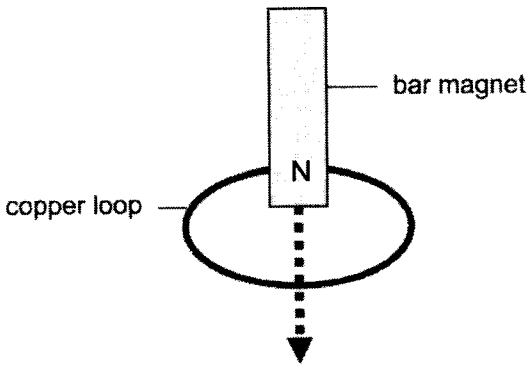
B The particles move in its original direction.

C The particles move towards the North pole.

D The particles move upwards.

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37 A bar magnet is dropped through a loop of copper wire as shown.



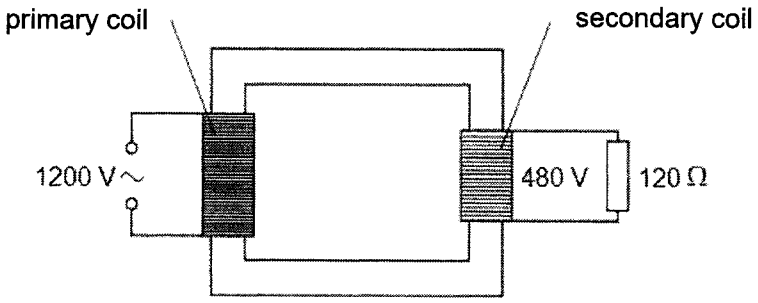
Which of the flowing statement(s) is/are correct?

1. Energy in the thermal store increases in the copper loop.
2. The magnet falls through the copper loop with an acceleration that is lower than the acceleration of free fall due to gravity
3. When the magnet approaches the copper loop, a current is induced in the loop that flows in a clockwise direction as seen by the observer from the top of the loop.
4. When the magnet moves through the copper loop, the current induced in the copper loop sets up a magnetic field that always repel the magnet.

A 2 only
B 1 and 2 only
C 2 and 3 only
D 3 and 4 only

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38 The primary coil of an ideal transformer is connected to a 1200 V alternating current source. Its secondary coil is connected to a 120 Ω resistor.



What is the power dissipated in the resistor and the current in the primary coil?

	power / W	current / A
A	480	1.6
B	480	4.0
C	1920	1.6
D	1920	4.0

39 Astatine is a radioactive substance. It has a nucleon number of 218 and a proton number of 85. It forms a polonium nucleus when it decays, emitting an α-particle and a β-particle.

What are the nucleon number and the proton number of the polonium nucleus?

	nucleon number	proton number
A	214	84
B	214	83
C	216	83
D	215	82

40 In a nuclear fission reactor, which particle causes a Uranium-235 nucleus to split into smaller nuclei?

A alpha-particle
B gamma ray
C neutron
D proton

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PRELIMINARY EXAMINATION 2025

SUBJECT	:	**PHYSICS PAPER 2 (6091/02)**
LEVEL	:	**Sec 4 G3**
DATE	:	**29 August 2025**
DURATION	:	**1 hr 45 mins**

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an 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 only **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.

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

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Section A

Answer all the questions in this section.

1 Fig. 1.1 shows a rocket just after its launch. At its launch, the rocket and its contents have a total mass of 1.2×10^5 kg. Fig. 1.2 shows how the upward thrust on the rocket changes with time in the first 40 s after the launch. The gravitational field strength g is 10 N/kg.

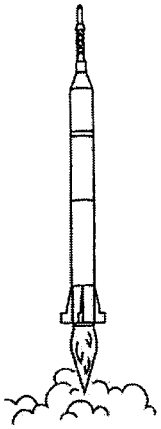


Fig. 1.1

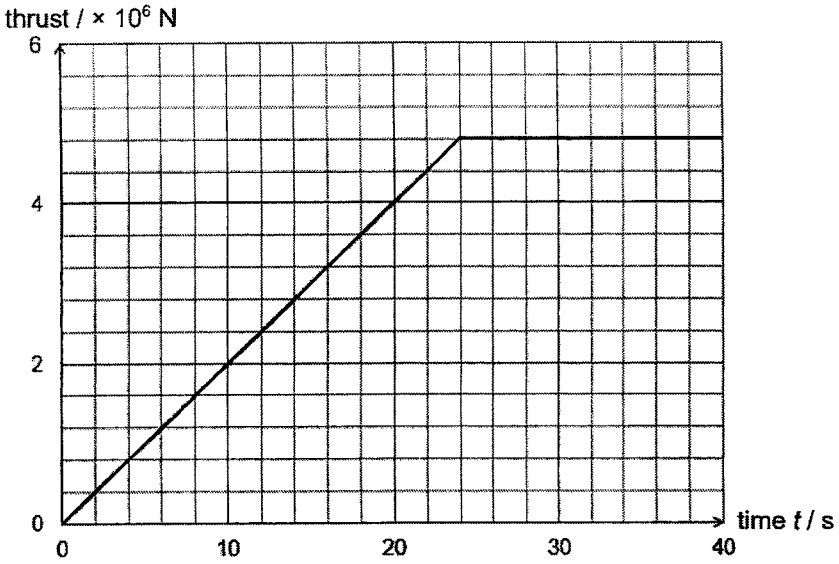


Fig. 1.2

(a) Calculate the weight of the rocket just before its launch.

weight = ... [1]

(b) At the point of launching, the rocket does not take off immediately. State the time when the rocket starts to take off and explain your answer.

.....

.....

