Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 EXPRESS
PRELIMINARY EXAMINATION 2024

PHYSICS 6091/01

Paper 1 Multiple Choice **27 August 2024**

Tuesday 0800 – 0900 **1 hour**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid or tape.

There are **forty** questions in this section. 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.

The use of an approved scientific calculator is expected, where appropriate.

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.

Setter : Mdm Siti Mariam **[Turn over**

1 A student measures, as accurately as possible, the length and internal diameter of a straight glass tube.

The length of the glass tube is approximately 25 cm and the internal diameter is approximately 2 cm.

What is the best combination of instruments for the student to use?

	internal diameter	length
A	digital calipers	digital micrometer screw gauge
B	digital calipers	ruler
C	ruler	digital micrometer screw gauge
D	ruler	ruler

2 Each row contains a vector and a scalar.

In which row is the size of the vector always equal to the size of the scalar?

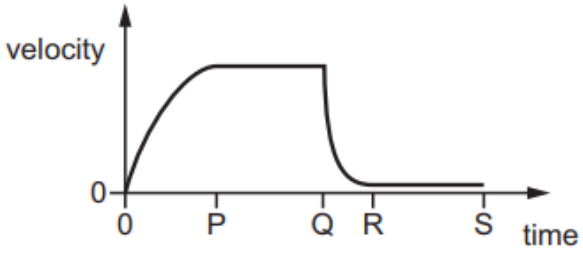
	vector	scalar
A	displacement of a car	distance travelled by the car
B	speed of a car	velocity of the car
C	velocity of a car	speed of the car
D	weight of a car	mass of the car

3 The diagram shows two forces, P and Q, drawn to scale.

Which diagram represents the resultant of forces P and Q?

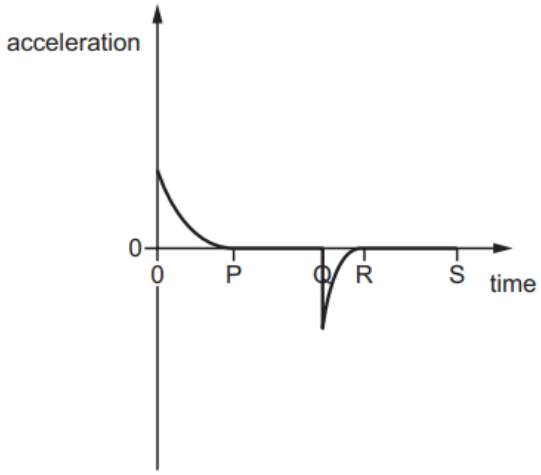
A **B** **C** **D**

4 A parachutist falls from a stationary balloon at time $t = 0$ s. The velocity-time graph for the parachutist from time $t = 0$ s until the time when he is just above the ground is shown.

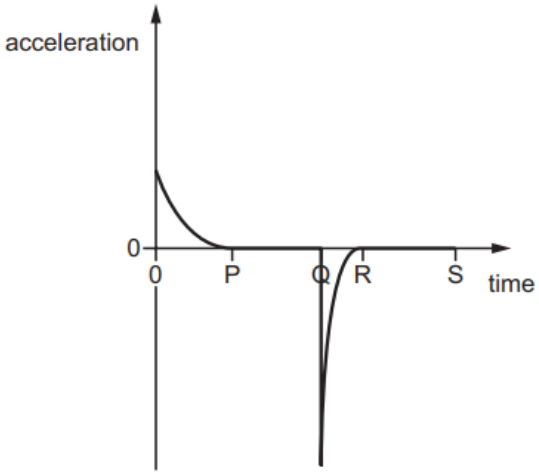


Which graph best shows the variation with time of the acceleration of the parachutist?

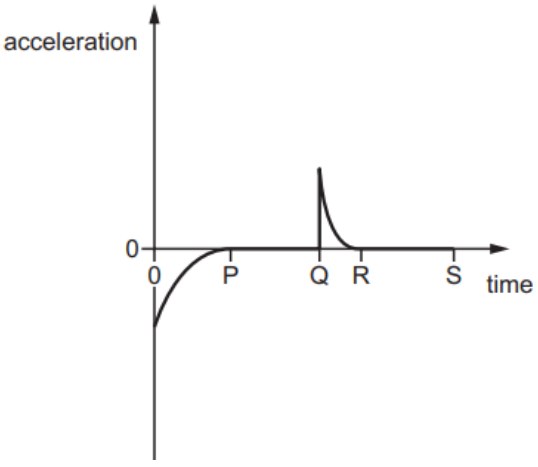
A



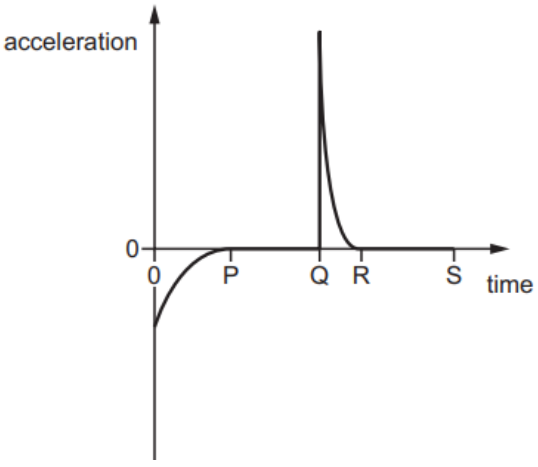
B



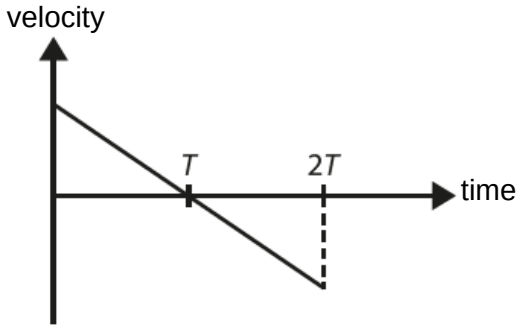
C



D



5 The velocity-time graph of an object being thrown up vertically into the air is shown.



Which information about the motion of the object is **incorrect**?

A The acceleration of the object at time *T* is zero.
B The displacement of the object at time 2*T* is zero.
C The object is momentarily at rest at time *T*.
D The only force acting on the object during its motion is gravitational force.

6 The gravitational field strength on Earth is 9.8 N/ kg.
The gravitational field strength on Mars is 3.7 N/ kg.

The difference between the weight of an object on Earth and the weight of the same object on Mars is 25 N.

What is the mass of the object?

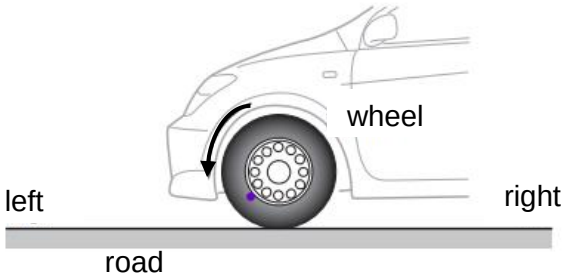
A 1.9 kg **B** 2.6 kg **C** 4.1 kg **D** 6.8 kg

7 A stone has a mass of 390 g and a density of 2.7 g/cm^3.
Cooking oil has a density of 0.90 g/cm^3.

Which mass of cooking oil has the same volume as the stone?

A 130 g **B** 160 g **C** 900 g **D** 1200 g

8 The front wheel of a car is turned in a anticlockwise direction by the engine as the car accelerates towards the left, as shown in the diagram. There is a force of friction between the wheel and the road.



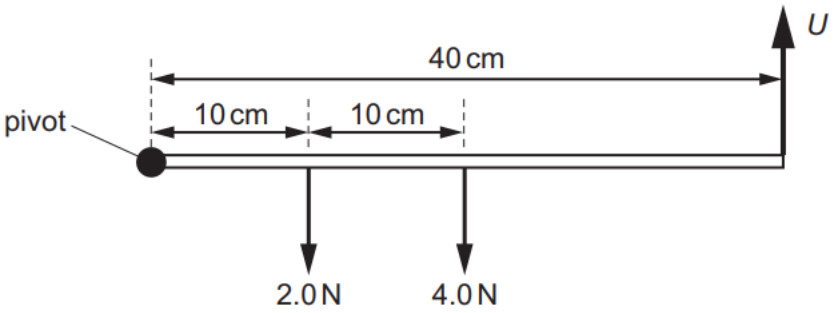
What are the directions of the frictional forces on the wheel of the car and on the road?

	direction of frictional force on wheel	direction of frictional force on road
A	to the left	to the left
B	to the left	to the right
C	to the right	to the left
D	to the right	to the right

9 A car of mass 1500 kg is towing a trailer of mass 1100 kg along a level road. The acceleration of the car is 1.30 m/s^2. Ignoring friction and air resistance, what is the driving force on the car?

A 520 N **B** 1430 N **C** 1950 N **D** 3380 N

10 A beam of length 40 cm is pivoted at one end. The weight of the beam is 4.0 N and acts at a point 20 cm from the pivot. A 2.0 N weight hangs 10 cm from the pivot.



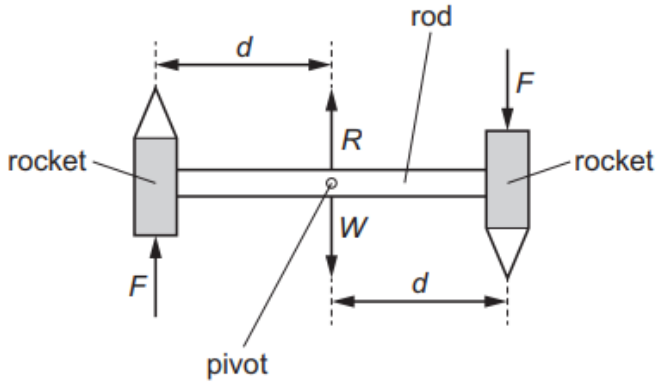
An upward force *U* is needed to keep the beam horizontal.

What is the size of *U*?

A 0.5 N **B** 1.5 N **C** 2.5 N **D** 6.0 N

11 A type of firework is made by connecting two rockets, facing in opposite directions, to a rod, as shown. The rod is attached to a frictionless pivot so that the firework can rotate in a vertical plane.

The firework has weight *W*. The pivot exerts a force *R* on the rod that is equal and opposite to *W*.

