1 Which is a vector quantity?

A a mass of 2.0 kg

B a temperature of -10 °C

C a weight of 15 N

D an average speed of 20 m/s

2 What must change when a body is accelerating?

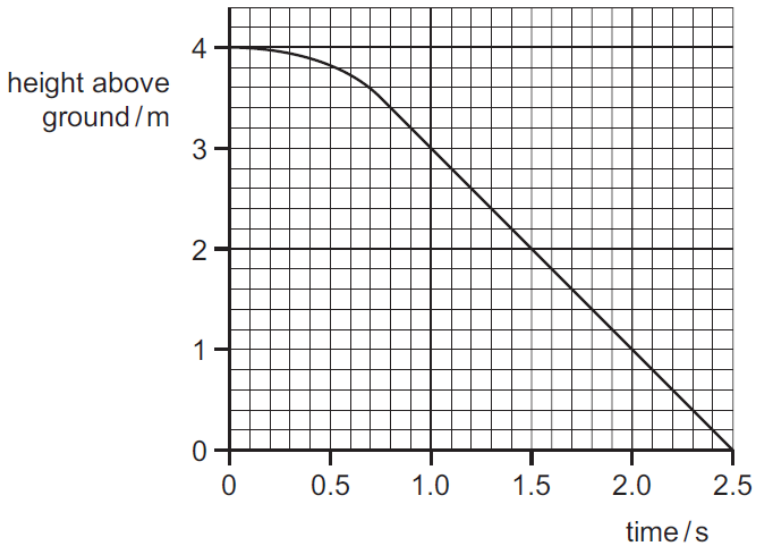
A the force acting on the body

B the mass of the body

C the speed of the body

D the velocity of the body

3 The graph shows how the height of an object above the ground changes with time.



What is the terminal velocity of the object?

A 1.0 m/s

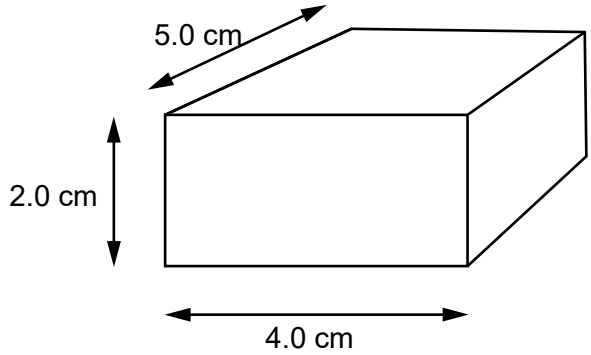
B 1.3 m/s

C 1.6 m/s

D 2.0 m/s

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4 The diagram shows a material with dimensions 5.0 cm × 4.0 cm × 2.0 cm. It has a mass of 100 g.



What is the density of the material?

A 0.40 g/cm^3

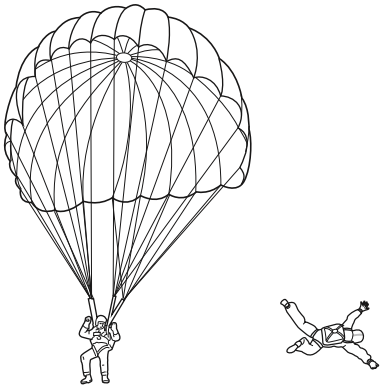
B 2.5 g/cm^3

C 5.0 g/cm^3

D 10 g/cm^3

5 Two men simultaneously jump out of an airplane at the same time.

One of the men is in free-fall and the other man opens his parachute.



Why is the man in free-fall moving faster than the parachutist?

A The man in free-fall experiences greater air resistance.

B The man in free-fall has a greater mass.

C The parachutist experiences greater air resistance.

D The parachutist has not reached terminal velocity.

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6 A body resists changes to its motion.

Which property of a body is responsible for this?

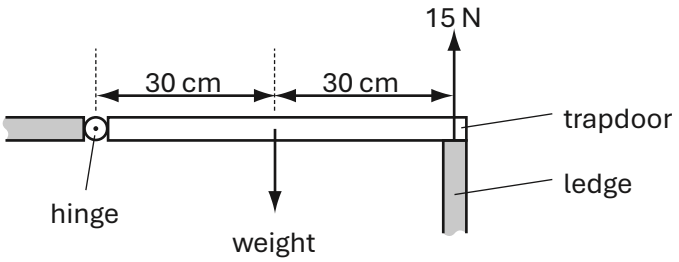
A density

B gravitational potential energy

C inertia

D kinetic energy

7 A trapdoor is hinged along one side and, when closed, is supported on the other side by a ledge.



When the trapdoor is closed, the ledge exerts an upward force of 15 N on the trapdoor. The gravitational field strength is 10 N/kg.

What is the mass of the trapdoor?

A 1.5 kg

B 3.0 kg

C 30 kg

D 150 kg

8 What affects the stability of an object?

A its base area and location of its centre of gravity

B its weight and its base area

C only the location of its centre of gravity

D only its weight

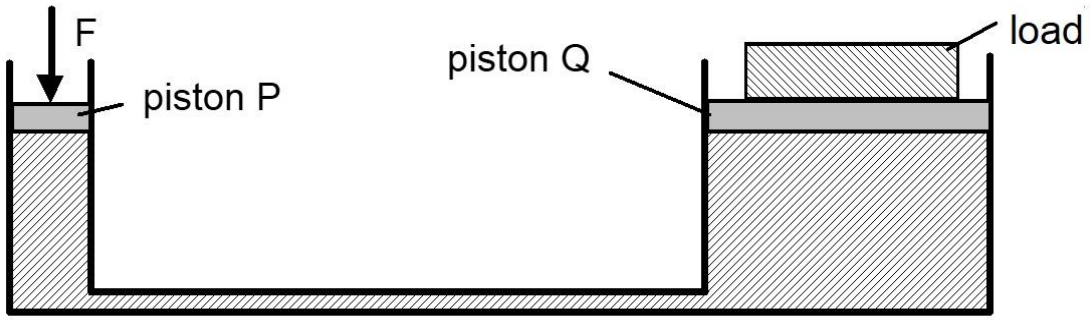
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9 Objects of different weights are placed on a rigid, horizontal surface.

Which row shows the correct pressure acting on the surface?

	weight / N	area in contact / m^2	pressure / Pa
A	10	0.1	1
B	20	0.2	0.01
C	30	0.1	300
D	40	0.2	8

10 The diagram shows a hydraulic pump.



Which of the following is correct?

A The force *F* is the same as the weight of the load.

B The force *F* is greater than the weight of the load.

C The pressure on piston P is the same as the pressure on piston Q.

D The pressure on piston P is smaller than the pressure on piston Q.

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11 Two beakers X and Y are filled to the same level with water. The area of the base of X is less than that of Y.



X Y

Which statement is correct?

A The force due to the liquid on the base of X is greater than the force on the base of Y.

B The force due to the liquid on the base of X is the same as the force on the base of Y.

C The pressure on the base of X is less than the pressure on the base of Y.

D The pressure on the base of X is the same as the pressure on the base of Y.

12 A small rock is dropped vertically from a height of 1.0 m. The gravitational field strength is 10 N/kg.

If air resistance is negligible and there is no transfer of thermal energy to the surrounding air molecules, what is the speed of the rock just before it hits the ground?

A 4.5 m/s

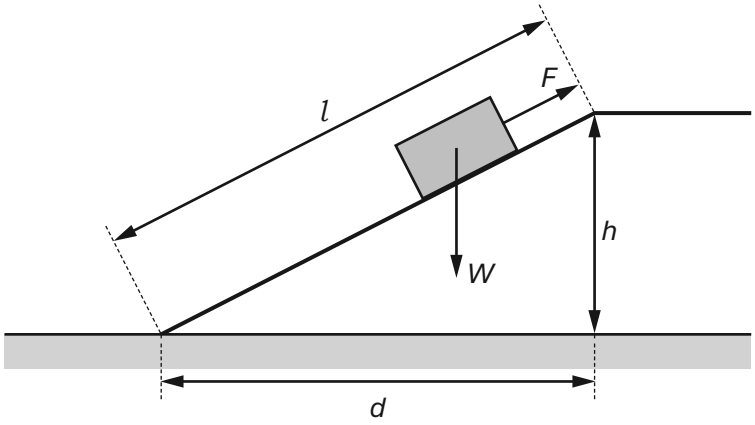
B 5.3 m/s

C 6.0 m/s

D It cannot be determined.

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13 A constant force *F* pulls a block up a slope shown.



How much work is done in pulling the block up the slope?