..... [2]

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(c) Calculate the acceleration of the rocket at t = 30 s.

acceleration = ... [2]

(d) 30 s after launch, the total weight of the rocket and its content decreases significantly as fuel is being burnt off while the thrust remains the same.
Describe the motion of the rocket after 30 s.

.....

..... [1]

2 Fig. 2.1 shows an electric kettle and the live, neutral and earth wires of a household electricity supply. The kettle has a power rating of 2.0 kW. The supply voltage is 240 V.

(a) Complete Fig. 2.1 to show how the kettle should be connected to the supply. [2]
Include a switch and a fuse in your drawing.

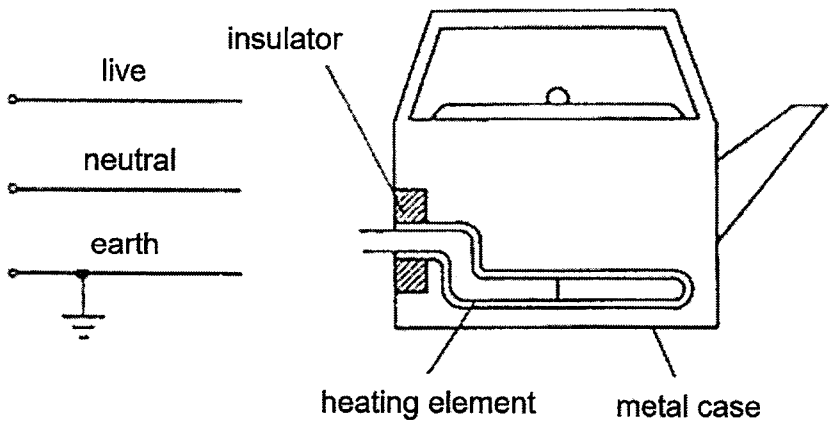


Fig. 2.1

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(b) The live wire becomes loose and touches the metal case. Explain why a person who later touches the case feels no shock and is not harmed.

.....

.....

.....

..... [3]

3 Fig 3.1 shows a mercury manometer connected to a gas supply.

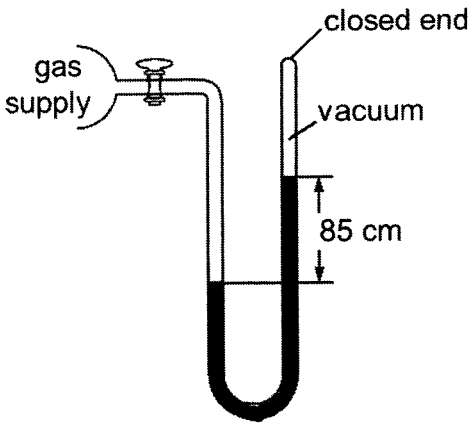


Fig. 3.1

(a) Explain, using the kinetic model of matter, how the gas supply exerts a pressure.

.....

..... [1]

(b) The atmospheric pressure is 74 cmHg. Determine the pressure of the gas supply.

gas pressure = ... cmHg [1]

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(c) Some air leaks into the closed end and the reading of the manometer changes to 78 cm. Determine the pressure within the closed end.

pressure in the closed end = ... cmHg [2]

4 Fig. 4.1 shows a walking stick that has a metal head and a rubber foot. It balances on a pencil placed 0.50 m from its rubber foot. The walking stick has a total length of 0.80 m.

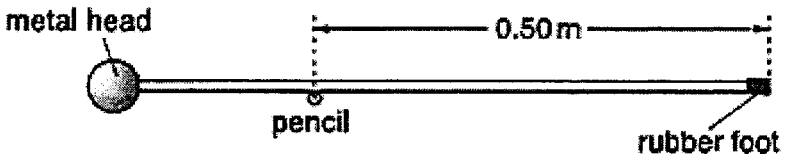


Fig. 4.1

(a) **(i)** State the definition of *centre of gravity*.

..... [1]

(ii) State the distance between the *centre of gravity* of the walking-stick and the end of the rubber foot.

..... [1]

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(b) Fig 4.2 shows a truck of mass *M* of 5000 kg crossing a horizontal bridge of uniform mass *m* 1000 kg and length *l* of 100 m.

The bridge is supported at its ends.

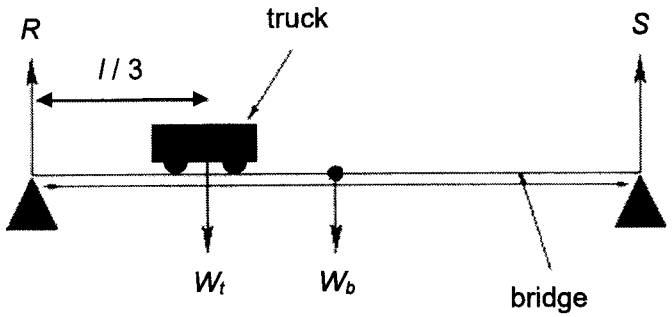


Fig. 4.2

Calculate the forces *R* and *S*, acting on the bridge when the truck is one-third of the way across the bridge. Show your working clearly.

R = ...

S = ... [3]

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5 Fig. 5.1 shows a section of a solar heating system which helps to provide hot water for a house. It consists of a solar panel placed outdoor on a roof. Connected to this panel are water pipes. Heat from the Sun warms the water in these pipes which is then pumped to a hot water tank inside the house. Inside the hot water tank, the hot water transfers its heat, becomes cooled and circulates back to the solar panel.

