CEDAR GIRLS' SECONDARY SCHOOL
Preliminary Examination 2024
Secondary Four

PHYSICS **6091/01**

Paper 1 **27 August 2024**

1 hour

Additional Materials: OMR Form

Candidates are to answer on the OMR Form.

READ THESE INSTRUCTIONS FIRST

Write your name, class, and index number in the spaces at the top of this page.
Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.

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 OMR form.

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

At the end of the examination, hand in OMR form separately.

The total number of marks for this paper is **40**.

1 What is the order of magnitude of the diameter of the Earth?

A 1×10^3 m **B** 1×10^7 m **C** 1×10^9 m **D** 1×10^{12} m

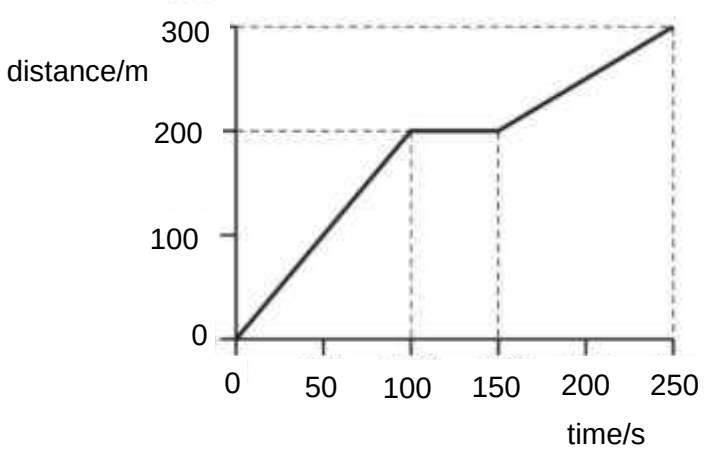
2 What is the unit of force expressed in SI base units?

A (kg m) / s^2 **B** kg / (m s) **C** kg / (m s^2) **D** (kg m) / s^{-2}

3 Which list contains only scalar quantities?

A acceleration, displacement, velocity
B distance, force, speed
C moment of force, length, time
D work done, mass, speed

4 A cyclist takes a ride lasting 250 s.
The distance-time graph shows the distance travelled by the cyclist



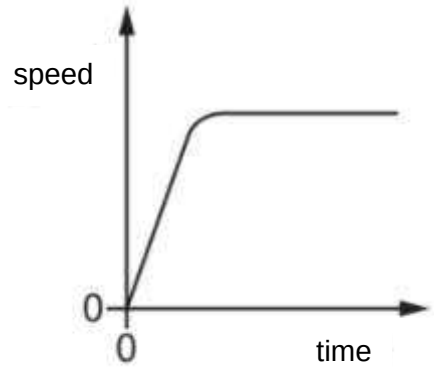
What is his average speed for the whole journey?

A 1.0 m/s **B** 1.2 m/s **C** 180 m/s **D** 200 m/s

5 A ball starts from rest and rolls down a steep slope. The ball then rolls along rough horizontal ground.

Which graph describe the motion of the ball?

A



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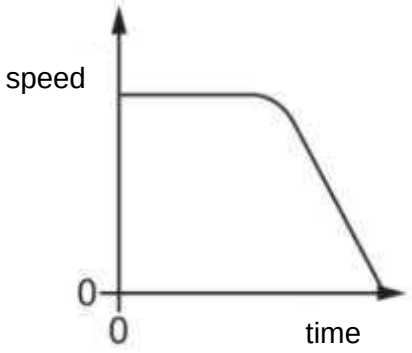

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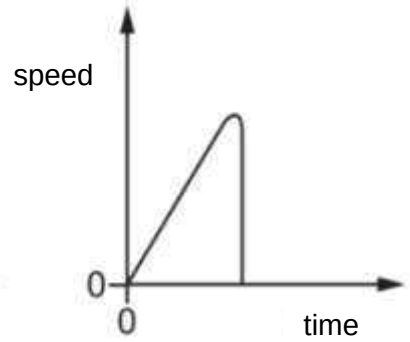
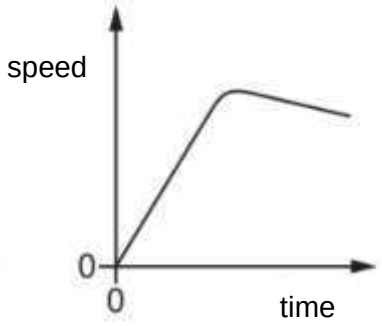
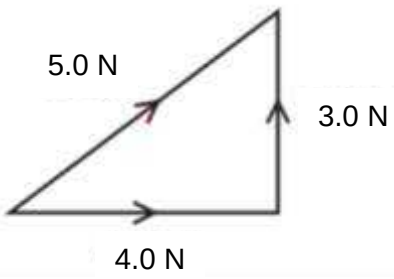