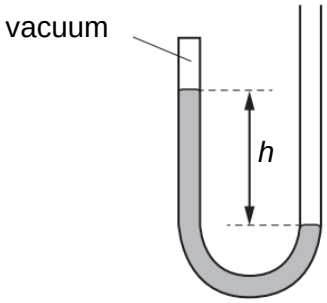


Each rocket exerts a force of magnitude *F* on the rod at a perpendicular distance *d* from the pivot. The forces exerted by the rockets are always in opposite directions. Air resistance is negligible.

Which statement is correct?

A The firework is in equilibrium because the resultant force acting on it is zero.
B The firework is in equilibrium because the resultant moment acting on it is zero.
C The firework is not in equilibrium because the resultant force acting on it is not zero.
D The firework is not in equilibrium because the resultant moment acting on it is not zero.

12 The diagram shows a manometer containing mercury that is sealed at one end.

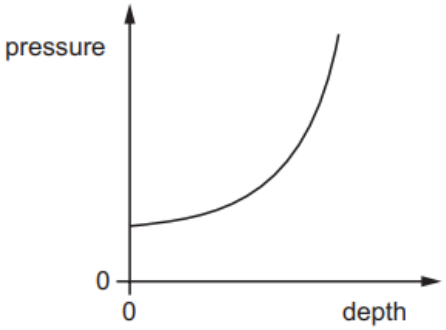


What happens to the height *h* when the manometer is taken to the top of a mountain?

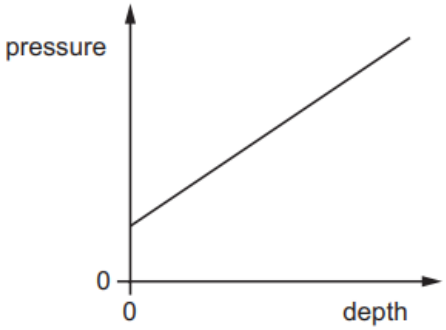
A It decreases, because atmospheric pressure decreases.
B It decreases, because atmospheric pressure increases.
C It increases, because atmospheric pressure decreases.
D It increases, because atmospheric pressure increases.

13 Which graph shows the total external pressure acting on a submarine at different depths below the surface of the sea?

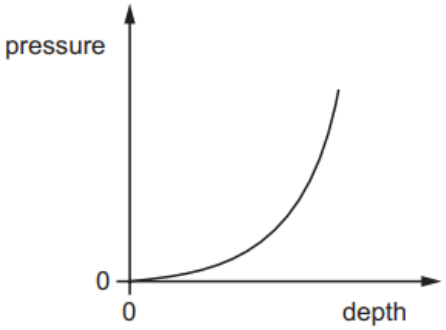
A



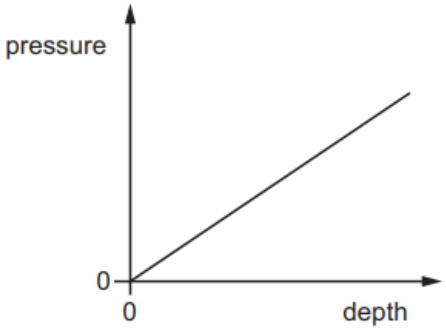
B



C



D

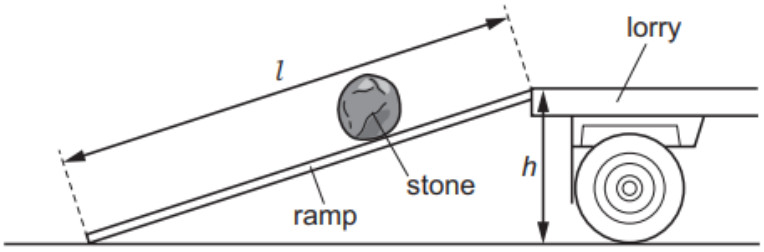


14 A builder holding a brick of mass 3000 g drops the brick on his foot.

What is a reasonable estimate of the change in the gravitational potential store of the brick?

A 30 J **B** 300 J **C** 3000 J **D** 30 000 J

15 A large stone is rolled onto a lorry using a ramp.



The length of the ramp is *l*. The stone is lifted a height of *h*. The mass of the stone is *m*. The weight of the stone is *W*.

Which expression is equal to the **useful** work done on the stone?

A *m* x *h* **B** *W* x *h* **C** *m* x *l* **D** *W* x *l*

16 The diagram shows a burning candle.

Which energy store is associated with the burning candle?

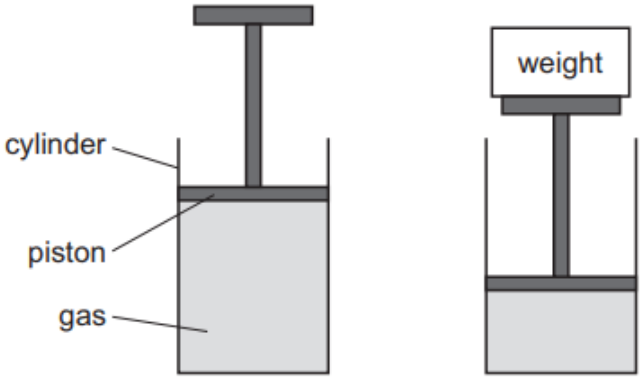
A chemical **B** elastic
C electrostatic **D** nuclear

17 An insulated beaker contains 300 g of water, initially at 30 °C. Water at 100 °C is added until the temperature of the mixture reaches 50 °C. The specific heat capacity of water is 4.2 J/(g°C).

How much water is added?

A 60 g **B** 120 g **C** 180 g **D** 750 g

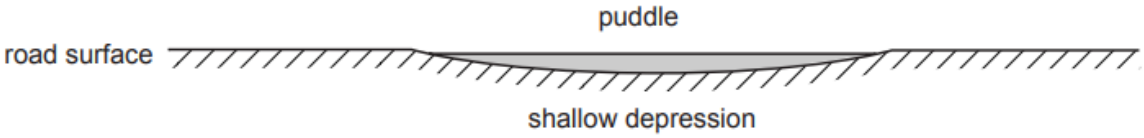
18 A piston is supported by gas trapped in a cylinder. A weight is put on the piston. The volume of gas supporting the piston decreases but the temperature of the gas is unchanged.



What happens to the gas molecules after the weight is put on the piston?

A They decrease in size.
B They have more energy in their kinetic stores.
C They hit the piston more frequently.
D They move more slowly.

19 The diagram shows a cross-section through a rain-water puddle formed in a shallow depression in a road surface.

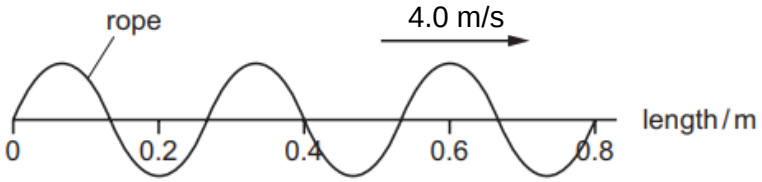


Over a period of time, the air temperature, wind speed and wind direction all remain constant.

What happens to the rate of evaporation of water from the puddle?

A It decreases, because the surface area decreases.
B It increases, because the puddle gets shallower.
C It increases, because the surface area decreases.
D It remains constant.

20 A transverse wave is produced on a rope. The diagram shows the rope at one instant. The wave travels at a speed of 4.0 m/s.

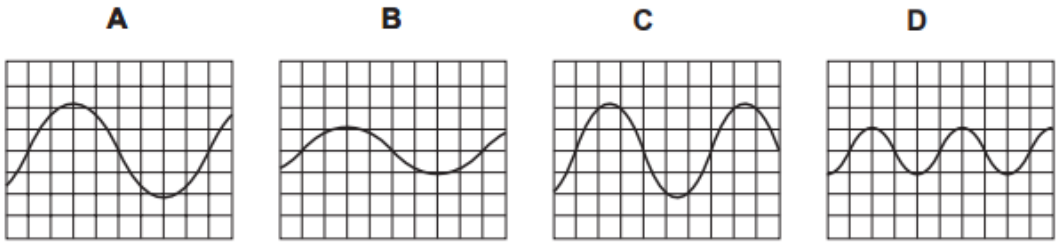


What are the wavelength and the frequency of the wave?

	wavelength / m	frequency / Hz
A	0.13	15
B	0.13	30
C	0.27	15
D	0.27	30

21 The diagrams show oscilloscope traces of sounds picked up by microphones. The oscilloscope controls are set in the same position for all the traces.

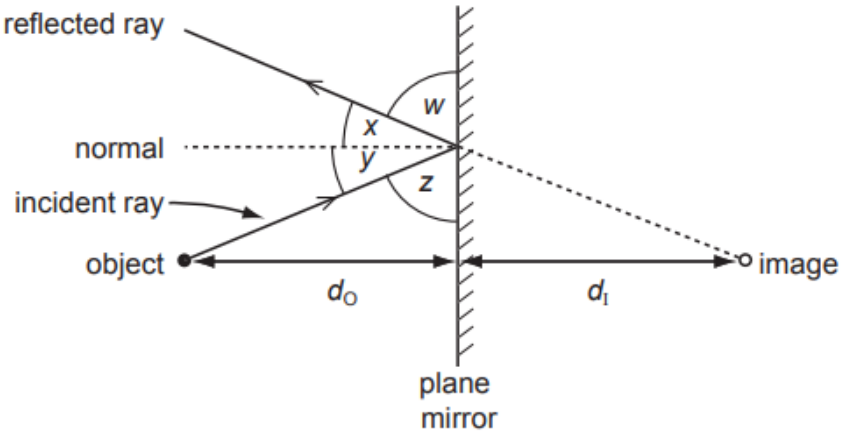
Which trace shows the sound that is both loud and low-pitched?



22 Which statement about electromagnetic waves in a vacuum is correct?

A γ-rays have lower frequencies than X-rays.
B Infrared waves have shorter wavelengths than visible light waves.
C Microwaves have longer wavelengths than radio waves.
D Ultraviolet waves have higher frequencies than visible light waves.