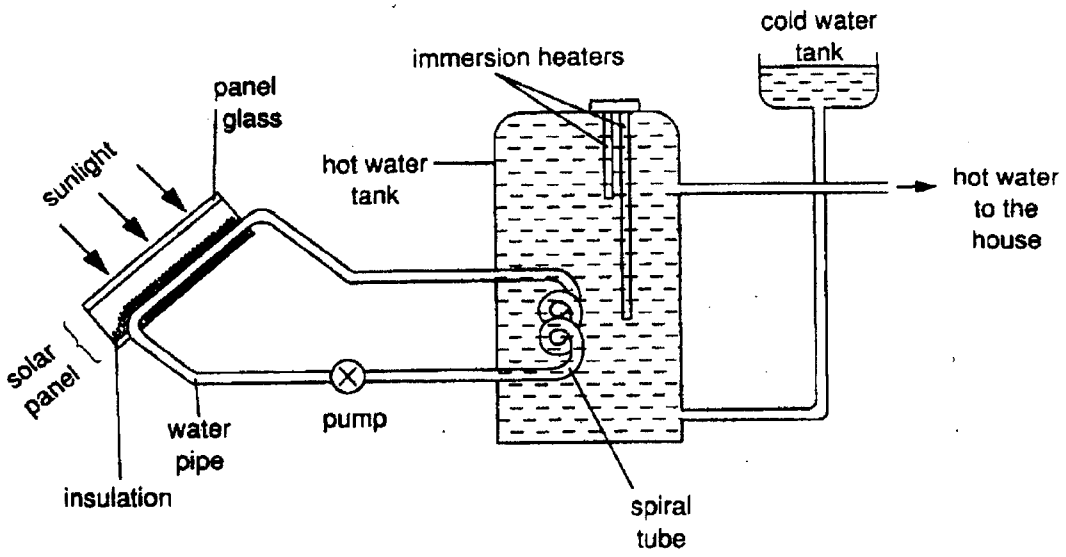


Fig. 5.1

(a) Explain the purpose of the following features:

(i) there is an insulation for the water pipe in the solar panel, and

.....

..... [1]

(ii) the water pipe in the hot water tank is spiral and painted black.

.....

.....

..... [2]

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(b) In the hot water tank, the water enters at a higher temperature than the surrounding metal of the tank.

Explain why the water eventually cools down.

.....

.....

..... [2]

6 Fig. 6.1 shows a rigid rectangular card which has a rectangular hole cut out in the centre. Fig. 6.2 shows the setup used to measure the acceleration of the card as it falls freely to the ground. A torchlight which is directed towards the light dependent resistor (LDR) is turned on. A computer is used to measure the potential difference across RS.

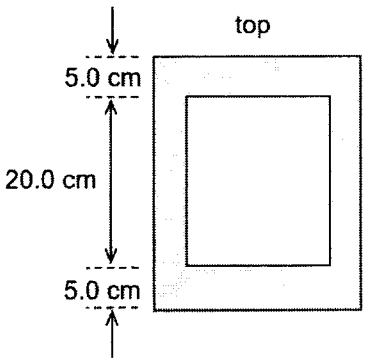


Fig. 6.1

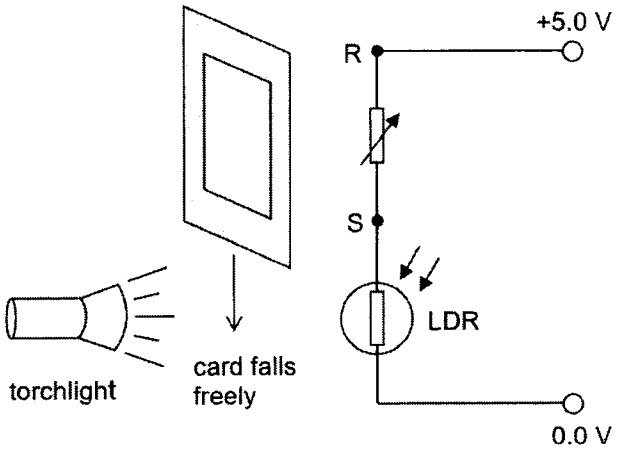


Fig 6.2

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Fig. 6.3 shows the graph of potential difference (p.d.) across RS against time.

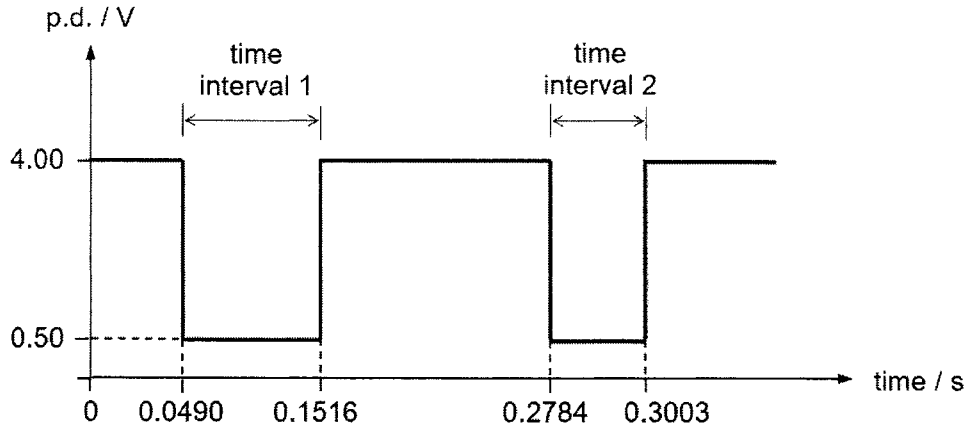


Fig. 6.3

(a) State what happens to the resistance of the LDR as the card falls.

.....

.....

.....

..... [2]

(b) Explain why the p.d. across the variable resistor drops to 0.50 V.

.....

.....

.....