A *F* x *h*

B *F* x *l*

C *W* x *d*

D *W* x *l*

14 One end of a copper rod is heated.

Which statement describes how transfer of thermal energy happens in the copper?

A Energetic copper atoms move from the cooler end to the hotter end.

B Energetic copper atoms move from the hotter end to the cooler end.

C Energetic free electrons move from the cooler end to the hotter end.

D Energetic free electrons move from the hotter end to the cooler end.

15 What is the colour and the texture of a good absorber of infrared radiation?

A black and shiny

B black and dull

C white and shiny

D white and dull

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16 A dish of liquid is left on a laboratory bench. Some of the liquid evaporates.

What happens to the remaining liquid and why?

A The liquid cools because the liquid molecules have more potential energy than gas molecules.

B The liquid cools because the faster-moving molecules escape.

C The liquid warms because liquid molecules have less potential energy than gas molecules.

D The liquid warms because slower-moving molecules are left behind.

17 Equal masses of copper and water are heated to the same temperature. As they cool down, the copper and the water lose thermal energy 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.

18 The temperature of a gas is increased.

Which property of the gas **must** also increase?

A volume

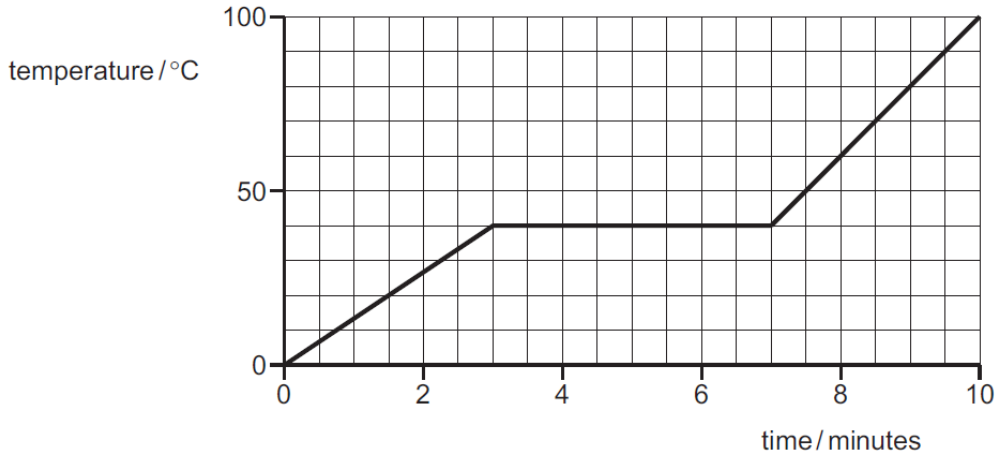
B pressure

C density

D internal energy

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19 The graph is the temperature-time graph for a sample of wax that is heated so that it melts.



The mass of the wax is 0.20 kg.

Thermal energy is supplied to the wax at a constant rate of 12 kJ/min.

What is the specific latent heat of fusion of the wax?

A 180 J/g

B 240 J/g

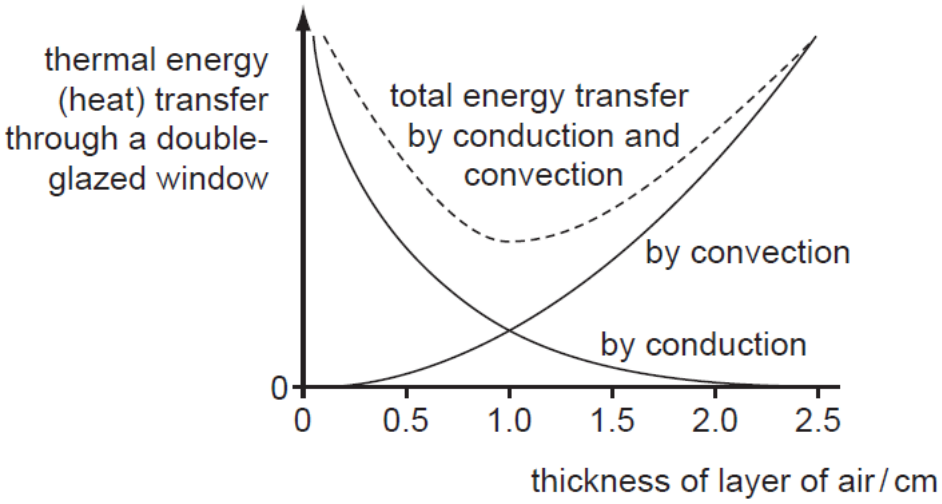
C 480 J/g

D 600 J/g

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20 A double-glazed window has two panes of glass with a layer of air in between them.

Thermal energy is transferred by conduction and convection through the layer of air. The amount of conduction and convection varies with the thickness of the layer of the air, as shown in the graph.



Which thickness of layer of air results in the least transfer of thermal energy, and why?

A 0.45 cm because there is not much convection.

B 1.0 cm because the total thermal energy transfer is least.

C 1.5 cm because the total thermal energy transfer is small and conduction is low.

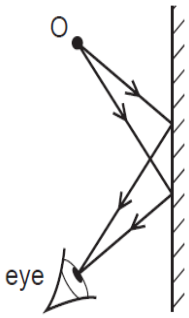
D 2.0 cm because there is little conduction.

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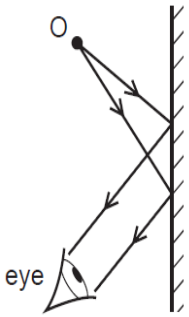
21 An eye views an object O by reflection in a plane mirror.

Which is the correct ray diagram?

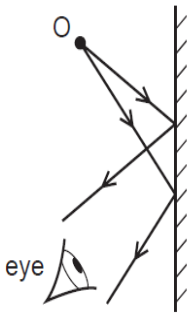
A



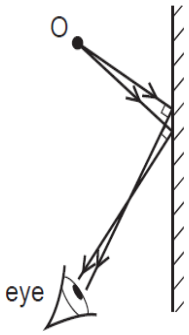
B



C



D



22 What is the refractive index of a medium?

A The ratio of the speed of light in air to speed of light in the medium.

B The ratio of the speed of light in the medium to speed of light in air.

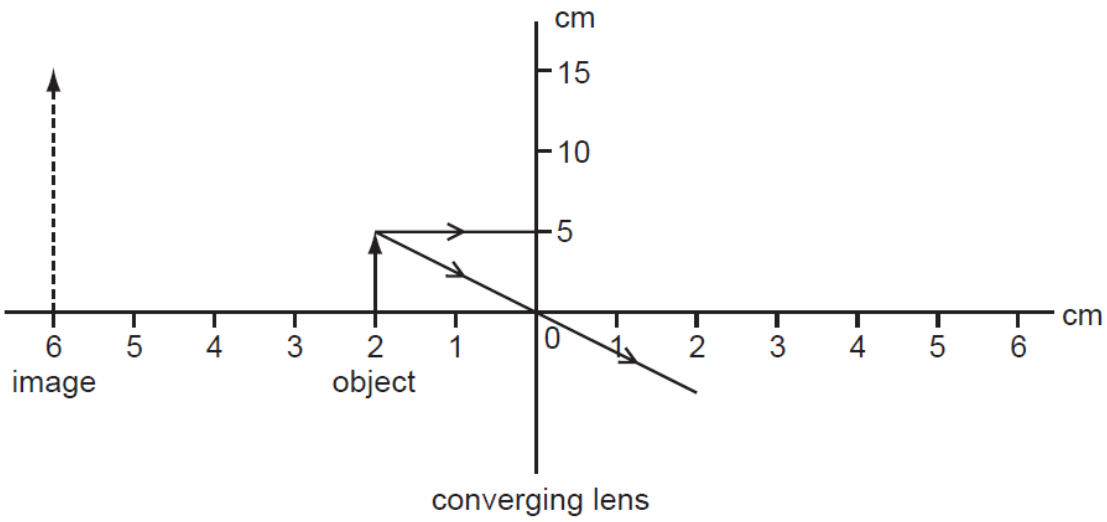
C The ratio of the speed of light in vacuum to speed of light in the medium.

D The ratio of the speed of light in the medium to speed of light in vacuum.

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23 An object 5.0 cm high is placed 2.0 cm from a converging (convex) lens which is being used as a magnifying glass.

The image produced is 6.0 cm from the lens and is 15 cm high.



What is the focal length of the lens?