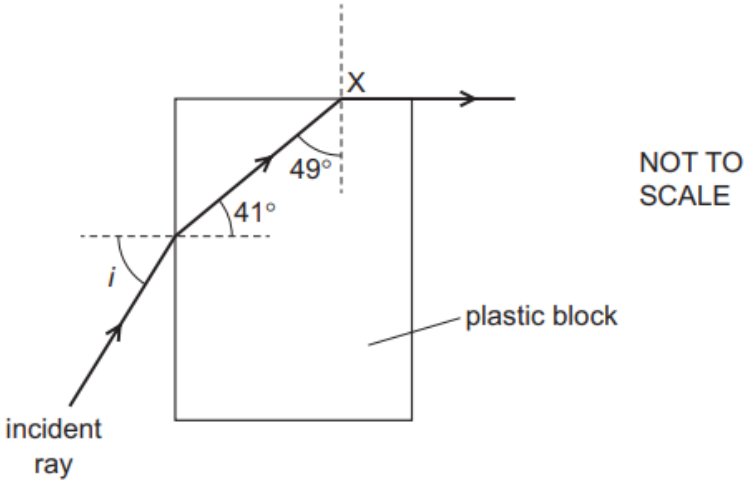
23 An image is formed in a plane mirror.



Which row must be correct?

	angles	distances
A	$w = y$	$d_0 = d_I$
B	$w = z$	d_0 is greater than d_I
C	x = y	$d_0 = d_I$
D	x = z	d_0 is greater than d_I

24 A ray of light is incident on a plastic block in air, at an angle of incidence *i*. The refractive index of the plastic is *n*. The light ray refracts along the plastic-air boundary when it reaches X.



Which is the correct equation to calculate sin *i* ?

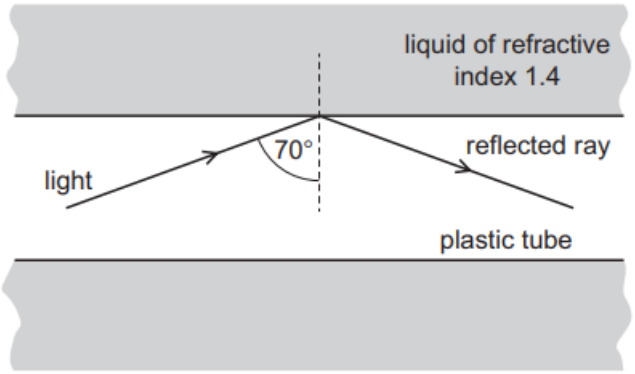
A sin *i* = sin 41°/ *n*

B sin *i* = *n* / sin 49°

C sin *i* = *n* x sin 41°

D sin *i* = *n* x sin 49°

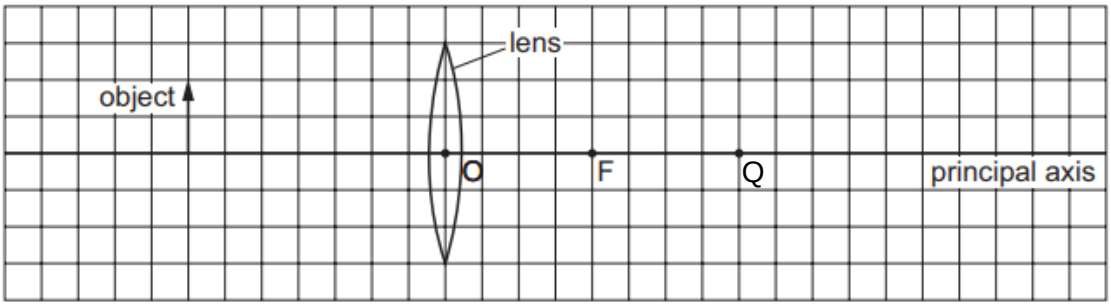
25 A plastic tube is immersed in a liquid of refractive index 1.4. Light travelling in the plastic tube strikes the inside surface at an angle of incidence of 70°. The light undergoes total internal reflection.



What describes the values of the critical angle in the plastic and the refractive index of the plastic?

	critical angle in plastic	refractive index of plastic
A	greater than 70°	greater than 1.4
B	greater than 70°	less than 1.4
C	less than 70°	greater than 1.4
D	less than 70°	less than 1.4

26 The diagram shows an object on the principal axis of a converging (convex) lens. F is the principal focus of the lens.



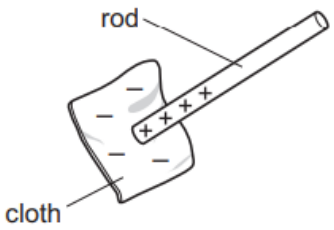
Where is the image formed by the lens?

A at Q
B between F and O
C between F and Q
D to the right of Q

27 In an electrostatics experiment, a plastic rod is rubbed with a cloth. The cloth becomes negatively charged.

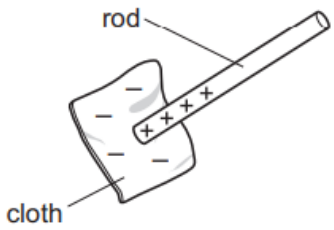
Which diagram shows the charge on the rod and describes the movement of charge?

A



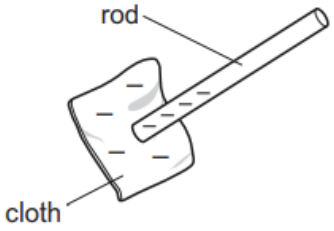
electrons move from the rod on to the cloth

B



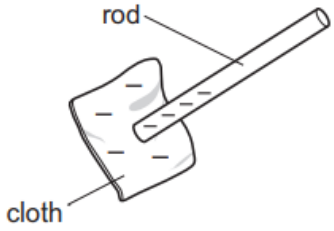
protons move from the cloth on to the rod

C



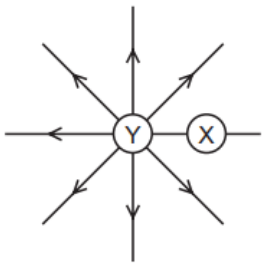
electrons move from the cloth on to the rod

D



protons move from the rod on to the cloth

28 Object X is stationary and positively 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?

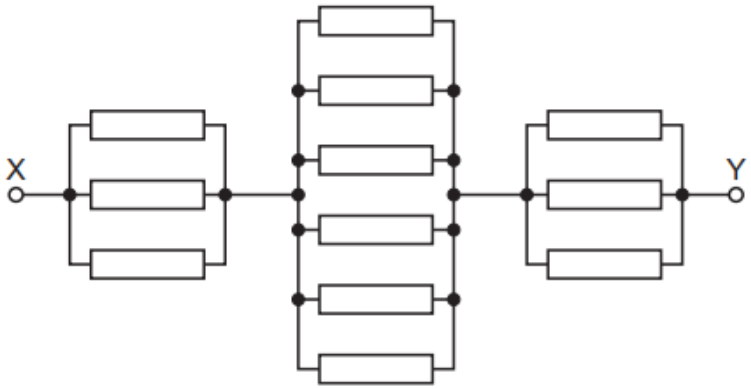
A It is towards the left because it is in a magnetic field.
B It is towards the left because it is in an electric field.
C It is towards the right because it is in a magnetic field.
D It is towards the right because it is in an electric field.

29 The potential difference across a metal wire is kept constant. The length l and the diameter d of the wire are both varied. The type of metal is kept the same.

How is the resistance of the wire related to l and d?

A It is directly proportional to l and inversely proportional to d.
B It is directly proportional to l and inversely proportional to d^2.
C It is inversely proportional to l and directly proportional to d.
D It is inversely proportional to l and directly proportional to d^2.

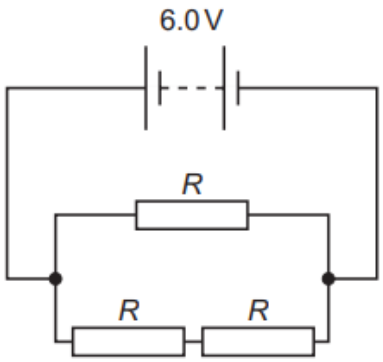
30 The diagram shows a network of resistors. Each resistor has a resistance of 6.0 Ω.



What is the total resistance of the network between points X and Y?

A 3.0 Ω **B** 5.0 Ω **C** 7.2 Ω **D** 18 Ω

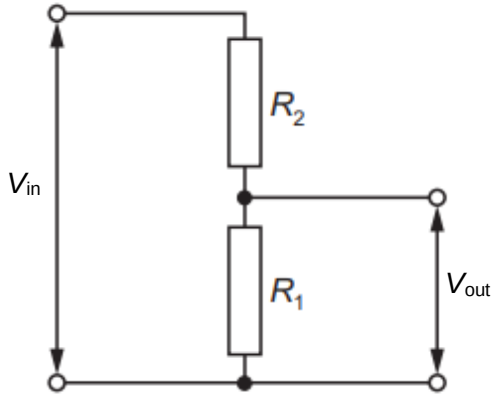
31 In the circuit shown, the battery has an electromotive force (e.m.f.) of 6.0 V and negligible internal resistance. The three resistors each have resistance R.



The total power dissipated in the resistor network is 24 W. What is the value of R?

A 0.5 Ω **B** 1.0 Ω **C** 1.5 Ω **D** 2.3 Ω

32 A potential divider consists of two resistors of resistances R_1 and R_2 connected in series across a source of potential difference (p.d.) V_{in}. The p.d. across R_1 is V_{out}.

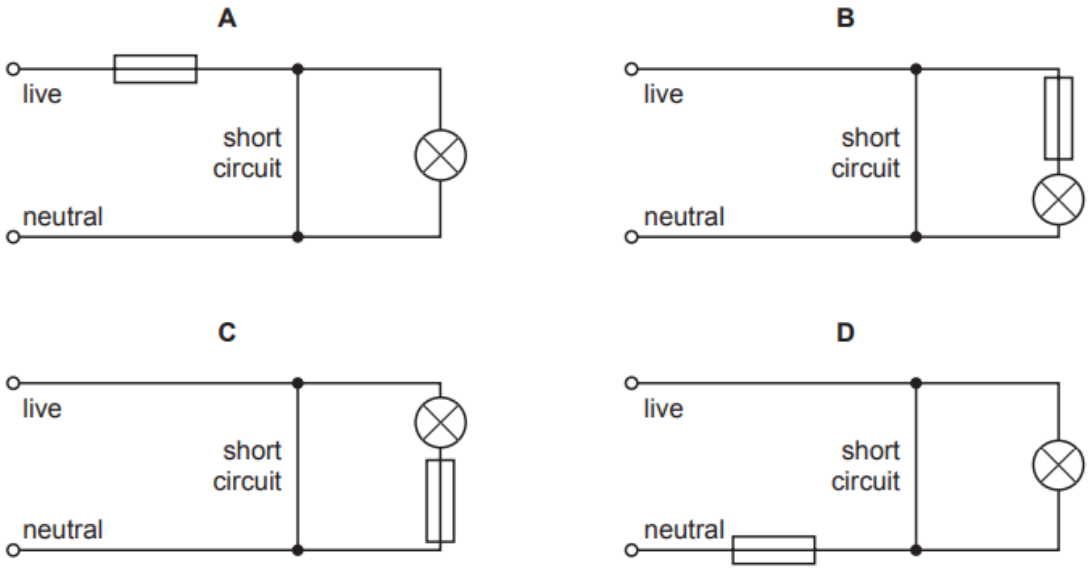


Which changes to R_1 and R_2 will increase the value of V_{out}?