..... [2]

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(c) Explain why time interval 1 is longer than time interval 2 (as shown in Fig.6.3) when the rigid card falls.

.....

.....

..... [2]

7 Fig. 7.1 shows the object and its image with ray **X** moving towards a converging lens.

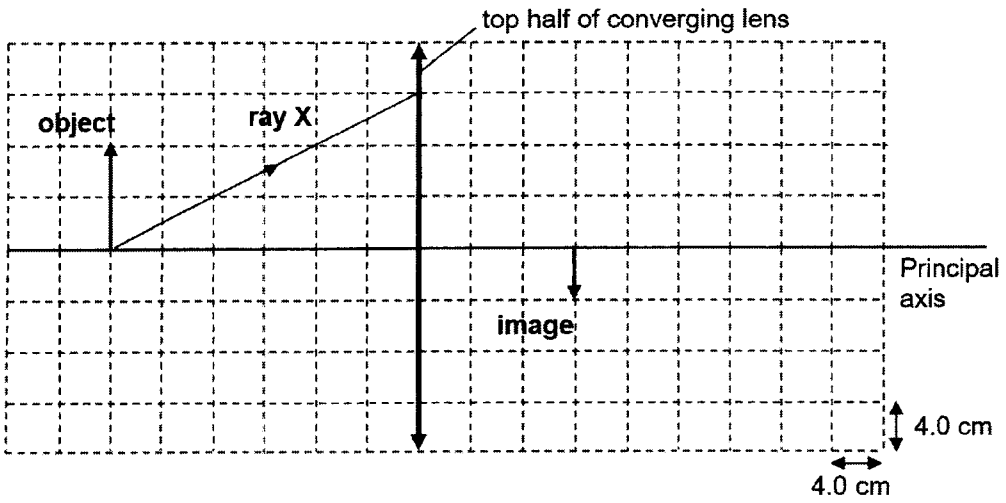


Fig. 7.1

(a) Draw, on Fig. 7.1, one ray to locate the focal point of the lens. Mark the focal point with the letter **F**. [1]

(b) Determine the focal length of the lens in Fig. 7.1.

focal length = ... [1]

(c) Complete the path for ray **X** on Fig. 7.1. [1]

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(d) If the top half of the converging lens is removed, state and explain whether the image is still formed.

.....

..... [2]

8. Fig 8.1 shows a light conducting sphere S hangs vertically on an insulating thread. A negatively charged plate P on an insulating stand is brought near to the sphere. Sphere S is observed to move towards plate P.

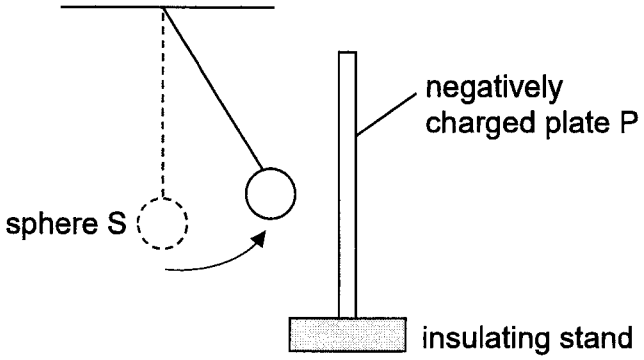


Fig. 8.1

(a) It is said that there is an electric field between sphere S and plate P.

Describe what is meant by an *electric field*.

.....

..... [1]

(b) Explain what can be deduced about the charge on sphere S.

.....

.....

.....

..... [3]

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9 Fig 9.1 shows a student holding a permanent magnet directly above a small paper clip of negligible mass. The paper clip was connected to a bench by a string.

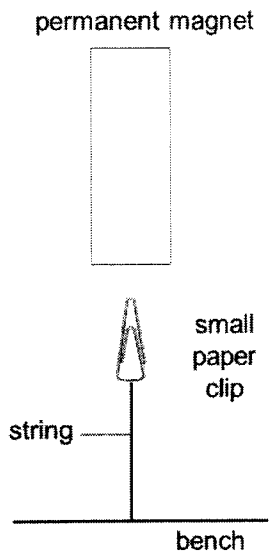


Fig. 9.1

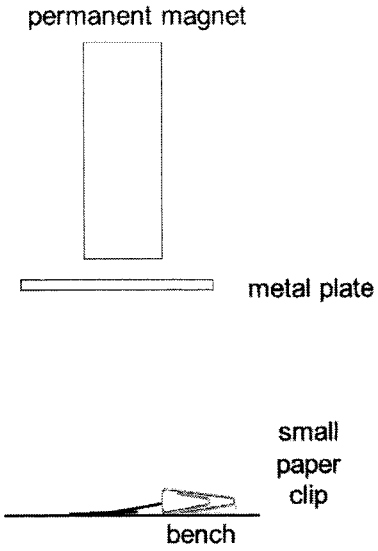


Fig 9.2

(a) Explain why the small paper clip is attracted to the magnet shown in Fig. 9.1.

.....

.....

..... [2]

(b) The permanent magnet is removed, and the small paper clip is then brought near some iron filings. The iron filings are attracted to the paper clip.

Suggest and explain what material the paper clip is likely made of.

.....

.....

..... [2]

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10 A liquid containing some radioactive material is injected into the patient's blood stream. This radioactive material would be absorbed by the kidneys and then passed to the patient's bladder.

A special camera is used to detect the radiation coming from the patient's kidneys.

The half-life of four gamma sources W, X, Y and Z are listed in the Table 10.1.

Table 10.1

radioactive Source	half- life
W	2 min
X	5 min
Y	4 hours
Z	8 days

(a) The initial count rate of Y is 8000 counts per minute.