A 2.0 cm

B 3.0 cm

C 4.0 cm

D 6.0 cm

24 Which shows correct applications for X-rays, ultraviolet light and microwaves?

	X-rays	ultraviolet light	microwaves
A	mobile phone	fluorescent tube	intruder alarm
B	killing cancerous cells	sunbed	satellite television
C	medical imaging	television controller	sunbed
D	sterilising surgical instruments	television controller	detecting cracks in metal

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25 An earthquake wave travels through the solid surface of the Earth from east to west. The solid surface vibrates in a north-south direction.

How can the earthquake wave be described?

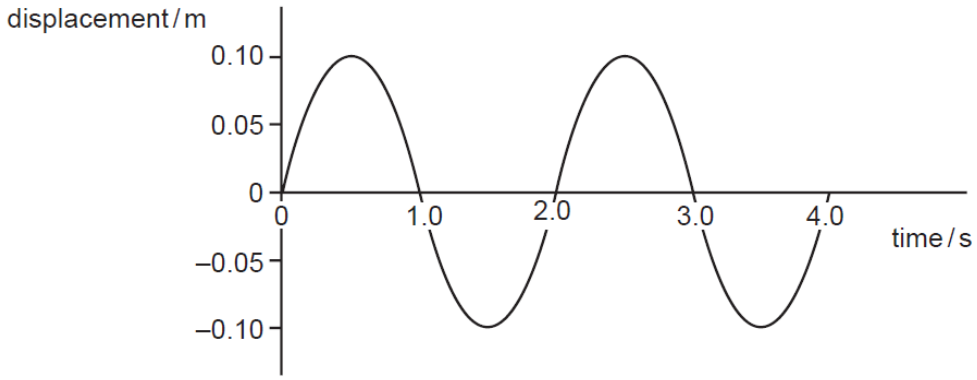
A electromagnetic

B longitudinal

C sound

D transverse

26 The diagram shows how displacement varies with time as a wave passes a fixed point.



What is the frequency of this wave?

A 0.25 Hz

B 0.50 Hz

C 1.0 Hz

D 2.0 Hz

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27 Two sound waves X and Y are compared.

X has the greater frequency.

Y has the greater amplitude.

How do the loudness and pitch of sound wave Y compare to those of X?

A Y is louder and higher pitch.

B Y is louder and lower pitch.

C Y is quieter and higher pitch.

D Y is quieter and lower pitch.

28 A pupil charged a metal ball by induction using a strip of polythene. She uses the following steps but not in the following order.

1 the metal ball is earthed momentarily
2 the polythene strip is brought up to the ball
3 the polythene strip is removed
4 the polythene strip is rubbed with a woolen cloth

To charge the ball correctly, in which order should she carry out the steps?

A 2 → 3 → 4 → 1

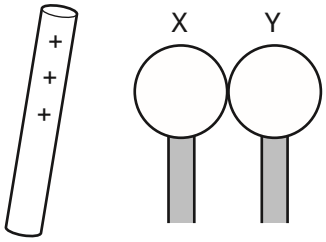
B 2 → 4 → 3 → 1

C 4 → 1 → 2 → 3

D 4 → 2 → 1 → 3

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29 Two insulated and uncharged metal spheres X and Y are touching.
A positively charged rod is held near X and then the spheres are moved apart. X now has a negative charge.



What is the charge on Y?

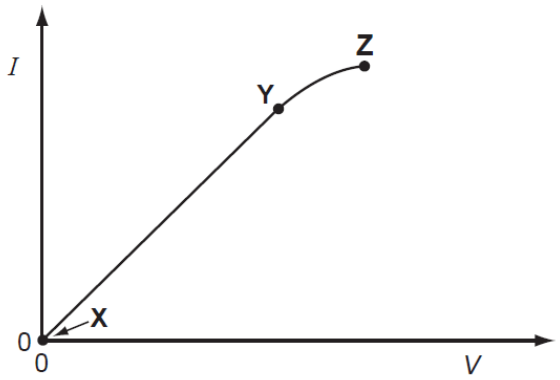
A negative and smaller than that on X

B negative and the same size as that on X

C positive and smaller than that on X

D positive and the same size as that on X

30 A graph of current I against voltage V is plotted for a length of resistance wire.



Which part of the graph is Ohm's law not applicable?

A at Y only

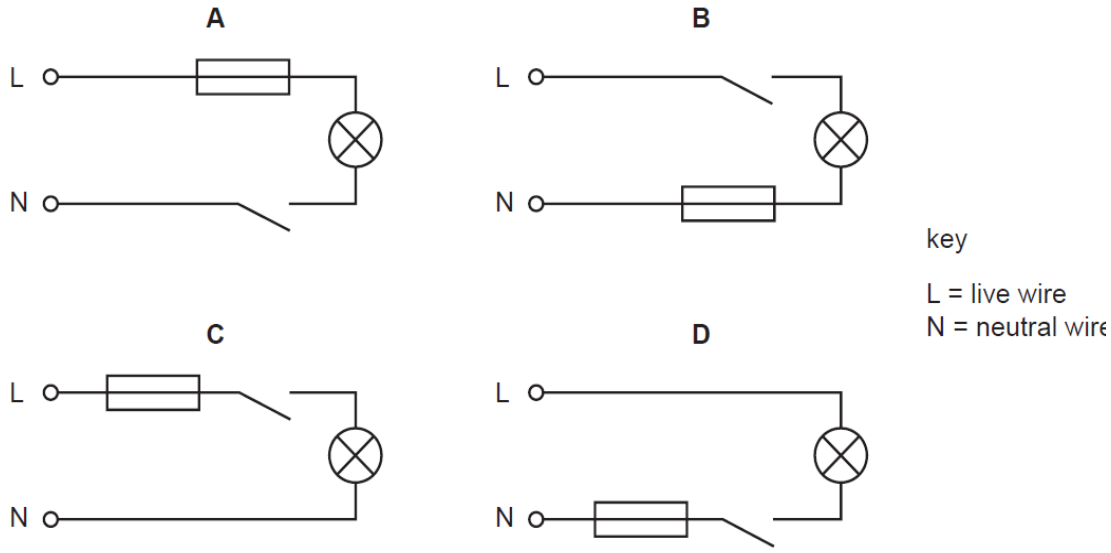
B at Z only

C from Y to Z

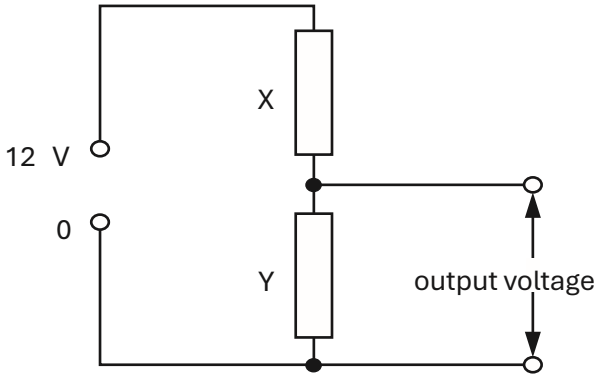
D from X to Y

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31 Which circuit shows the correct positions for the fuse and the switch in the lighting circuit of a house?



32 A potential divider uses a power supply of voltage 12 V.
The resistors X and Y initially have equal resistances.



The resistance of Y is doubled.

What is the change in the output voltage?

A -4.0 V

B -2.0 V

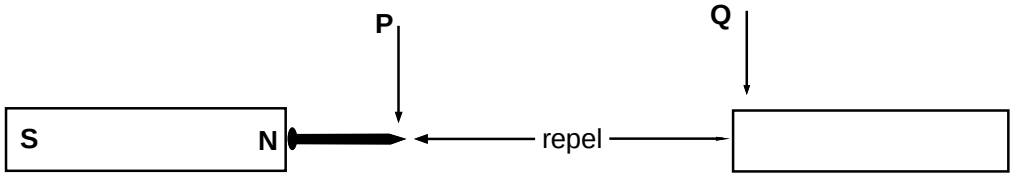
C +2.0 V

D +8.0 V

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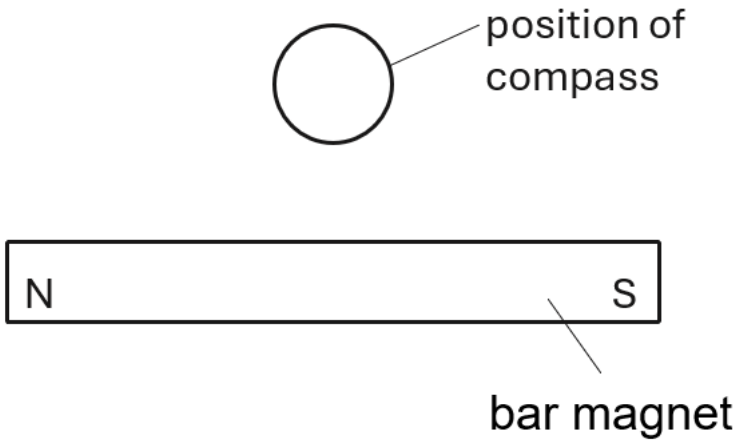
33 A student sets up the experiment below. P and Q repel each other.