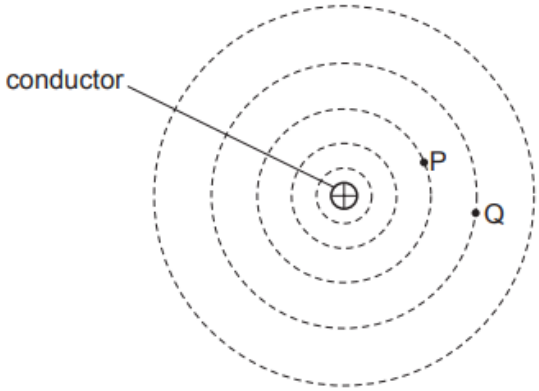
	R_1	R_2
A	doubled	doubled
B	doubled	halved
C	halved	doubled
D	halved	halved

33 In each of the circuits below there is a short circuit.

In which circuit does the fuse blow and make the circuit safe to repair?



34 The diagram shows the shape of the magnetic field lines near a current-carrying conductor.

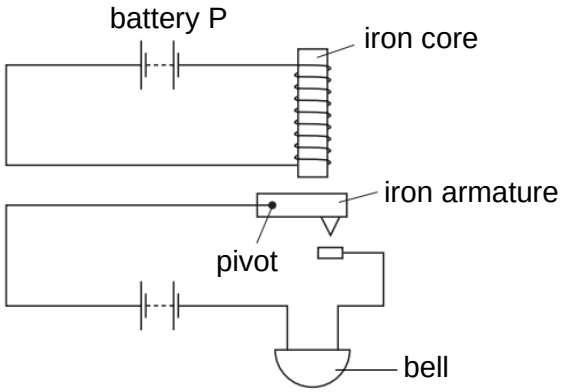


The current in the conductor is into the plane of the diagram.

Which row correctly states the direction of the field lines and compares the strengths of the field at points P and Q?

	direction of field lines	the field is stronger at
A	anticlockwise	P
B	anticlockwise	Q
C	clockwise	P
D	clockwise	Q

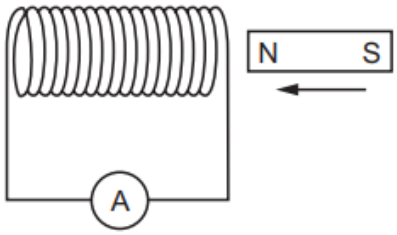
35 The diagram shows an alarm system.



What happens when battery P is disconnected?

	iron armature	bell
A	falls	rings
B	falls	stops ringing
C	moves up	rings
D	moves up	stops ringing

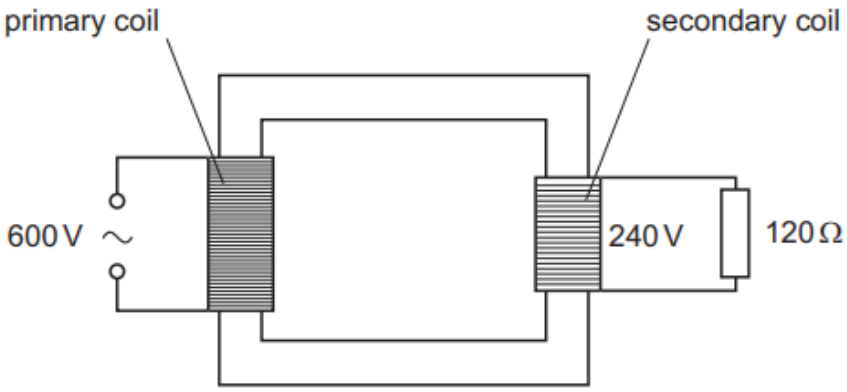
36 As a magnet is moved into the coil of wire as shown, there is a small reading on the sensitive ammeter.



Which change increases the size of the reading?

A moving the opposite pole into the coil
B pulling the magnet out of the coil
C pushing the magnet in faster
D unwinding some of the turns of wire

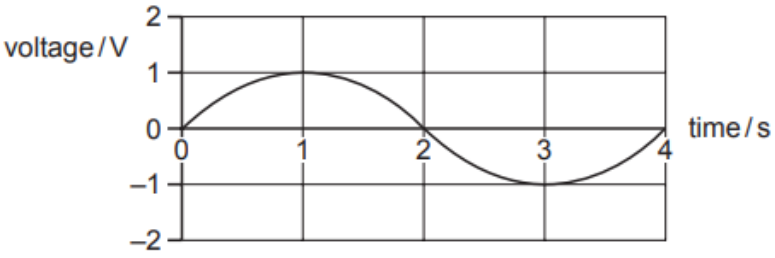
37 An ideal transformer has a primary voltage of 600 V and a secondary voltage of 240 V. The secondary coil is attached to a resistor of resistance 120 Ω.



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

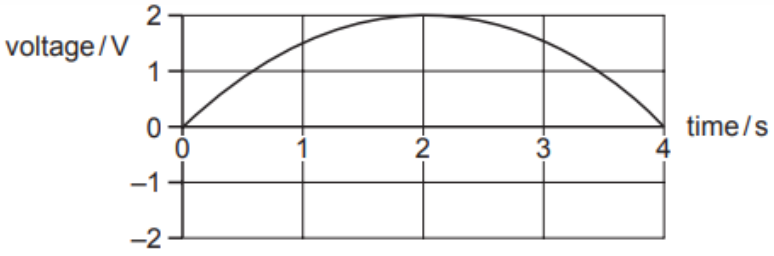
	power / W	current / A
A	120	0.20
B	120	5.0
C	480	0.80
D	480	1.3

38 A simple a.c. generator produces a voltage that varies with time as shown.

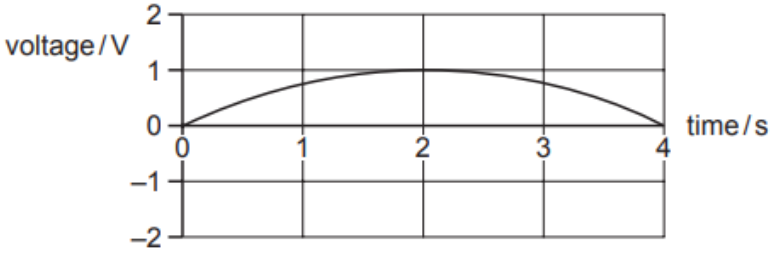


Which graph shows how the voltage varies with time when the generator rotates at twice the original speed?

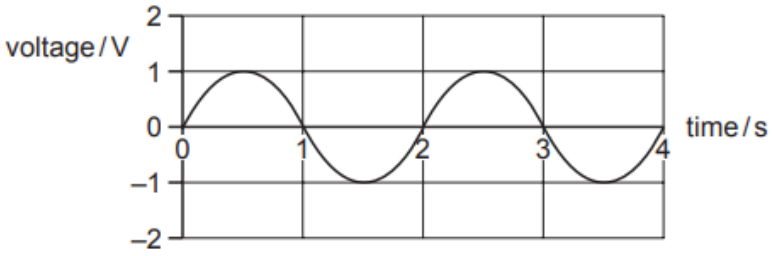
A



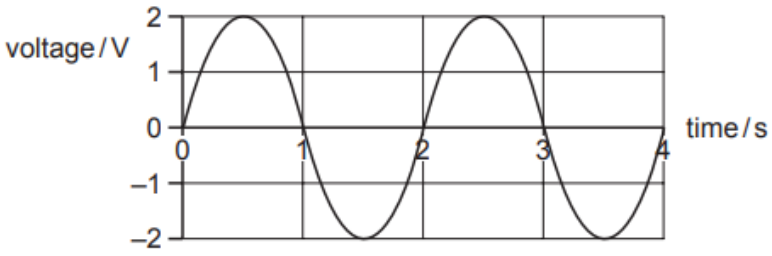
B



C



D

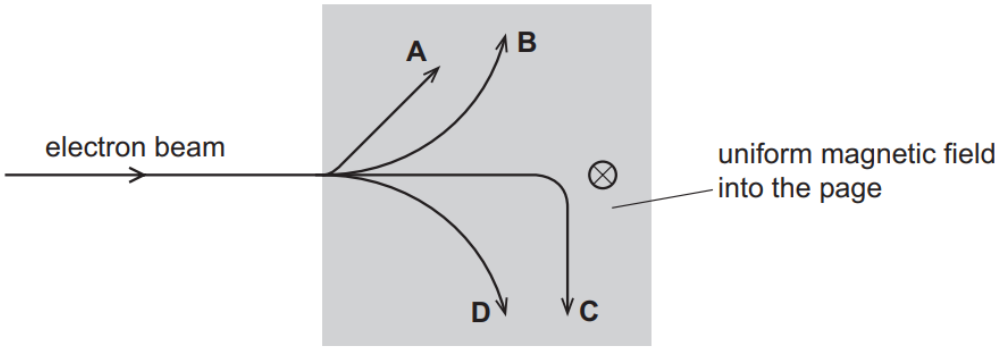


39 Which nucleus is produced when americium ($^{241}_{95}Am$) emits an alpha-particle?

A $^{237}_{93}Np$ **B** $^{237}_{97}Bk$ **C** $^{245}_{93}Np$ **D** $^{245}_{97}Bk$

40 A beam of electrons is fired into a uniform magnetic field as shown. The direction of the magnetic field is into the page.

Which path do the electrons follow?



End of Paper

Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 EXPRESS

PRELIMINARY EXAMINATION 2024

PHYSICS 6091/02

Paper 2 Theory **22 August 2024**

Thursday 1105 - 1250 **1 hour 45 minutes**

Candidates answer on the Question Paper.
No additional materials are required.

READ THESE INSTRUCTIONS FIRST
Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen. You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid or tape.

Section A [70 marks]
Answer **all** questions.

Section B [10 marks]
Answer **one** out of two questions

Candidates are reminded that **all** quantitative answers should include appropriate units.
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 use of an approved scientific calculator is expected, where appropriate.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

Section A (70 marks)
Answer **all** the questions in the spaces provided.