What is the count rate of Y after 24 hours?

count rate = ... counts per min [2]

(b) The examination of the patient lasts for 15 minutes

State and explain which radioactive source would be most suitable for the examination.

.....

..... [2]

(c) Radioactive materials that emit alpha particles are never injected into the body to obtain medical images of parts of the body.

State two reasons why alpha emitting materials are unsuitable.

.....

..... [2]

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(d) Protactinium-234 ($^{234}_{91}Pa$) is a radioactive isotope of protactinium that decays to uranium-234 ($^{234}_{92}U$).

Complete the equation: $^{234}_{91}Pa \rightarrow {}^{234}_{92}U +$ ..... [1]

11 Fig. 11.1 represents wavefronts of a sound wave travelling in air from left to right.

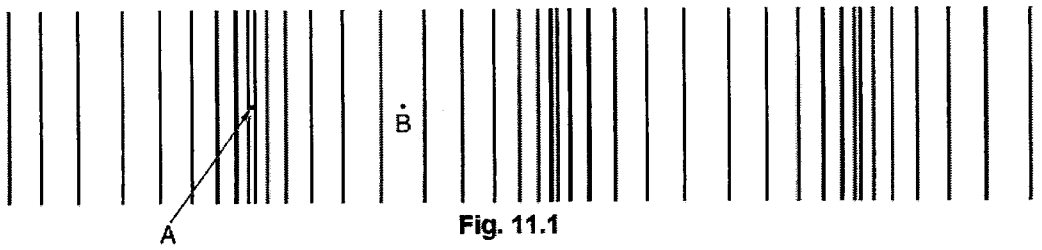


Fig. 11.1

(a) State the name given to the:

(i) region around A in the diagram .....

(ii) region around B in the diagram ..... [1]

(b) On Fig. 11.1, draw a double-headed arrow to show **one** wavelength. [1]

(c) State what is meant by *wave motion*.

.....

..... [1]

(d) State what is meant by a *wavefront*.

.....

..... [1]

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(e) The loudness of the sound increases at the same pitch.

State and explain any change there would be in the pattern of wavefronts shown in Fig. 11.1.

.....

.....

.....

..... [3]

(f) The wave passes into water.

State and explain any change in the pattern of wavefronts shown in Fig. 11.1.

.....

.....

.....

..... [3]

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12 Read the passage carefully and answer the questions that follow.

The microwave oven is now commonly used in kitchens to quickly heat up pre-prepared and fresh food. It produces microwave radiation of frequency 2500 MHz that is absorbed by water molecules. The water molecules have charge distributions which are not symmetric. When the electromagnetic field in the microwave radiation is incident on them, the water molecules increase in vibration. The microwaves can only penetrate a short distance inside the food.

The typical power in the microwave beam is 750 W. Over each distance of 3 mm, the power available from the microwave decreases by 60%.

(a) Explain what is meant by a frequency of 2500 MHz.

.....

..... [1]

(b) Calculate the wavelength of the microwave used in the microwave oven.
Take the speed of the microwave as 3.0×10^8 m/s.

Wavelength of the microwave = ... [2]

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(c) Use information in the passage to sketch a graph showing how the power available from the microwave varies with depth. Plot points at depths of 0, 3, and 6 mm on Fig. 12.1.

Draw the curve of best fit for these plotted points. [3]

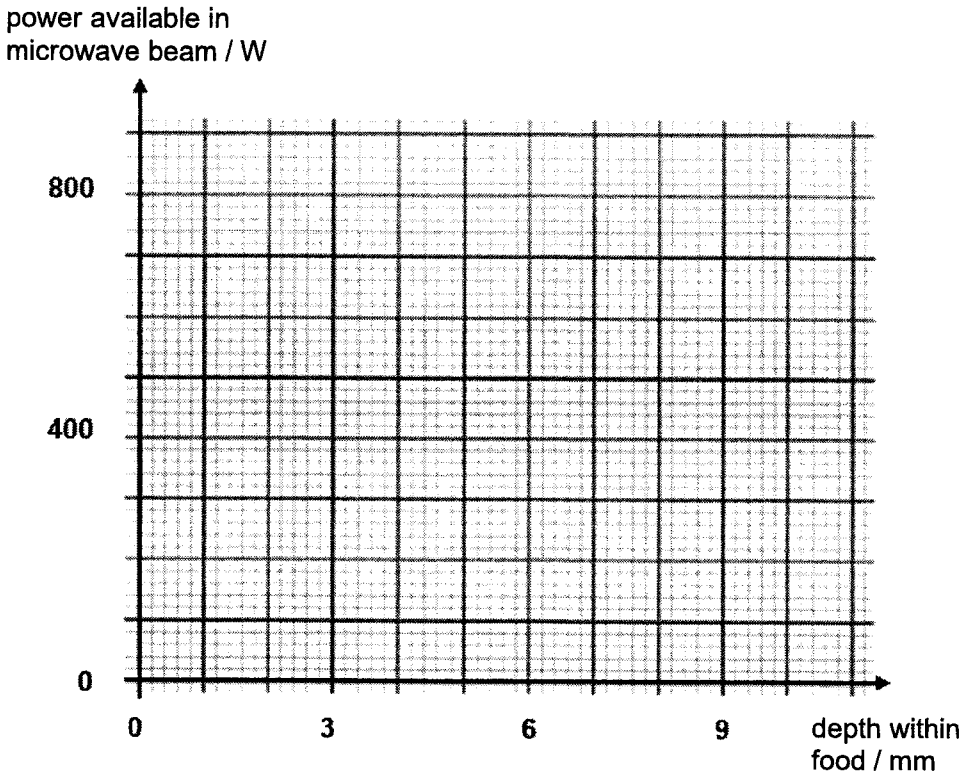


Fig. 12.1

(d) The soup is initially at -18 °C and is to be just turned into liquid at 0 °C. The soup can be assumed to be made entirely of water. Estimate the minimum time it will take a 750 W microwave oven to thaw 0.25 kg of frozen soup. Take the specific heat capacity of ice as 2100 J/(kg °C) and the specific latent heat of fusion of ice as 340 000 J/kg.