Which of the following correctly gives the poles at P and Q?



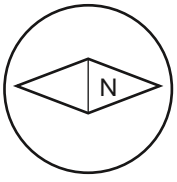
	P	Q
A	north	south
B	north	north
C	south	north
D	south	south

34 A small plotting compass is placed near to a bar magnet as shown.

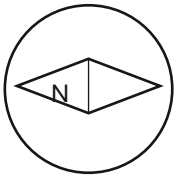


Which diagram shows the direction in which the compass needle points?

A



B



C



D



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35 The diagram shows a beam of electrons entering a magnetic field.



What will be the initial direction of the deflection of the electrons as the beam passes through the field?

A into the page

B out of the page

C towards the bottom of the page

D towards the top of the page

36 What does not alter the size of the turning effect on the coil of an electric motor?

A the direction of the current in the coil

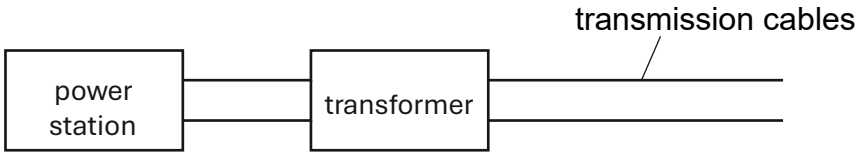
B the number of turns in the coil

C the size of the current in the coil

D the strength of the magnetic field

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37 Transformers are used to transmit electrical energy between power stations and transmission cables, as shown.



What is the purpose of the transformer in the diagram?

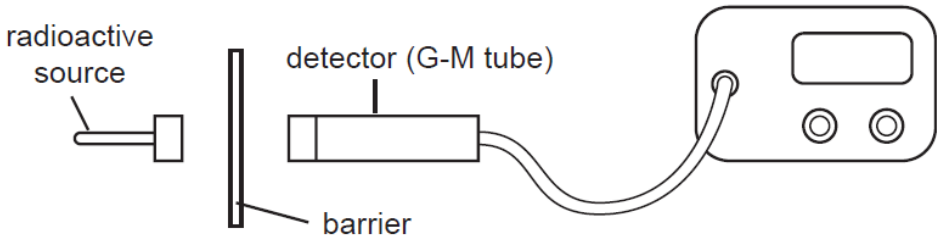
A to decrease the current and potential difference from the power station

B to decrease the current and increase the potential difference from the power station

C to increase the current and the potential difference from the power station

D to increase the current and decrease the potential difference from the power station

38 The diagram shows the apparatus used in an experiment in which barriers of various materials are placed in turn between different radioactive sources and a detector.



The table shows the count rates recorded by the detector for four sources.

Which source emits alpha-particles only?

source	count rate / counts per minute			
	no barrier	paper	thin aluminium	thick lead
A	250	250	250	35
B	250	35	35	35
C	1200	600	250	35
D	1200	1200	35	35

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39 An isotope P is radioactive and has a half-life of 7.0 years.
A sample initially contains 0.016 kg of P.

After how long will the sample contain 0.0020 kg of P?

A 7.0 years

B 14 years

C 21 years

D 28 years

40 Which row shows the atomic structure of a neutral atom with a nucleon number of 9?

	number of neutrons	number of protons	number of electrons
A	4	5	4
B	4	5	5
C	5	4	5
D	5	5	4

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Section A

Answer **all** the questions.

1 A hovercraft moves on a cushion of air which is trapped underneath it.

The trapped air reduces friction.

(a) The hovercraft starts from rest and, as it starts, the propeller produces a forward force *F* of 28 000 N. The mass of the hovercraft is 25 000 kg.

Calculate the initial acceleration of the hovercraft. You may assume there is no friction.

acceleration = ... [2]

(b) Some time later, the hovercraft reaches a steady velocty, even though the force *F* is unchanged.

Explain, in terms of forces acting on the hovercraft why the velocity is now constant.

.....

.....

..... [2]

[Total: 4]

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2 There is no atmosphere on the Moon.

An astronaut on the Moon drops a feather and a hammer from the same height at the same time. They both accelerate downwards at 1.6 m/s^2 and hit the ground at the same time.

(a) The weight of the hammer is much larger than that of the feather.

Explain why their accelerations are equal.

.....

.....

.....

.....

.....

..... [3]

(b) The feather takes 1.5 s to fall to the ground from rest.

(i) Calculate the velocity of the feather as it hits the ground.

velocity = ... [2]

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(ii) On Fig. 2.1, draw the velocity-time graph of the feather.

Mark on the vertical axis, the velocity of the feather at time t = 1.5 s.

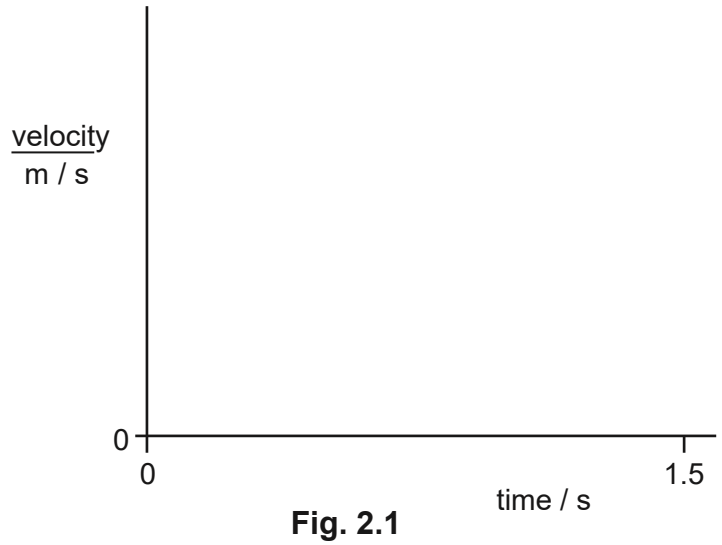


Fig. 2.1

[1]

(iii) Using the velocity-time graph in **(b)(ii)**, determine the height from which the objects are dropped.

height = ... [2]

[Total: 8]

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3 Fig. 3.1 shows a chair resting on a smooth ground. A horizontal force *F* keeps the chair balanced.

C is the centre of gravity of the chair and the weight of the chair is 70 N.

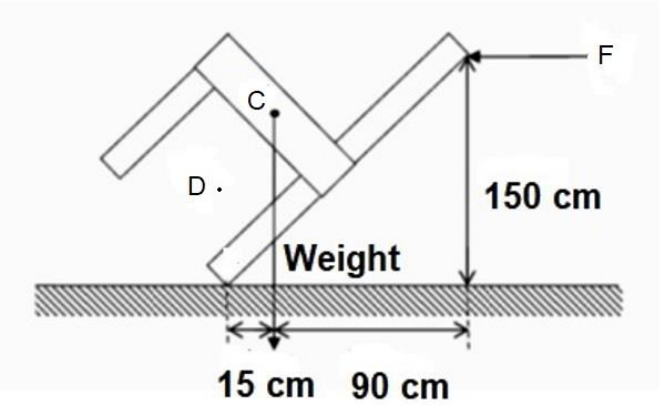


Fig. 3.1

(a) State the principle of moments.

.....

.....

..... [2]

(b) Calculate the force *F* applied to keep the chair balanced.

force *F* = ... [2]

(c) Small metal discs were added to the bottom of the legs of the chairs, causing the position of the centre of gravity of the chair to shift from C to D.

Explain why force *F* is no longer required to prevent the chair from toppling if the position of the centre of gravity shifts from C to D.

.....

.....

..... [2]

[Total: 6]

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4 Fig. 4.1 shows a container of gas connected to a manometer.

The tube in the manometer has a constant cross-sectional area.