1 Two small tugboats are pulling a large ship in a harbour. Fig. 1.1 represents the view from above and shows the directions of the forces on the ship.

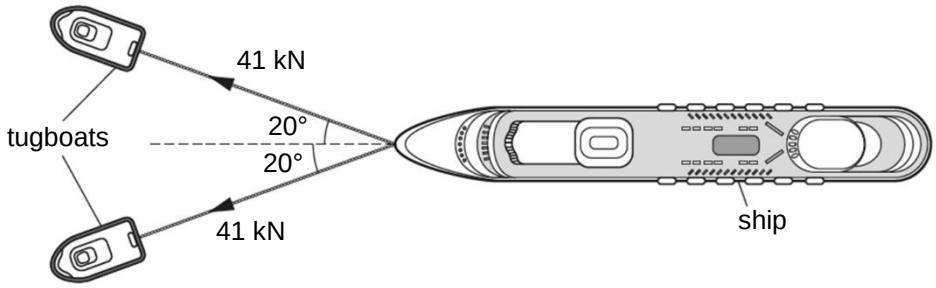


Fig. 1.1
(not drawn to scale)

Each of the tugboats exerts a force of 41 kN on the ship.

(a) Determine, by means of a scaled drawing, the resultant of these two forces.

scale ……...……..

resultant = ……...……..

[3]

(b) The engines of the ship are switched off and the water currents in the harbour are negligible. Explain, in terms of the forces acting, why the ship is moving with constant velocity.

…….

…….

…...……...……[2]

2 A wooden plank of weight 220 N is placed on two identical supports as shown in Fig. 2.1. The plank has length 3.2 m, width 0.30 m and thickness 0.020 m. A painter stands on the plank directly above the left support. The weight of the painter and his brush is 770 N.

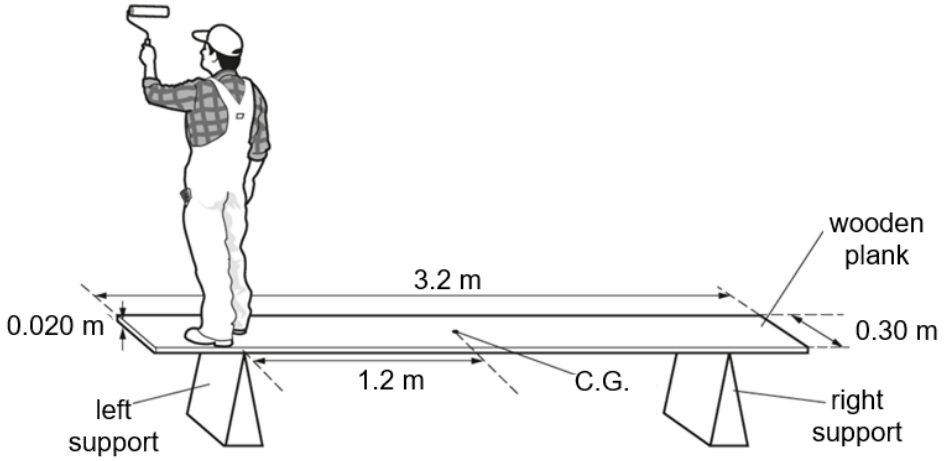


Fig. 2.1

(a) Describe one force acting on the plank at the right support.

……

…..……..……[1]

(b) The centre of gravity (C.G.) of the plank is in the middle of the plank at a distance of 1.2 m from each of the supports.
Calculate the moment of the weight of the plank about the left support.

moment = ……...…….. [1]

(c) The painter moves further to the left along the plank and the plank rotates about the left support.

(i) Explain why the plank rotates.

……

……..……[1]

(ii) Calculate the minimum distance of the painter from the left support before the plank starts to rotate.

minimum distance = ……...…….. [2]

3 Fig. 3.1 shows a syringe containing trapped air. One end of the syringe is sealed but the piston inside the syringe is free to move left and right.

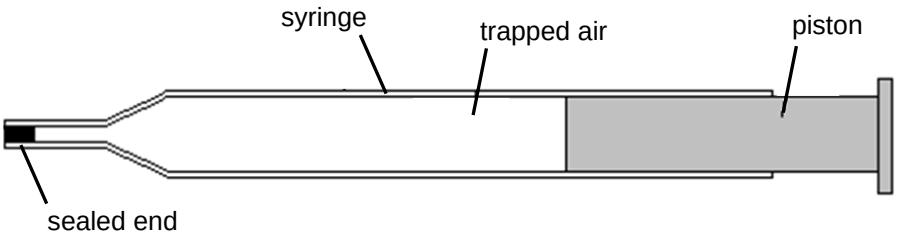


Fig. 3.1

(a) The piston has a cross-sectional area of 1.2×10^{-4} m^2. Given that the air trapped in the syringe has a pressure of 1.0×10^5 Pa, calculate the force exerted on the piston by the air.

force = ……..…….. [1]

(b) Explain, using ideas about molecules, why

(i) the air inside the syringe exerts a pressure on the piston,

…….

…….

…..……..……[2]

(ii) the piston moves to the right when the syringe is heated over fire.

…….

…….

…..……..……[2]

(c) The syringe is now filled with water instead of air.
Explain why the piston moves less to the right when the syringe is heated over fire.

…….

…….

…..……..……[2]

4 Fig. 4.1 shows an electric immersion heater being used to heat water in a cup.

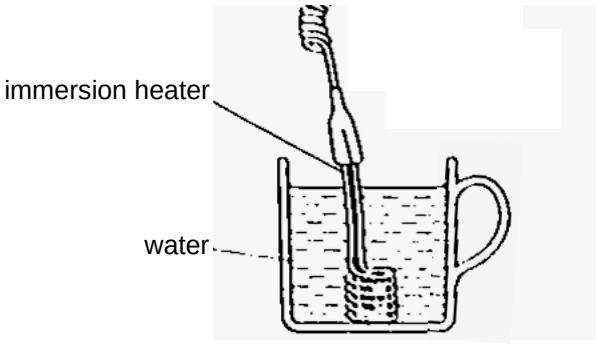


Fig. 4.1

The cup contains 0.20 kg of water at a temperature of 30 °C.
The heat capacity of the cup is 90 J/°C.
The specific heat capacity of water is 4200 J/(kg °C).
The specific latent heat of vaporisation of water is 2250 J/g.

(a) State the difference between heat capacity and specific heat capacity.

……

…..……..……[1]

(b) The immersion heater is rated at 100 W.
Determine the time taken needed to raise the temperature of the water and cup from 30 °C to 100 °C.

time taken = ……...…….. [3]

(c) **(i)** After the water starts boiling, the heater is left on for a further 15 minutes. Determine the mass of water left in the cup after 15 minutes.

mass of water left = ……...…….. [2]

(ii) Explain why the heat capacity of the cup is **not** factored into the calculation in **(c)(i)**.

……

……[1]

5 Fig. 5.1 shows a teacher holding a bottle of cold drink at rest above the ground.

Fig. 5.1

(a) A convection current forms in the air outside the bottle. Explain how the convection current is formed.

……

……

……[2]

(b) The teacher notices that the cold drink is warming up rapidly. She puts the bottle of cold drink into a plastic bag. When the bag is sealed, there is a layer of air between the bottle and the bag.
Explain how this layer of air stops the cold drink from warming up rapidly.

……

……

……[2]

6 **(a)** A microphone is placed at one end of a room to record the sound from a musical instrument placed at the other end.

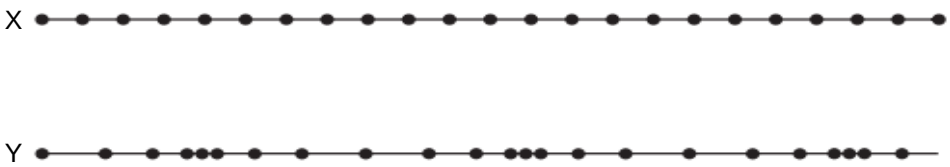


Fig. 6.1

Line X in Fig. 6.1 represents the original positions of air molecules in the room. Line Y represents the positions of the same molecules at time *t* as a sound wave from the instrument moves through.

(i) Describe what happens to the distance between two adjacent molecules, as the wave moves through the air.

……

……[1]

(ii) On line Y, mark a distance equal to half the wavelength of the sound wave. [1]

(b) Fig. 6.2 shows an electric bell inside a glass bell-jar that contains air. The bell produces a sound of frequency 2000 Hz.

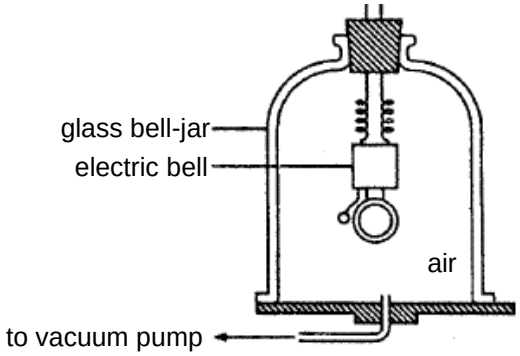


Fig. 6.2

(i) State what is meant by *frequency of 2000 Hz*.

……

……[1]

(ii) The sound passes from the air into the glass.
State what happens to

1. the frequency of the sound,

……..

2. the speed of the sound.

……..
[1]

(iii) A tube at the bottom of the glass bell-jar is connected to a vacuum pump. The pump is switched on and air is removed from the glass bell-jar.
Explain why the volume of the sound heard outside the glass bell-jar decreases.

……

……

……..……[2]

7 Fig. 7.1 shows a negatively charged rod close to an uncharged metal sphere that is mounted on an insulating stand.

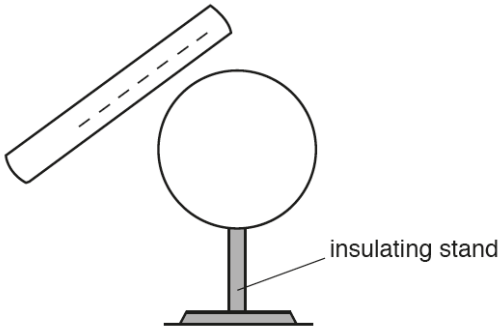


Fig. 7.1

(a) On Fig. 7.1, draw the distribution of charges on the sphere. [1]

(b) A metal wire connected to earth is used to touch the sphere.

(i) Explain what happens to the charge on the sphere.

……

……

……..……[2]

(ii) The earth wire remains in contact with the sphere.
Describe what happens in the wire as the rod is moved away.