Minimum time to thaw the frozen soup = ... [3]

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Section B

Answer **one** question from this section

13 In a car test, a dummy driver is placed in a car seat which is 0.6 m from the steering wheel as shown in Fig 13.1. The car is made to crash into a wall at a constant speed of 15 m / s. During the collision, the front of the car collapses and is shortened by 0.5 m before the car comes to rest as shown in Fig. 13.2. The dummy continues forward freely during the impact. The total mass of the car is 1200 kg.

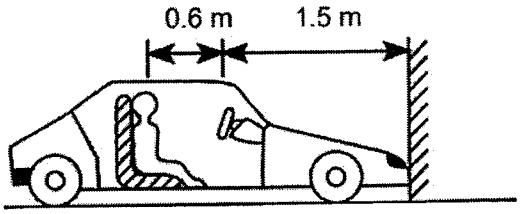


Fig. 13.1

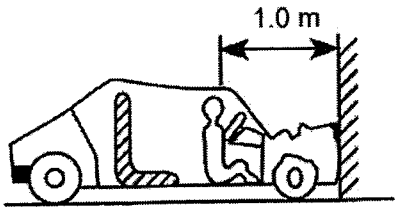


Fig. 13.2

(a) Calculate the energy in the kinetic store of the car before it crashes into the wall.

energy in the kinetic store = ... [2]

(b) Work is done by a force acting on the car at the point of the collision to slow it down.

(i) On Fig. 13.1, draw and label the action-reaction pair of forces at the point of collision. [1]

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(ii) Calculate the average force acting on the car during the collision when the front of the car collapses by 0.5 m.

average force = ... [2]

(iii) Using the answer in (b)(ii), calculate the duration of collision between the car and the wall.

time = ... [2]

(c) **(i)** Explain why the dummy continues to move forward upon impact.

.....

.....

..... [2]

(ii) A seat belt is secured over the dummy.
Explain how this can protect the dummy from the accident in (c)(i).

.....

.....

..... [1]

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14 A battery of electromotive force (e.m.f.) 4.5 V is connected to two filament lamps P and Q and a resistor R, as shown in Fig. 14.1.

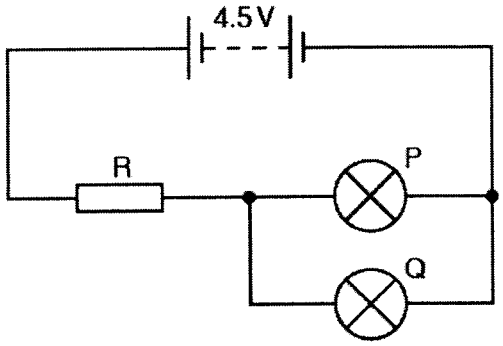


Fig. 14.1

The *I*–*V* characteristics of the filament lamps are shown in Fig. 14.2.

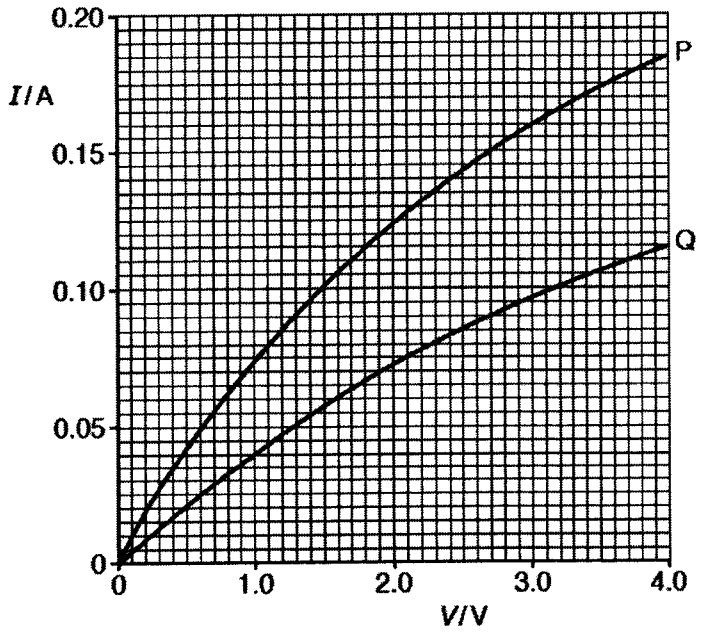


Fig. 14.2

(a) Define *e.m.f.*

.....

..... [1]

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(b) The filament lamps do not obey Ohm's Law.

(i) Describe how Fig. 14.2 shows that the filament lamps do **not** obey Ohm's Law.

.....

..... [1]

(ii) Explain why the filament lamps do **not** obey Ohm's Law.

.....

..... [1]

(c) **(i)** The current in lamp P is 0.15 A.
Calculate the resistance of resistor R.

resistance = ... [2]

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(ii) The filament wires of the two lamps are made from material with the same resistivity at their operating temperature in the circuit. The diameter of the wire of lamp P is twice the diameter of the wire of lamp Q.

Determine the ratio of $\frac{\text{length of filament wire of lamp P}}{\text{length of filament wire of lamp Q}}$.

ratio = ... [3]

(iii) The filament wire of lamp Q breaks and stops conducting.
With reference to Fig. 14.2, state and explain qualitatively, the effect on the resistance of lamp P.