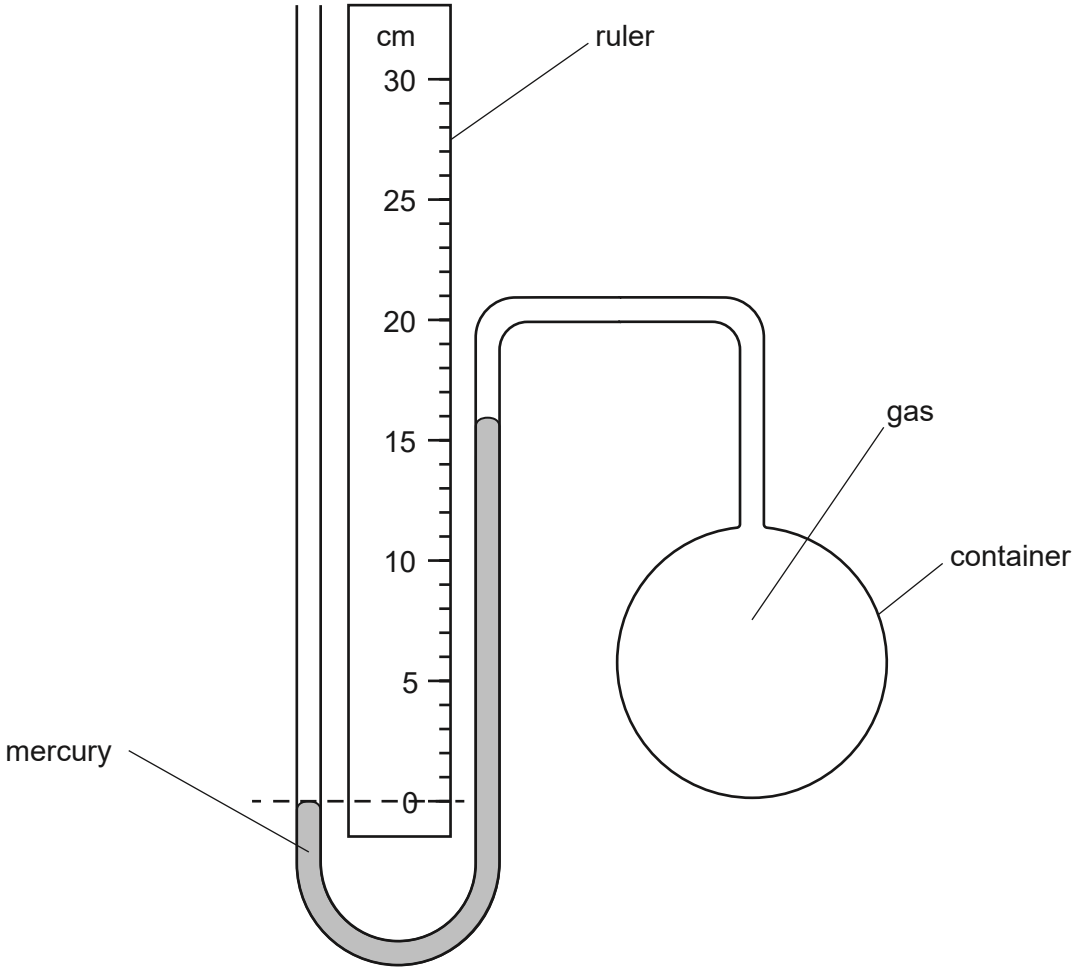


Fig. 4.1

(a) Define the term *pressure*.

.....

.....

..... [1]

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(b) The density of mercury is 1.4×10^4 kg / m^3. The gravitational field strength g is 10 N/kg.

The pressure of the atmosphere is 1.0×10^5 Pa.

Calculate the pressure in Pa of the gas in the container.

pressure = ... [3]

(c) In Fig. 4.1, the mercury level on the left-hand side of the manometer is lower than on the right hand side.

The gas inside the container is heated. This causes the mercury levels on both sides to become the same.

(i) Mark on the ruler in Fig. 4.1 with a cross (x) when this happens.

..... [1]

(ii) Explain, in terms of the gas molecules, what causes the level of mercury to become the same.

.....

.....

.....

..... [3]

[Total: 8]

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5 Fig. 5.1 shows a square block of glass JKLM with a ray of light incident on side JK at an angle of incidence of 60º. The refractive index of glass is 1.5.

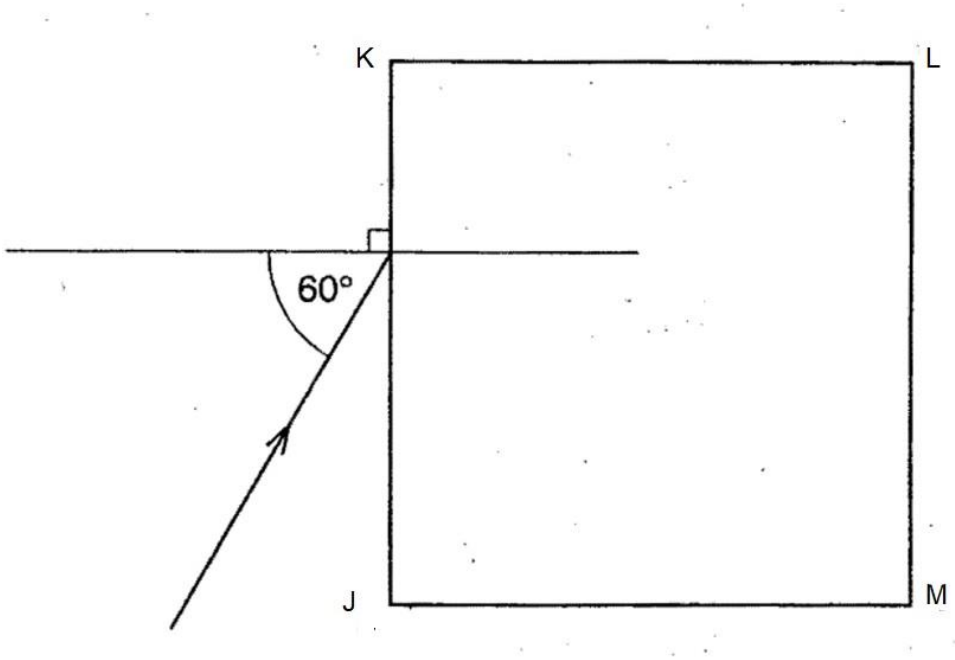


Fig. 5.1

(a) Calculate the angle of refraction of the ray.

angle of refraction = ... [2]

(b) Calculate the critical angle for a ray of light in this glass.

critical angle = ... [2]

(c) Explain why the ray shown in Fig. 5.1 cannot emerge from side KL but will emerge from side LM.

.....

.....

..... [2]

[Total: 6]

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6 Brownian motion is the motion of tiny particles suspended in a liquid or gas. It can be seen when smoke in a sealed container is observed by using a microscope.

(a) Explain what causes Brownian motion.

.....

.....

.....

..... [2]

(b) Suggest why Brownian motion is not observed for very large particles.

.....

.....

.....

..... [2]

(c) Convection currents do not cause Brownian motion. Explain what is observed when the smoke particles are in a convection current.

.....

..... [1]

[Total: 5]

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7 Two lamps, P and Q, are connected to a 6.0 V battery and an ammeter as shown in Fig. 7.1.

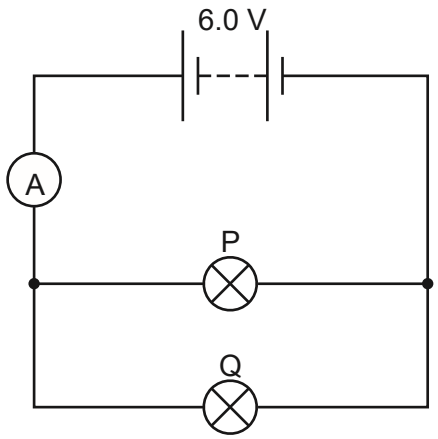


Fig. 7.1

Lamp P has a resistance of 15 Ω. The ammeter reading is 0.65 A.

(a) Calculate the current in lamp P.

current = ... [2]

(b) Calculate the resistance of lamp Q.

resistance = ... [2]

(c) The two lamps are now connected in series to the ammeter and the same battery.

Explain why the resistance of Q is smaller when connected in series.

.....

..... [1]

[Total: 5]

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8 Fig. 8.1 shows the fuse inside the plug of a hairdryer.

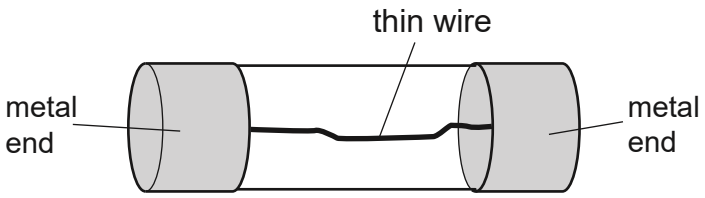


Fig. 8.1

(a) State how the fuse protects the wires in the hairdryer.

.....

..... [1]

(b) The hairdryer is rated at 240 V, 1500 W. It is switched on.