……

……..……[1]

8 Fig. 8.1 shows a circuit containing a 12.0 V battery, a resistor of resistance 1 000 Ω and a light dependent resistor, LDR.

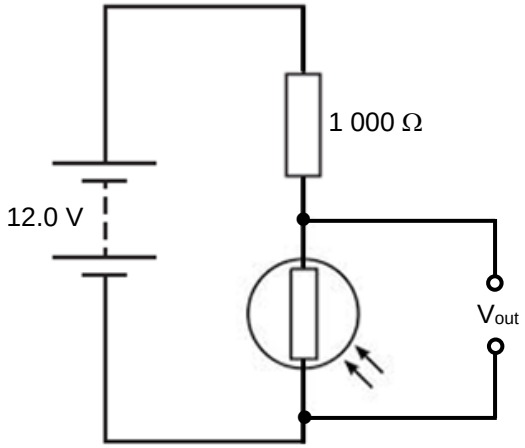


Fig. 8.1

(a) The LDR has a resistance of 600 Ω in bright light.
Calculate the output voltage, V_{out} when the LDR is in bright light.

V_{out} = ……..…….. [2]

(b) The output voltage is connected to an electronic switch and a motor. The motor switches on when V_{out} is larger than 6.0 V.
Explain how the motor may be switched on when as the level of light falls.

…….

…….

…….

…..……..……[2]

9 One source of background radiation is cosmic rays. The cosmic rays that enter the Earth's atmosphere are known as primary cosmic rays. Most of these rays are fast-moving protons or fast-moving alpha-particles. Both the Earth's magnetic field and the Earth's atmosphere reduce the number of primary cosmic rays that reach the Earth's surface.

(a) (i) Name another source of background radiation apart from cosmic rays.

……..……[1]

(ii) State one effect of background radiation.

……..……[1]

(iii) Explain how the Earth's atmosphere reduces the number of alpha-particles that reach the surface.

…….

…….

……..……[2]

(b) Primary cosmic rays produce carbon-14 in the atmosphere. The half-life of carbon-14 is 5 700 years.

(i) Define the term *half-life*.

…….

……..……[1]

(ii) A specimen of wood is found to contain 25 000 atoms of carbon-14. An otherwise identical specimen taken from a living tree is found to contain 200 000 atoms of carbon-14.
Determine the age of the specimen that contains 25 000 atoms of carbon-14.

age of specimen = ……..…….. [2]

(iii) Carbon-14 is one of the isotopes of carbon. Another isotope is carbon-12.
Describe how a nucleus of carbon-14 differs from a nucleus of carbon-12.

…….

……..……[1]

10 An optical fibre is a flexible and transparent fibre that transmits data in the form of light or optical signals over large distances at high speeds. One of the materials used to make optical fibres is fused silica. Fig. 10.1 shows the relationship between refractive index of fused silica to the wavelength of the light passing through it.

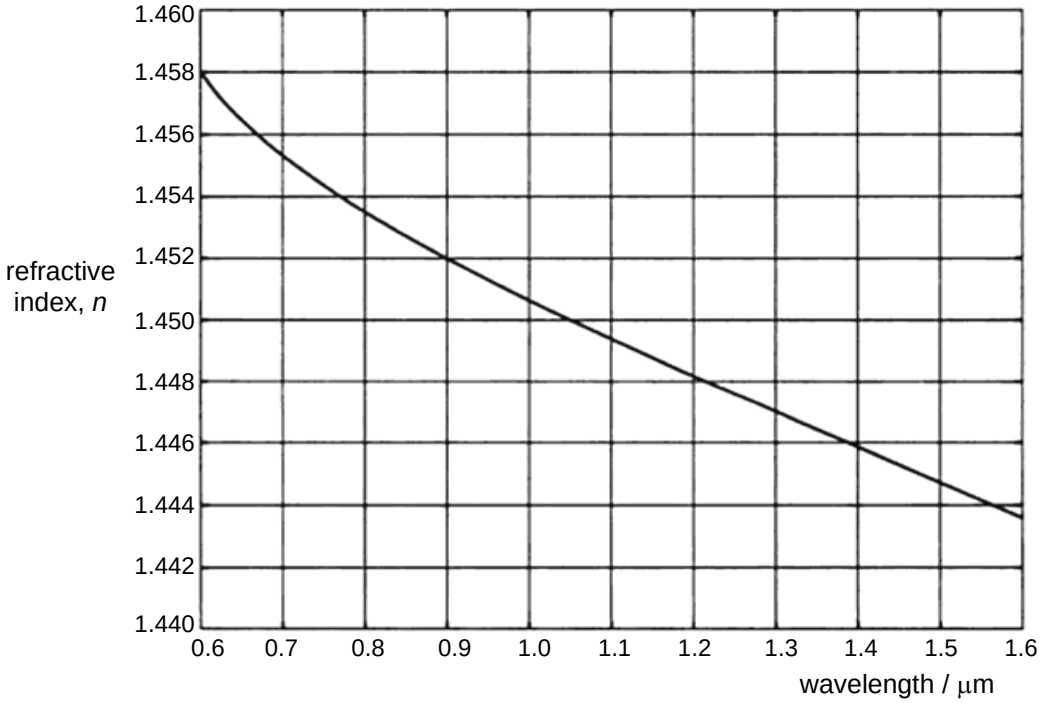


Fig. 10.1

(a) Define *refractive index* of a medium.

……

……[1]

(b) Using Fig. 10.1, describe the relationship between the refractive index and the wavelength of the light.

……

……[1]

(c) The refractive index, *n*, for light of wavelength 0.6 μm and 1.3 μm passing through a fused silica optical fibre is different. In this situation, state

(i) one other difference, and

……

……[1]

(ii) one similarity between them.

……

……[1]

(d) The speed of light in vacuum is 3.0 x 10^8 m/s. A pulse of light of duration 20 μs is directed into a fused silica optical fibre of length 10 km. This light consists of a mix of two wavelengths, 0.6 μm and 1.3 μm.

(i) Using Fig. 10.1, determine the speed of light of wavelength 1.3 μm in the optical fibre.

speed = ……...…….. [2]

(ii) Calculate the minimum time needed for the light of wavelength 1.3 μm to exit the optical fibre.

time = ……...…….. [1]

(iii) State one assumption you made when calculating **(d)(ii)**.

…….

……...……[1]

(iv) Explain what happens to the duration of the pulse, if any, when the light exits the optical fibre.

…….

…….

…….

……...……[2]

11 A slotted copper disc is driven to spin clockwise and then placed between the poles of two permanent magnets as shown in Fig. 11.1.

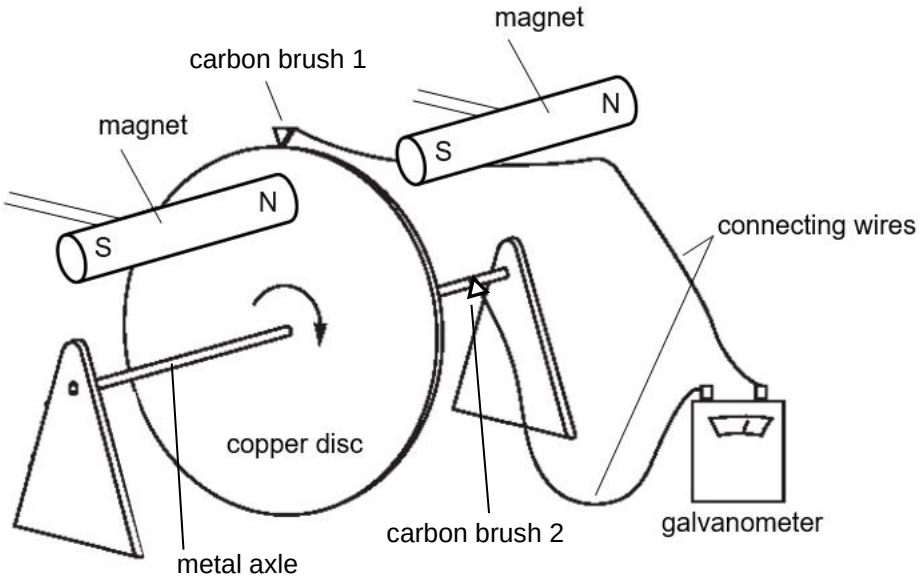


Fig. 11.1

The north pole of one magnet is placed in front of the copper disc and the south pole of the other magnet is behind the disc. Two carbon brushes are connected to the setup, one at the edge of the disc and one at the metal axle. When a galvanometer is connected across the two brushes, it is found that a current flows through the galvanometer.

(a) Explain why the copper disc is **not** attracted to the magnets.

…..……[1]

(b) Explain why a current flows through the circuit when the copper disc spins clockwise.

…….

…….

…..……[2]

(c) State the direction of the current flowing through the circuit. Explain how you arrived at your answer.

…….

…….

…….

…..……[2]

(d) The copper disc takes 0.20 s to make one complete rotation. Using the axes provided, sketch a graph to show how the current produced varies with time.

[1]

(e) State and explain one change that increases the size of the current produced. The parts of the apparatus shown in Fig. 11.1 may be altered.

……

……

…..……..……[2]

(f) The disc is then stopped. The galvanometer is then removed and replaced by a d.c. power source as shown in Fig. 11.2. The disc begins to spin on its own.

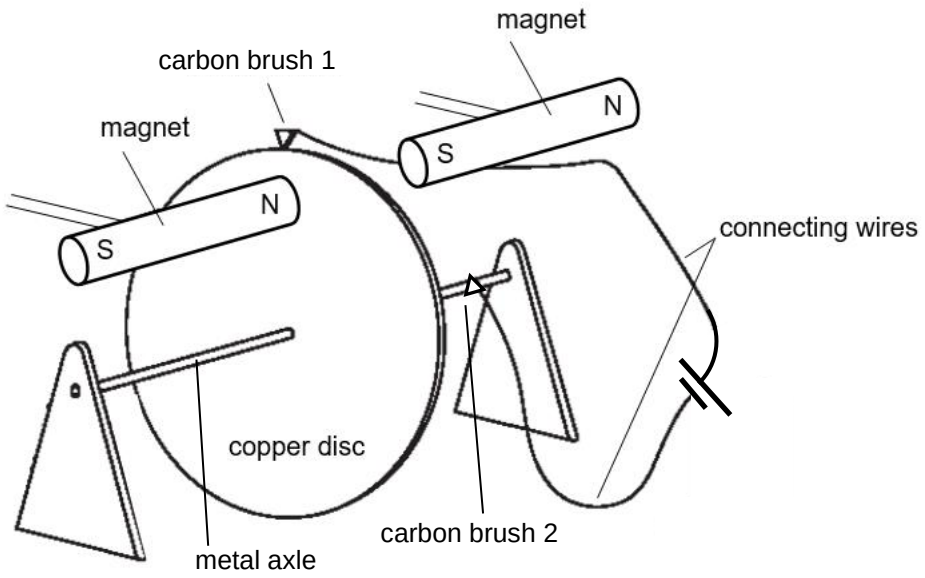


Fig. 11.2

Explain why the disc begins to rotate on its own.