.....

.....

..... [2]

End of Paper

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2025 4G3 Phy Prelim ans

Paper 1

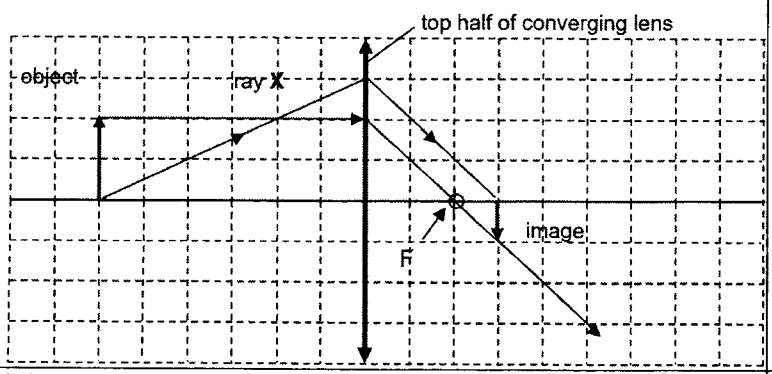
1	C	9	C	17	B	25	B	33	B
2	A	10	C	18	B	26	C	34	C
3	D	11	A	19	A	27	C	35	B
4	D	12	D	20	C	28	D	36	D
5	A	13	A	21	A	29	D	37	B
6	A	14	B	22	D	30	C	38	C
7	C	15	B	23	B	31	D	39	A
8	C	16	D	24	C	32	A	40	C

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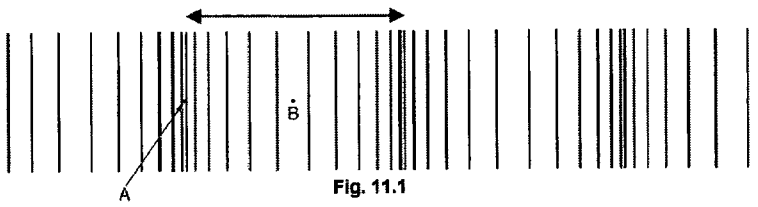
Paper 2

Qn	Ans	Marks	Remarks
1a	$W = mg = 1.2 \times 10^5 (10)$ $= 1.2 \times 10^6$ N	 B1	
1b	6.0 s. It is the time at which the thrust is equal to the weight of the rocket. From 6.0 s onwards thrust is greater than the weight.	B1 B1	
1c	At 30 s, thrust = 4.8×10^6 N $F_{net} = ma$ $4.8 \times 10^6 - 1.2 \times 10^6 = (1.2 \times 10^5)(a)$ $a = 30$ m/s^2 (2sf)	 M1 A1	
1d	When the total weight decreases significantly, the upward resultant force increases. The rocket will move with increasing acceleration	B1	
2a	Fuse and switch on live wire Live, neutral and earth wires connected correctly	B1 B1	
2b	The metal case of kettle is earthed. When the metal casing becomes live, a large current flows through the low resistance earth wire instead of the user. This causes the fuse to melt. Thus, the metal case is isolated from high voltage and the user does not get an electric shock.	B1 B1 B1	
3a	Gas particles are in constant random motion. When they collide with the walls, they apply a force, which results in a pressure.	B1	
3b	85 cmHg	B1	
3c	$P_{GAS} = 85 - 78$ 7.0 cmHg (2sf)	C1 A1	
4ai	Centre of Gravity is the point in a body or object at which the whole weight of the body can be considered to act.	B1	
4aii	0.50 m (2sf)	B1	
4b	Taking moments about the left support, Sum of CM = Sum of ACM $S \times 100 = (5000 \times 10)(100/3) + (1000 \times 10)(50)$ $100\ S = 5000000/3 + 500000$ $S = 50000/3 + 5000 = 21\ 667$ = 21 700 N (3sf) By resultant forces $R + S = 10000 + 50000$ $R = 60000 - 21\ 667$	 M1 A1	