(i) Calculate the current in the hairdryer.

current = ... [1]

(ii) Suggest a suitable current rating for the fuse.

current rating = ... [1]

[Total: 3]

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9 A piece of plastic is held in the hand and rubbed with a cloth. Both the plastic and the cloth become charged.

(a) Describe how the plastic becomes negatively-charged and the cloth becomes positively-charged.

.....

.....

..... [2]

(b) Suggest why a piece of metal held in the hand does not become charged when it is rubbed with the cloth.

.....

..... [1]

(c) An average lightning strike transfers a charge of 4.0 C and releases as much energy as a 100 W lamp switched on for 5.0×10^6 s.

Calculate the average electromotive force (e.m.f.) of a lightning strike.

e.m.f = …….. [2]

[Total: 5]

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10 Fig. 10.1 shows a motor lifting a mass.
Fig. 10.2 shows part of the circuit diagram of the connections to the motor.

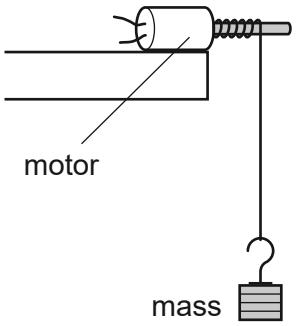


Fig. 10.1

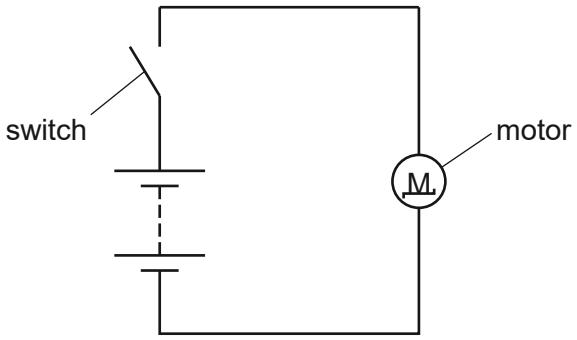


Fig. 10.2

(a) The current in the motor is 1.5 A and the voltage supplied by the battery is 8.0 V.

(i) Complete the circuit diagram in Fig. 10.2 to show an ammeter and a voltmeter in the correct positions to take these measurements while the motor is working. [2]

(ii) The motor takes 4.0 s to lift the mass.

Calculate the energy transferred to the motor in this time.

energy = ... [2]

(iii) The motor lifts the 150 g mass through a height of 80 cm in the 4.0 s.

Calculate the increase in energy in the gravitational potential store of the mass.

The gravitational field strength g = 10 N/kg.

energy in the gravitational potential store = ... [2]

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(b) Fig. 10.3 shows the structure of the motor in Fig. 10.2

When the mass reaches the top of its motion, the switch is opened.
This disconnects the battery and causes the mass to fall. The coil turns as the mass falls.

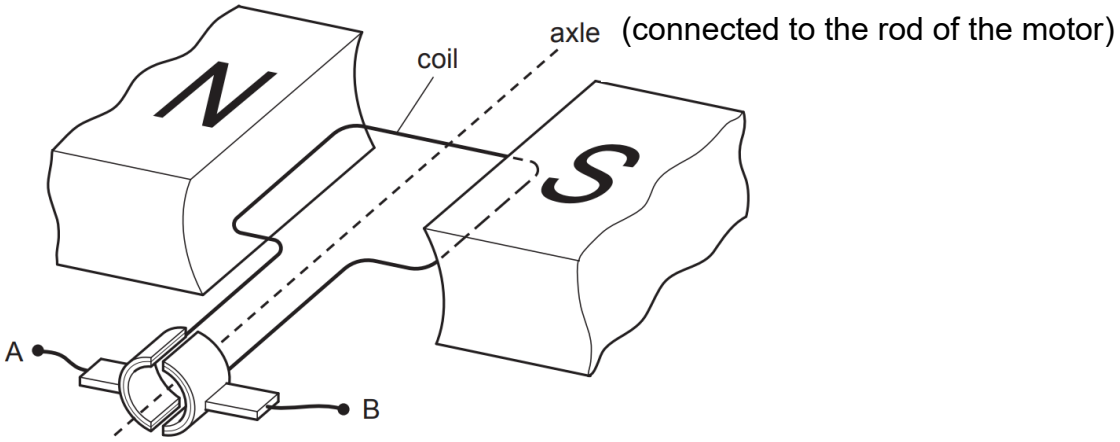


Fig. 10.3

As the coil turns, a small voltage is produced.

(i) Explain why a voltage is produced as the coil turns.

.....

.....

..... [2]

(ii) As the mass falls, a student connects a wire between the points A and B shown in Fig. 10.3.

He notices that the mass takes a longer time to fall when the wire is connected.

Suggest why the mass takes longer to fall.

.....

.....

.....

.....

.....[2]

[Total :10]

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11 Fig. 11.1 shows two types of filament lamps, one with its filament wire coiled and the other with its filament wire uncoiled.

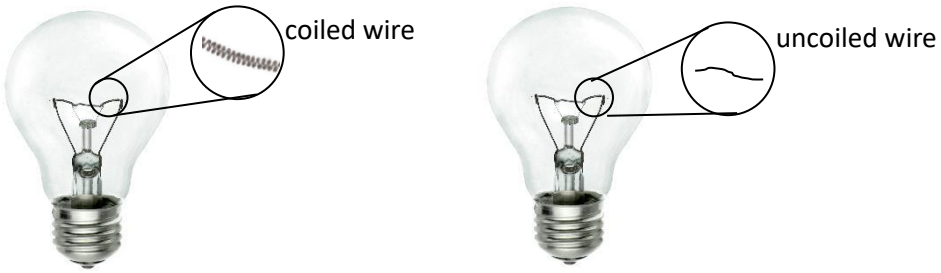


Fig. 11.1

Table 11.2 below summarises the design and characteristics of four filament lamps A, B, C, D.

Table 11.2

lamp	characteristics of filament wire					
	material	coiled or uncoiled	cross-sectional area / m^2	specific heat capacity / J/(kg^{o}C)	resistance per unit length Ω/m	temperature reached at maximum brightness / ^{o}C
A	tungsten	coiled	3.1×10^{-6}	133	1.8×10^{-2}	3420
B		uncoiled				
C	copper	coiled	6.2×10^{-6}	378	2.8×10^{-3}	1085
D		uncoiled				

(a) State and explain, using the values in Table 11.2, which of the lamps will give off the brightest light.

……

……

……

……

……[3]

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(b) Explain, using energy stores and transfers, how the principle of conservation of energy applies to the lamp transferring its energy to the surroundings.

……

……

……

……

……[3]

(c) A filament lamp has a power rating of 0.050 kW and is connected to a 240 V power supply. It reaches its maximum brightness in 0.18 s.

Assuming no transfer of energy to the surroundings and that the room temperature is 30^{o}C,

(i) calculate the total thermal energy produced by the lamp in 0.18 s, and

total thermal energy = ……[2]

(ii) using your answer in **c(i)**, determine the minimum mass of the filament wire when copper is used.

mass = ……[2]

[Total: 10]

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Section B

Answer **one** question from this section.

12(a) Fig. 12.1 shows a simple relay used to switch a mains electric motor on and off.

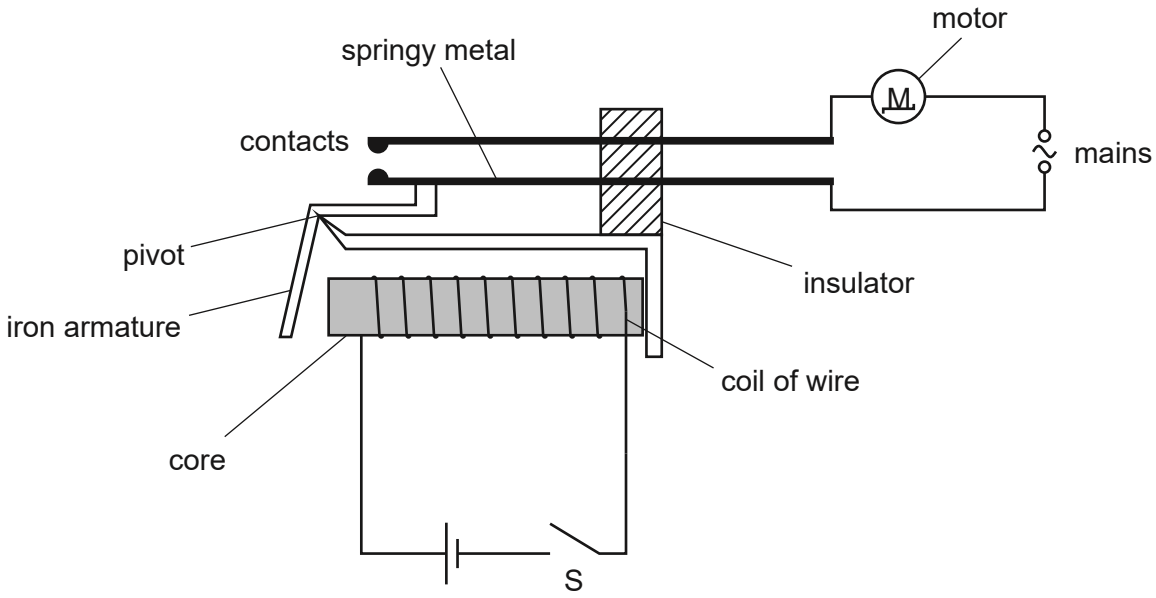


Fig. 12.1

(i) Explain why the motor switches on when switch S is closed.