……

……

…..……..……[2]

Section B (10 marks)

Answer **one** question from this section in the spaces provided.

12 Fig. 12.1 shows a boy, of mass 30 kg, jumping on a trampoline, a device consisting of a piece of taut, strong fabric stretched over a steel frame using many coiled springs. The elasticity is provided by the springs that connect the fabric to the frame.

Fig. 12.1

The speed-time graph of the boy is shown in Fig. 12.2. At time = 0 s (point V), the boy started his motion at the maximum height above the fabric. The boy was in contact with the fabric between points W and Y.

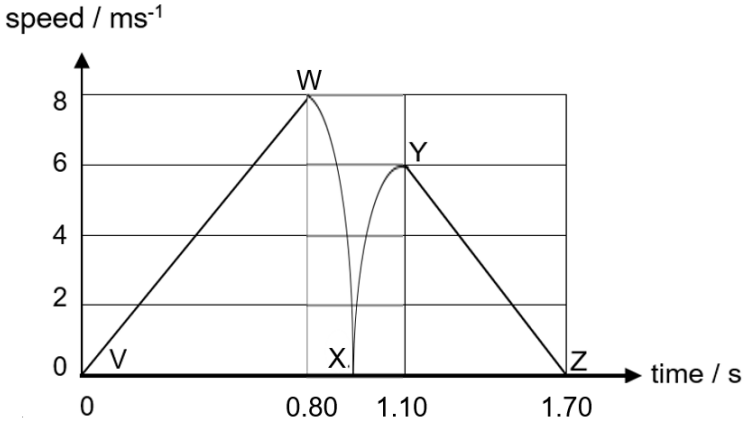


Fig. 12.2

(a) Describe the motion of the boy from V to X.

……

……

……[2]

(b) Explain the motion of the boy from W to X.

……

……

……

……[2]

(c) State the change in the

(i) speed of the boy from W to Y.

change in speed = ……...…….. [1]

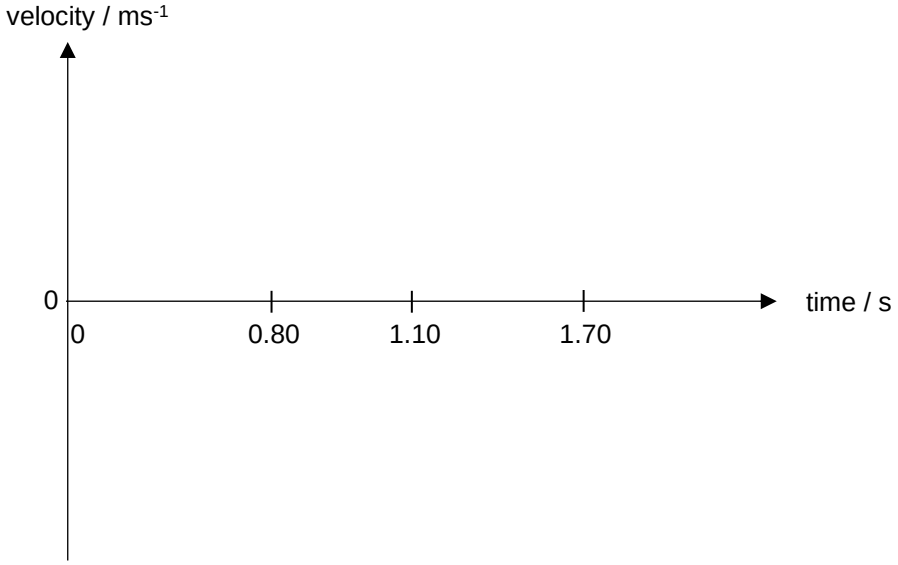
(ii) velocity of the boy from W to Y.

change in velocity = ……...…….. [1]

(d) Calculate the maximum height (above the fabric) reached by the boy after he bounces up from the fabric.

maximum height = ……...…….. [2]

(e) On the axes, sketch the velocity-time graph of the boy during the 1.70 s of his motion. Label the graph V to Z as in Fig. 12.2.



[2]

13 **(a)** A student conducts an experiment to make measurements of the current, I in a metal wire and the potential difference, V across it. Fig. 13.1 shows a graph of I against V.

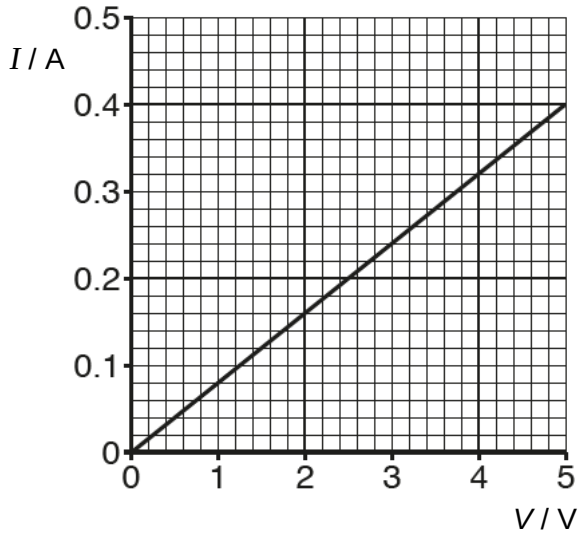


Fig. 13.1

(i) Explain how the graph shows that the temperature of the wire does **not** change during the experiment.

……

……

……[2]

(ii) A new wire of the same material has the same length as the original wire but has only half the cross-sectional area.

1 Compare the resistance of the new wire and the original wire.

……

……[1]

2 On Fig. 13.1, draw the graph for the new wire. [1]

(b) Fig. 13.2 shows a 240 V, 2500 W electric kettle connected to an a.c. mains supply by a flexible cable.

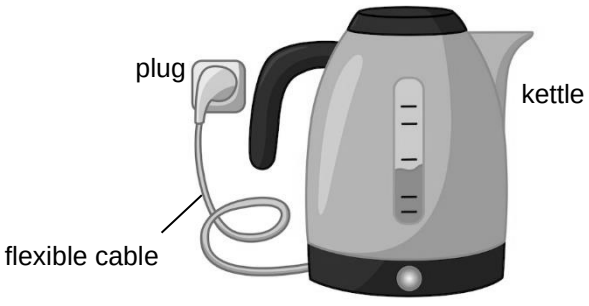


Fig. 13.2

Fig. 13.3 shows the maximum current that may be carried safely by wires of various diameters in the flexible cable.

wire diameter / mm	maximum current / A
0.50	3
0.75	6
1.00	10
1.25	13
1.50	15

Fig. 13.3

(i) Calculate the current flowing in the cable when the kettle is in use.

current = ……...…….. [2]

(ii) State the smallest diameter of wire that can safely be used for this kettle.

smallest diameter = ……...……mm [1]

(iii) Explain why it is dangerous to use a wire thinner than that in **(ii)**.

…….

…….

……...……[2]

(iv) A student suggests that a thinner wire can be used in the flexible cable if the mains supply is lower than 240 V. Explain if his suggestion is correct.

…….

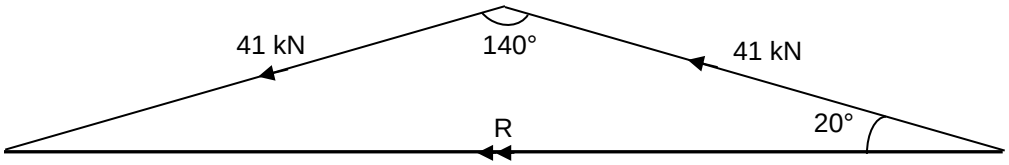
……...……[1]

End of Paper

Suggested Answers for 4E Prelim Physics 2024

Section A

1 (a) Scale: 1 cm rep 5 kN (Accept 1 cm rep 10 kN)



Resultant = 77 kN (Accept 75 to 79 kN)

(b) The resultant force of the tugboats is equal to the drag force due to water / water resistance / total resistive force of the water.
There is no resultant force on the ship / forces are balanced / forces cancel each other.
The ship therefore moves with constant velocity.

2 (a) Normal contact force by the right support on the plank.

(b) Moment = F x d
= 220 x 1.2
= 260 / 264 Nm

(c) (i) The anticlockwise moment due to the weight of the painter about the left support is greater than the clockwise moment due to the weight of the plank.

(ii)

Anticlockwise moment due to painter	=	Clockwise moment due to plank
770 x d	=	260
d	=	0.34 m

3 (a) Force, F = P x A
= $(1.0 \times 10^{5}) \times (1.2 \times 10^{-4})$
= 12 N

(b) (i) The air molecules collide with the piston and exerts a force.
As pressure is force per unit area, the air exerts a pressure on the piston.

(ii) Energy is transferred from the fire to the kinetic store of the air molecules .
The frequency and force of collision between the air molecules / particles with the piston increases and this increases the pressure exerted on the piston.

(c) Water molecules have stronger intermolecular forces of attraction. Heated water expands less than air / the molecules move less further away from each other when heated.

4 **(a)** Specific heat capacity is the heat capacity per unit mass.

(b)
$Q = mc\Delta\theta + c\Delta\theta$
$P \times t = mc\Delta\theta + c\Delta\theta$
$100 \times t = (0.20 \times 4200 \times [100 - 30]) + (90 \times [100 - 30])$
$100 \times t = 58800 + 6300$
$t = 651$ s

(c) **(i)**
$Q = ml_v$
$100 \times (15 \times 60) = m \times 2250$
$m = 40$ g

Mass of water left = 200 - 40
= 160 g

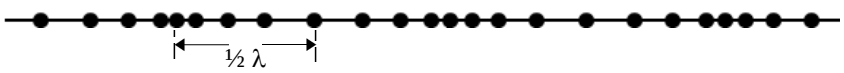
(ii) During boiling, there is no change in temperature of the water and hence there is no change in the temperature of the cup.