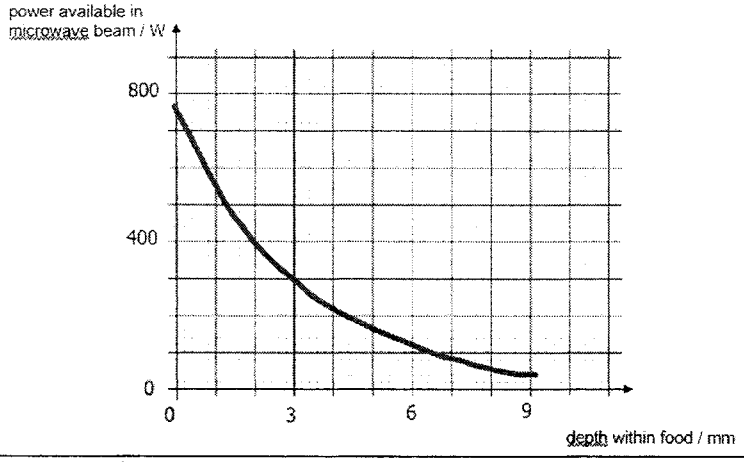
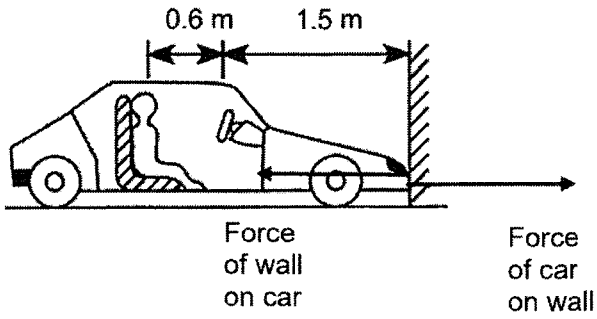
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	R = 38 300 N (3sf)	A1	
5a	It reduces heat loss from the water in the pipe by conduction to the solar panel when the Sun is not shinning.	B1	
5b	Spiral increase surface area to allow more heat to be transferred to water by radiation/ conduction. Black is a good emitter of infra-red radiation which allow smore heat to be transferred to water by radiation	B1 B1	
5c	Heat is transferred from the hot water to the cooler metal walls of the tank. This continues until thermal equilibrium is reached, where both are at the same temperature.	B1 B1	
6a	When light from the torchlight is blocked by the card, the resistance of the LDR increases. When the light is not blocked by the card and reaches the LDR, the resistance of the LDR decreases.	B1 B1	
6b	When light is blocked by the card, the brightness around the LDR is low, hence the resistance of the LDR increases and the potential difference across the LDR also increases. Since the variable resistor is in series with the LDR, when p.d. of LDR increases, the p.d. across the variable resistor will decreases to 0.50 V.	B1 B1	
6c	The top of the card passes through the LDR level faster than the bottom of the card. When the top of the card reaches the LDR level, the speed of the card is faster due to acceleration caused by gravity, hence the shorter time in interval 2.	B1 B1	
7ai		B1	correct ray drawing correct marking of F
7aii	8.0 cm	B1	
7aiii	correct subsequent ray drawing for ray X	B1	
7b	The image is still formed as all the rays from the object can still be refracted through the bottom part of the lens.	B1 B1	
8a	An electric field is a region of space where an electric charge experiences a force	B1	
8b	Sphere S could be positively charged since unlike charges attract. It could be neutral as well. When negatively charged plate P is brought near to sphere S, negative charges in S are repelled to the left side of S, leaving right side of S positively charged. S will hence be attracted to P.	B1 B1 B1	[1] for positively charged with

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			explanation [2] for neutral with explanation
9a	An <u>opposite pole was induced at the end of the paper clip that was closer/facing the magnet</u> while a like pole was induced at the farther end. Since the unlike poles of the paper clip and magnet are nearer than the like poles, <u>a net attractive force is exerted on the paper clip</u>.	B1 B1	
9b	The paper clip is likely made of <u>iron</u>. Iron is a magnetic material and <u>can be temporarily magnetised when placed near a magnet.</u>	B1 B1	
10a	$8000/ 2^6$ = 125 counts per min	C1 A1	
10b	Source Y Able to last the examination period but not to remain in the blood for too long.	B1 B1	
10c	Alpha radiation cannot penetrate through the body for detection. It has high ionising power, thus it is harmful to the body's cells.	B1 B1	
10d	$^{0}_{-1}\beta$	B1	
11a	Compression Rarefaction	B1	
11b	 Fig. 11.1	B1	
11c	Wave motion is the <u>transfer of energy</u> from one point to another <u>without the transfer of matter</u>.	B1	
11d	A wavefront is an imaginary line that connects points on a wave that are in phase	B1	
11e	The <u>compressions will more closely packed</u>, and the <u>rarefactions more spread out</u>, <u>indicating increased amplitude.</u>	B1 B1 B1	
11f	The wave <u>travels faster in water but frequency of the sound wave stays the same</u>, so the <u>wavelength increases</u> The <u>compressions and rarefactions become more widely spaced</u>	B1 B1 B1	
12a	2500 000000 complete oscillations are being made in 1s.	B1	
12b	$V = f\lambda$ $\lambda = v / f = 3.0 \times 10^8 / 2500\ 000000$ = 0.12m	C1 A1	

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12c		B3	d=3, P= 750 [1] d=6, P= 300 [1] d=6, P = 120 [1]
12d	Pt = mc ΔΘ + ml 750 x t = 0.25(2100)(18) [1] + 0.25 l t = 130 s	M2 A1	
	Section B		
13a	$E_k = 1/2\ mv^2 = 1/2\ (1200)(15)^2$ = 135 000J	C1 A1	
13bi		B1	
13bii	Work done on car = Loss in E_k F x d = 135 000 F x (0.5) = 135 000 F = 270 000 N	 M1 A1	
13bii i	F = ma -270 000 = 1200 ($v-u\ t$) -270 000 = 1200 (0−15 t) t = 0.0667 s	 M1 A1	
13ci	Every object <u>will continue in its state of rest or uniform motion in a straight line unless a resultant force acts on it</u>. Hence the dummy will <u>continue in its state of motion as there is no resultant force</u> to stop / slow down the motion.	B1 B1	
13cii	As the dummy exerts a force on the belt when it moves forwards, the belt will also <u>exert a force on the dummy in the opposite direction</u> to prevent it from moving further forward.	B1	
14a	E.m.f is defined as the <u>work done by an electrical energy source in driving a unit charge around a complete circuit</u>.	B1	
14bi	The <u>gradient of the graph decreases with increasing voltage</u> Or	B1	

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	The graph is a curve instead of a straight line that passes though the origin.		
14bii	The resistance of the lamp increases as the lamp heats up hence the resistance is not constant.	B1	
14ci	From graph, lamps have p.d. of 2.7 V R = (4.5 – 2.7) / 0.24 = 7.5 Ω	 M1 A1	
14cii	$R = \rho l / A$ RP / RQ = [(2.7 / 0.15) / (2.7 / 0.09)] = 0.60 ratio = 0.60×2^2 = 2.4	 M1 M1 A1	
14ciii	Pd across resistor P increases, gradient at higher pd is smaller. Since gradient of graph = 1/R, R increases.	B1 B1	

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