.....

.....

.....

.....[3]

(ii) Explain why the core is made of iron rather than steel.

.....

.....

..... [2]

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(b) Fig. 12.2 shows the coil of wire wrapped around a cardboard tube with no core.

There is an electric current in the wire in the direction shown by the arrows.

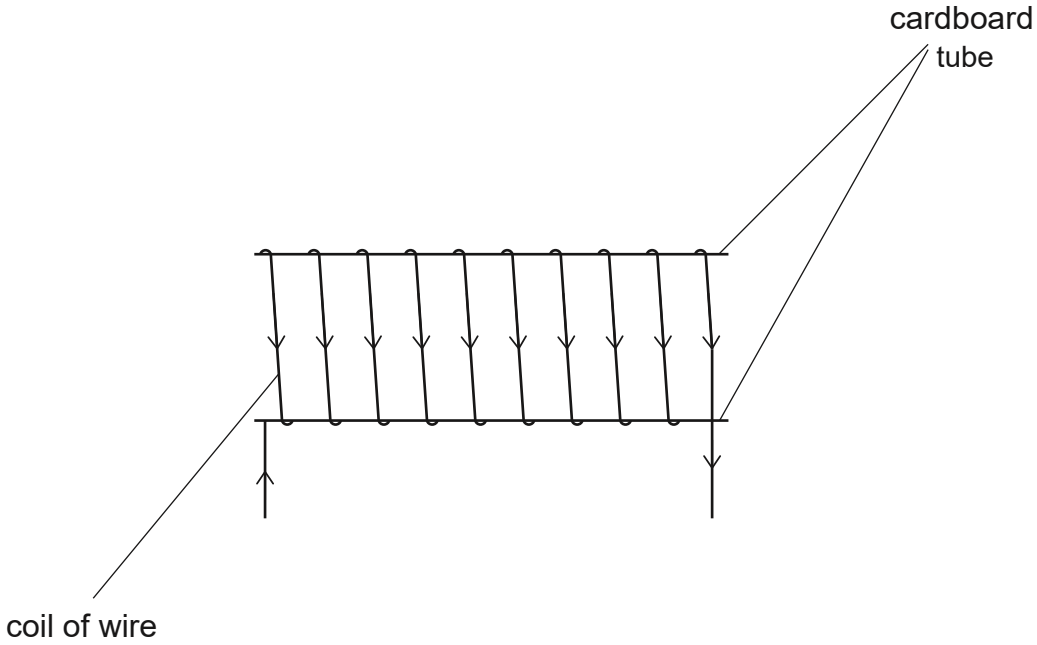


Fig. 12.2

On Fig. 12.2, mark the N-pole of the coil. [1]

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(c) The supply of current to the coil is removed.

The coil is also removed and reused to make a transformer with an alternating current supply of 3.0 V as shown in Fig. 12.3

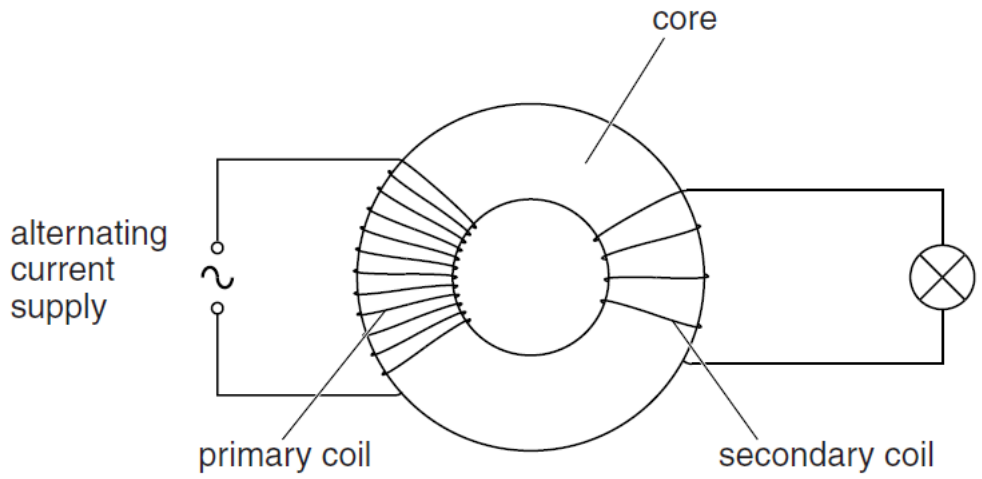


Fig. 12.3

(i) Explain how the alternating current in the primary coil causes the lamp to light.

……

……

……[2]

(ii) The transformer has 1200 turns on the primary coil and 400 turns on the secondary coil.

Assume that the transformer is ideal and does not have any power loss.

Given that the current in the primary coil is 0.25 A, calculate the current in the lamp.

.

current = …….. [2]

[Total: 10]

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13 Ultrasound and X-rays are both used in medical imaging.

(a) (i) Define *ultrasound*.

.....

..... [1]

(ii) Describe what happens to ultrasound waves as they travel across two different materials.

.....

..... [1]

(iii) To produce the image of an unborn child, an ultrasound emitter and receiver are placed close to each other on the mother's skin.

Fig. 13.1 shows pulses detected by the receiver.

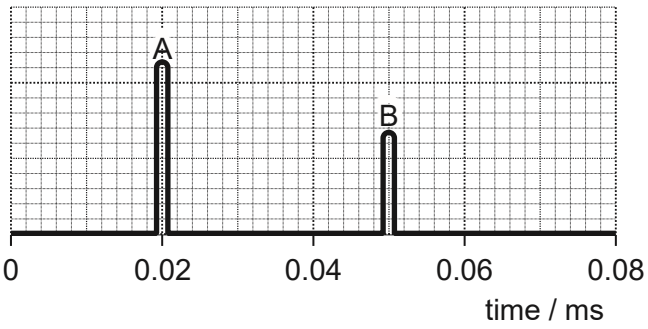


Fig. 13.1

Pulse A is the emitted pulse and pulse B is the first pulse that returns from the unborn child.

The average speed of ultrasound in human tissue is 1500 m/s.

Calculate the distance between the emitter and the child.

distance = ……..[3]

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(ii) Describe how ultrasound is transmitted from the emitter to the human tissue.

.....

.....

..... [2]

(b) Fig. 13.2 shows an X-ray image of a hand. An X-ray detector is placed just below the hand. An image of the bones and human tissue around the bones is formed on a screen by the detector.

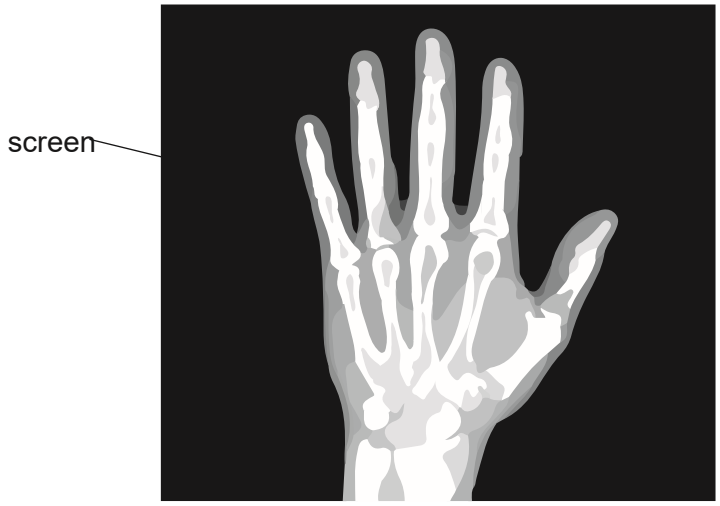


Fig. 13.2

(i) State a characteristic of X-ray.