5 **(a)** The cold drink first cools the air around it by conduction.
The cooler air sinks as it is denser than surrounding air and the hotter air from other regions flows in to replace the cooler air that sinks.
This movement of air sets up a convection current.

(b) A layer of air is trapped between the bottle and the bag reduces energy gain by convection.
Air is also a poor conductor of heat and reduces energy gained by conduction.

6 **(a)** **(i)** The distance between the two particles will repeatedly increase then decrease.

(ii)

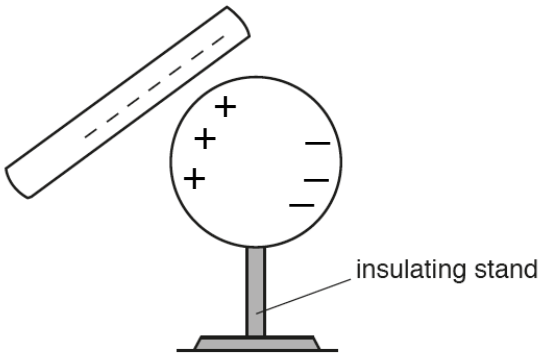


(b) **(i)** The number of oscillations / vibrations / waves generated / compressions / rarefactions per second or per unit time is 2000.

(ii) 1. no change
2. increases [1] Both correct

(iii) There are fewer air particles / molecules in the bell-jar.
Less energy is transferred to the outside of the bell-jar.

7 (a)



(b) (i) Electrons are repelled by the rod and flows towards the earth.
The sphere becomes positively charged.

(ii) Electrons will flow through the wire from earth to sphere.

8 (a) V_{out} = [600 / (600 + 1000)] x 12.0
= 4.5 V

(b) As the level of light falls, the resistance of the LDR increases.
V_{out} will be larger than 6.0 V when the resistance of the LDR is more than 1000 Ω.

9 (a) (i) Sources: Building materials
Waste products from nuclear power stations
Rocks / Soil / Earth's surface
Radon gas in the air
Selected food and drink e.g. bananas, carrots

(ii) It can cause cancer / cell damage
OR
It can affect experimental readings / count rate measured by GM Counters
OR
It can cause ionisation

(iii) Alpha-particles have low penetrating ability.
Alpha-particles are absorbed by the atmosphere or it cannot penetrate through the atmosphere.

(b) (i) It is the time taken for half the nuclei of a radioactive nuclide to decay.

(ii) 200 000 → 100 000 → 50 000 → 25 000

Age of specimen = 3 x 5700
= 17 100 years

(iii) The nucleus of carbon-14 has the same number of protons as that of carbon-12 but has 2 more neutrons.

10 **(a)** It is the ratio of the speed of light in vacuum to the speed of light in the medium.
(Accept other complete definitions of refractive index)

(b) As the wavelength increases, there is a non-linear decrease in the refractive index.

(c) **(i)** Both travel at different speeds in the optical fibre.
OR
Both have different frequencies.
(Do not accept – They have different wavelengths)

(ii) Both carry energy through the optical fibre.
OR
Both undergo total internal reflection in the optical fibre.

(d) **(i)** For light of wavelength 1.3 μm, refractive index = 1.447.
Speed of light in optical fibre = $(3.0 \times 10^8) / 1.447$
= 2.07×10^8 m/s

(ii) Time taken to exit the optical fibre = $10\,000 / 2.07 \times 10^8$
= 48.3 μs or 4.83×10^{-5} s

(iii) Light travels straight without total internal refraction in the optical fibre
OR
The optical fibre is straight.

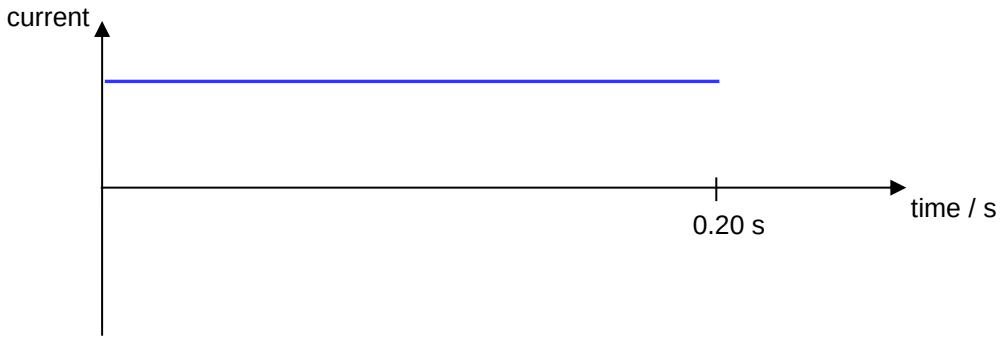
(iv) The duration of the pulse increases as light of wavelength 0.6 μm takes a longer time to exit the optical fibre.
The speed of light of wavelength 0.6 μm is lower in the optical fibre due to a higher refractive index.

11 **(a)** Copper is a non-magnetic material.

(b) When the copper disc spins, the magnetic field in the disc changes / the disc cuts the magnetic field of the magnet.
This induces an e.m.f. / current in the disc.

(c) The current flows from carbon brush 1 to galvanometer to carbon brush 2.
Using Fleming's right hand rule, the direction of induced current is flowing upwards from the axle to carbon brush 1.

(d)



(e) Increase the speed of rotation of the disc / Increase the magnetic strength of the magnet / Place the magnets closer to the disc.

This increases the rate of change of magnetic field linking the disc / increases the rate of disc cutting the magnetic field.

(f) **(i)** A current flowing in the disc produces a magnetic field that interacts with the magnetic field of the magnet.

This interaction of magnetic fields produces a force on the disc enabling it to spin.

(ii) Clockwise.

Section B

12 **(a)** From V to W, the boy accelerates uniformly (constantly).
From W to X, the boy has an increasing / non-uniform deceleration.

(b) The upward force / tension in the spring is larger than the weight of the boy.
The resultant force on the boy is negative / acts upwards and the boy decelerates.

OR

Energy in the kinetic store of the boy is transferred mechanically to the elastic potential store of the springs.
As the kinetic store of the boy decreases, his speed decreases.

(c) **(i)** 2 m/s

(ii) 14 m/s or - 14 m/s

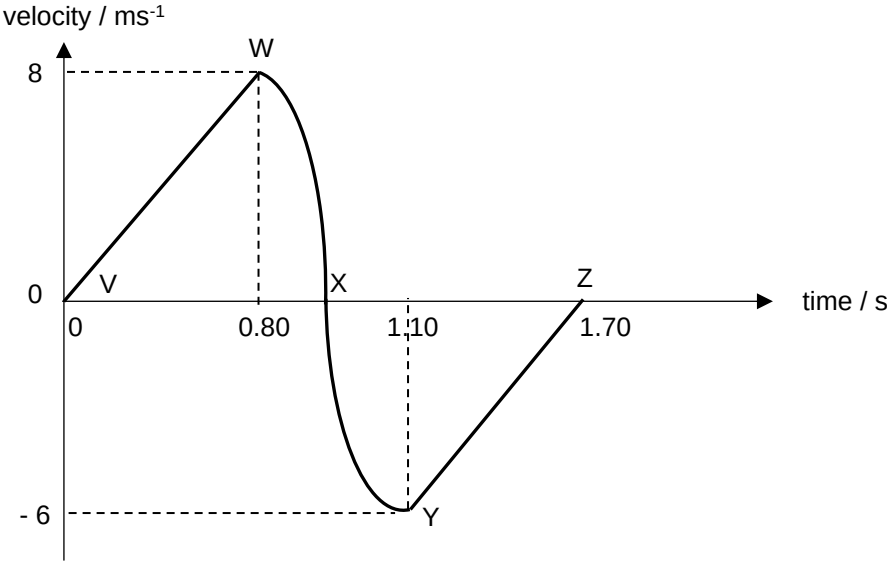
(d) Maximum height = Area under graph
= ½ x 6 x (1.70 – 1.10)
= 1.8 m

OR

Gain in energy in the gravitational potential store = Loss in energy in the kinetic store

$mgh = \frac{1}{2} mv^2$
$10 \times h = \frac{1}{2} \times 6 \times 6$
$h = 1.8$ m

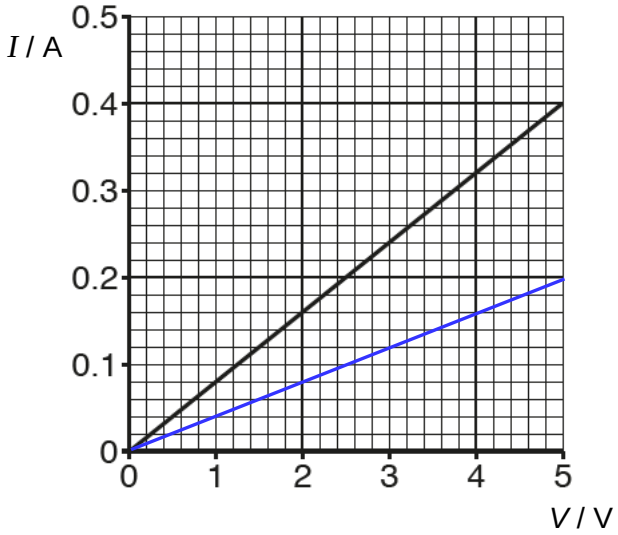
(e)



13. (a) (i) A change in temperature of the wire causes a change in resistance.
The graph is a straight line passing through the origin showing that resistance is constant.

(ii) 1. The new wire has twice the resistance of the original wire.

2.



(b) (i) I = P / V
= 2500 / 240
= 10.4 A

(ii) 1.25 mm

(iii) A thinner wire has a larger resistance.
This could cause the wire to be heated up and may cause a fire.

(iv) His suggestion is correct.
Using a lower voltage will also reduce the current flowing through the cable.

Pasir Ris Secondary School
Preliminary Examination 2024
Physics 6091 Paper 1

No.	Ans	No.	Ans	No.	Ans	No.	Ans
1	**B**	11	**D**	21	**A**	31	**D**
2	**C**	12	**A**	22	**D**	32	**B**
3	**A**	13	**B**	23	**C**	33	**A**
4	**B**	14	**A**	24	**C**	34	**C**
5	**A**	15	**B**	25	**C**	35	**A**
6	**C**	16	**A**	26	**D**	36	**C**
7	**A**	17	**B**	27	**A**	37	**C**
8	**B**	18	**C**	28	**D**	38	**D**
9	**D**	19	**A**	29	**B**	39	**A**
10	**C**	20	**C**	30	**B**	40	**D**