D

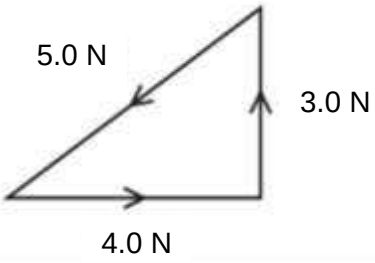


6 Which diagram shows the addition of the 4.0 N and the 3.0 N forces?

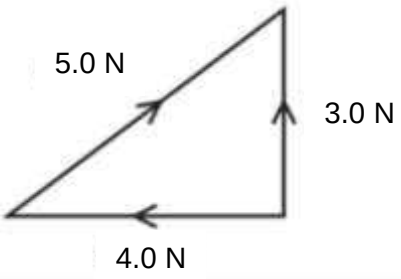
A



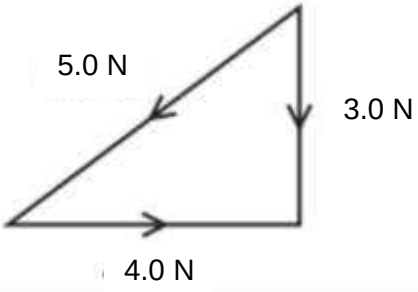
B



C

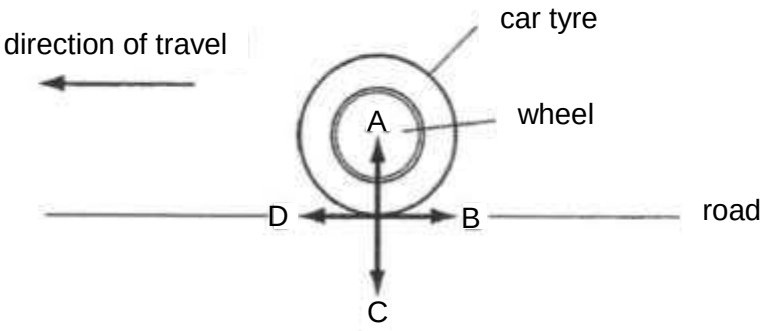


D



7 A car is accelerating along a road in the direction shown. The wheel shown is connected to the engine.

In which direction is the force of friction exerted by the road on the car tyre?



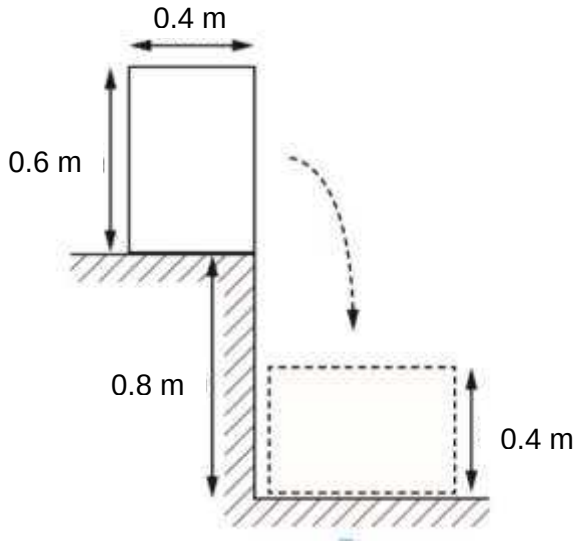
8 The diagram shows a parachutist falling towards Earth.

The lengths of the arrows represent the sizes of the forces on the parachutist and the parachute.

How is the parachutist moving at the instant shown?

A accelerating downwards
B constant speed
C decelerating downwards
D decelerating upwards

9 A uniform solid block has weight 500 N, width 0.40 m and height 0.60 m. The block rests on the edge of a step of depth 0.80 m, as shown.



The block is knocked over the edge of the step and rotates through 90° before coming to rest with the 0.60 m edge horizontal.

What is the change in gravitational potential store of the block?

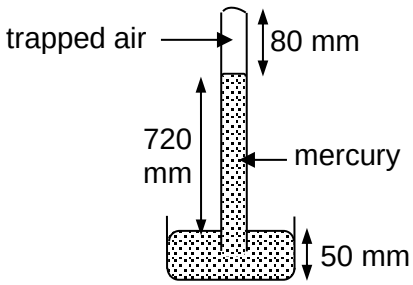
A 300 J **B** 400 J **C** 450 J **D** 550 J

10 A train of mass 40 000 kg is moving along a straight track. The velocity of the train decrease from 30 m/s to 25 m/s.

How much work done to slow the train down?