.....[1]

(ii) The wavelength of the X-rays used is 2.0×10^{-9} m.

The speed of electromagnetic waves is 3.0×10^{8} m/s.

Calculate the frequency of the X-rays.

frequency = ... [2]

[Total: 10]

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Marking scheme for 2024 Physics Prelim

Paper 1

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

Paper 2

Section A

Qn	Mark Scheme	Marks	Sub-total
[-1] *per section* for any errors in sig. fig. or unit.			
1(a)	a = F/m OR 28000 / 25000 1.1 m/s^2	B1 A1	[2]
(b)	The forward force is equal to the air resistance / opposing forces acting in the opposite direction. Resultant force is zero, hence acceleration is zero.	B1 B1	[2]
2(a)	mass and weight of hammer is larger than feather weight equals resultant force which is the product of mass and acceleration (F_R = ma, W = ma) acceleration is equal since F_{hammer} / m_{hammer} = $F_{feather}$ / $m_{feather}$	B1 B1 A1	[3]
2(b)(i)	v = u + at OR 1.6 x 1.5 2.4 m/s	B1 B1	[2]
2(b)(i)	Straight line from origin with positive gradient with v = 2.4 m/s at t = 1.5s indicated	B1	[1]

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Qn	Mark Scheme	Marks	Sub-total
2(b)(iii)	½ x 1.5 x 2.4 OR distance travelled = area under the graph 1.8 m	C1 A1	[2]
3(a)	The principle of moments states that the sum of clockwise moments about a pivot is equal to the sum of anticlockwise moments **about the same pivot** When object is in equilibrium	B1 B1	[2]
3(b)	The body is in equilibrium, Taking moments about point P, Anti clockwise moment = Clockwise moment *F* X 150 = 70 X 15 *F* = 7.0 N	 B1 A1	[2]
3(c)	Weight of chair acting from centre of gravity passes through pivot No resultant moment produced OR line of action of weight acting slightly to the left of pivot, producing anticlockwise restoring moment	C1 A1	[2]
4(a)	Pressure is the force acting per unit area	A1	[1]
4(b)	$P_{gas} + P_{mercury} = P_{atm}$ $P_{mercury} = h\rho g$ OR $0.16 \times 1.4 \times 10^4 \times 10$ $1.0 \times 10^5 - (0.16 \times 1.4 \times 10^4 \times 10)$ = 77600 =78000 Pa	B1 B1 A1	[3]
4(c)(i)	8.0cm	A1	[1]
4(c)(ii)	Gas molecules move faster and gain kinetic energy as the gas is heated Gas molecules collide against the mercury surface more frequently with greater force, increasing pressure exerted on the right column of mercury Mercury column on right falls and mercury column on left rises until gas pressure is equal to atmospheric pressure, i.e. equilibrium	B1 C1 A1	[3]
5(a)	sin i / sin r = 1.5 OR sin 60 / sin r = 1.5 35º	M1 A1	[2]
5(b)	n = 1/sin c	M1	

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Qn	Mark Scheme	Marks	Sub-total
	critical angle = 41.8 = 42º	A1	[2]
5(c)	The angle of incidence of the light ray at KL is more than the critical angle and undergoes total internal reflection. The angle of incidence of the light at LM is less than the critical angle and undergoes refraction, bending away from the normal.	B1 B1	[2]
6(a)	Brownian motion is due to the random continuous motion of invisible air molecules moving a high speed colliding against the illuminated smoke particles	B1 B1	[2]
6(b)	Large particles have greater inertia More difficult to move the larger particles as the force exerted by invisible air molecules is not large enough	B1 B1	[2]
6(c)	The smoke particles rise in a zig zag motion as the surrounding air is heated and becomes less dense, and sinks in a zig zag motion when the surrounding air is cooler and denser.	B1	[1]
7(a)	I = V/R OR 6.0/15 0.40 A	B1 A1	[2]
7(b)	Current in B = 0.25A R = 6 / 0.25 24Ω	B1 A1	[2]
7(c)	As the lamps are non-ohmic, lamp Q has a smaller potential difference across it when connected in series, hence smaller resistance.	B1	[1]
8(a)	The fuse melts and breaks the circuit when current exceeds the fuse rating.	B1	[1]
8(b)(i)	I = P/V =1500/240 6.3A	 A1	[1]
8(c)(ii)	7.0A	A1	[1]
9(a)	Electrons are transferred from the cloth to the plastic due to charging by friction. Cloth loses electrons to become positively charged, plastic gains electrons to become negatively charged.	B1 B1	[1] [1]
9(b)	Metals have free electrons and can move within the metal easily OR good conductor of electricity	B1	[1]
9(c)	$E = Pt = 100 \times 5.0 \times 10^6 = 5.0\ 5.0 \times 10^8$ J e.m.f. = $E/Q = (5.0 \times 10^8 / 4.0) = 1.3 \times 10^8$ V	B1 B1	[1] [1]

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Qn	Mark Scheme	Marks	Sub-total
10(a)(i)	Ammeter connected in series Voltmeter connected in parallel	B1 B1	[2]
10(a)(ii)	E = IVt OR 6.0 x 2.0 x 5.0 60J	B1 A1	[2]
	E = mgh = 0.10 x 10 x 0.80 0.8 J	B1 A1	[2]
10(b)(i)	Change in magnetic flux linking the coil Induced emf / voltage according to Faraday's Law	B1 B1	[2]
10(b)(ii)	The induced current flows in a direction to produce an opposing magnetic field and a force in the opposite direction of motion thereby creating an opposing moment and causing the coil to turn slower as the mass falls.	B1 B1	[2]
11(a)	● Lamp A ● For same length, tungsten wire has a higher resistance per unit length of 1.8×10^{-2} Ω/m compared to that of Copper (2.8×10^{-3} Ω/m) ● A is coiled and is longer and has smaller cross-sectional area of 3.1×10^{-6} m^2 , hence largest resistance	C1 B1 B1	[3]
11(b)	Principle of conservation of energy states that energy cannot be created or destroyed but only transferred from one store to another. All the energy from the internal (thermal) store of the filament is transferred by propagation of waves in the form of light AND by heating to the internal (thermal) store of the surrounding air molecules.	B1 B1 B1	[3]
11(c)(i)	E = P t = 50 W x 0.18 s = 9.0 J	 M1 A1	[2]
11(c)(ii)	Energy supplied to filament = energy gain by filament (Copper) $9.0 = m\ c_r \Delta\theta$ $9.0 = m\ (378)\ (1085 - 30)$ $m = 2.3 \times 10^{-5}$ kg	 M1 A1	[2]

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Section B

Qn	Mark Scheme	Marks	Sub-total
[-1] *per section* for any errors in sig. fig. or unit.			
12(a)(i)	Current flows through the solenoid and it becomes magnetized. Solenoid attracts the iron armature by magnetic induction. Contacts touch, forming a closed circuit for current to flow through motor.	B1 B1 B1	[3]
(a)(ii)	Iron can be magnetized and demagnetised easily, making it suitable for an electromagnet. Steel is difficult to magnetize and demagnetize. (iron can be magnetized and demagnetized more easily than steel)	B1 B1	[2]
(b)	N-pole marked on right side	A1	[1]
(c)(i)	The alternating current in the primary coil produces a changing magnetic field The changing magnetic field causes a change in the number of magnetic field lines going through the secondary coil to change with time continuously and an induced emf in the secondary coil. The induced current lights up the bulb.	B1 B1	[2]
(c)(ii)	Ns / Np = Vs / Vp = Ip / Is 4/12 = 3/9 = 0.25 / Is 0.75A	M1 A1	[2]

13(a)(i)	Sound waves with a frequency of higher than audible range (more than 20 kHz)	B1	[1]
13(a)(ii)	Some of the sound waves are reflected at the boundary. (some pass through or are absorbed)	B1	[1]
13(a)(iii)	t = 0.03/1000 s s = 2d/t OR 1500 = 2d / (0.03 /1000) d = 0.023 m	B1 B1 A1	[3]

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13(a)(iv)	Sound is transmitted from the emitter as a longitudinal wave in which the surrounding air molecules and the human tissuevibrate in a series of compressions and rarefactions	B1 B1	[2]
13(b)(i)	Transverse wave / travel at 3.0 x 10^8 m/s in a vacuum / more penetrating / ionising	B1	[1]
13(b)(ii)	**v = f** λ OR $3.0 \times 10^8 = f \times 2.0 \times 10^{-9}$ f = 1.5 x 10^{17}Hz	B1 A1	[2]

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