A 1.0×10^5 J **B** 5.0×10^5 J **C** 5.5×10^6 J **D** 1.1×10^6 J

11 The figure shows some air trapped above the mercury in an inverted glass tube.



If the atmospheric pressure is 750 mm Hg, the pressure exerted by the trapped air is

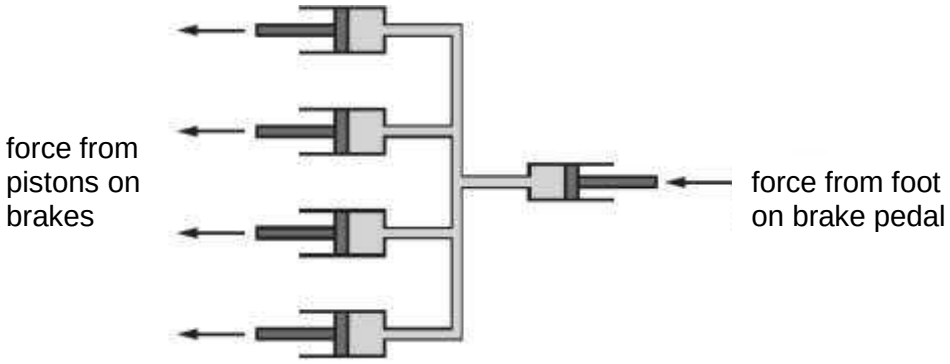
A 30 mm Hg.

B 80 mm Hg.

C 720 mm Hg.

D 800 mm Hg.

12 The pipes are filled with an incompressible liquid. When a force is applied to the brake pedal, the pressure in the liquid increases and applies a force to each of the four wheels.



The area of the piston connected to the brake pedal is 8 cm^2. The area of each piston connected to the brakes is 12 cm^2. A force of 800 N is applied by the foot to the brake pedal.

What is the force applied to each brake?

A 300 N **B** 530 N **C** 1200 N **D** 4800 N

13 Illuminated smoke particles, suspended in air, are viewed with a microscope. They are seen to move randomly.

This is because the smoke particles are

A bombarded continually by air molecules.

B moved about by convection currents.

C shaken by the vibration of the molecules within them.

D supplied with energy by the light illuminating them.

14 The pressure of a gas in a cylinder is the same at all points in the cylinder.
Which statement explains this?

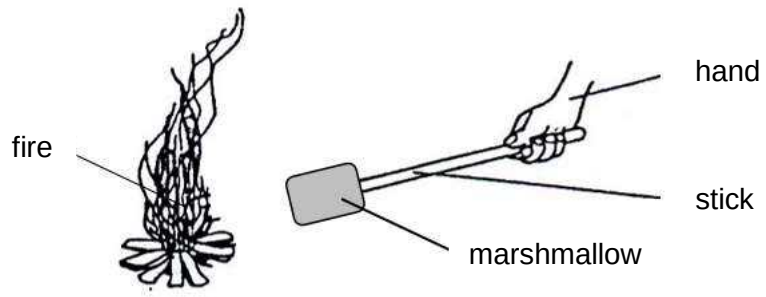
A The molecules of the gas are all the same size.

B The molecules of the gas attract one another.

C The molecules of the gas move at different speeds.

D There are many molecules, all moving at random.

15 A boy places a marshmallow near the fire.



How is energy transferred from the fire to the marshmallow?

A By radiation only

B By convection only

C By conduction and convection

D By convection and radiation

16 When a person holds the door knob made of metal, the knob feels cold. This is because the knob

A has a high heat capacity

B has a high specific heat capacity

C is at a lower temperature than its surroundings

D conduct heat away from her hands faster

17 In car engines, a coolant is used to transport heat away from the engine to be dissipated to other parts of the car.

The liquid that is used as a coolant in motor car engines should have a

A low specific heat capacity.

B high specific heat capacity.

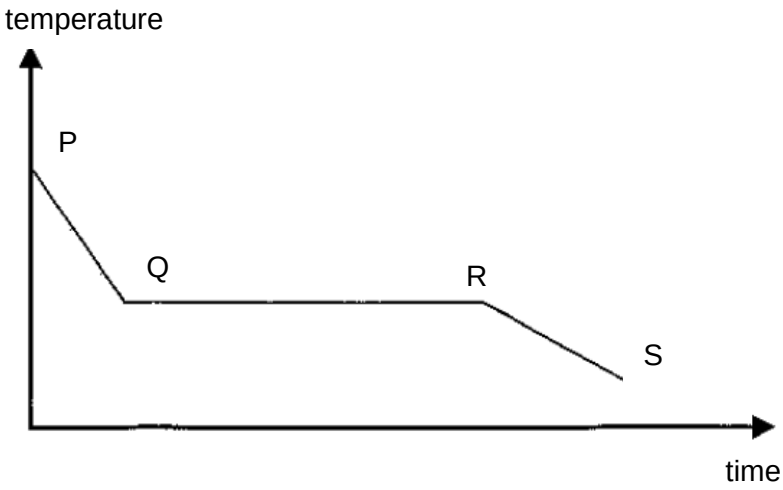
C constant heat capacity.

D low specific latent heat of vaporization.

18 A 500 g mass of copper is heated for 0.75 minutes by a heater which produces thermal energy at a constant rate of 80 J/s. The specific heat capacity of copper is 360 J / (kg ℃). What is the rise in temperature?

A 0.20 ℃ **B** 0.30 ℃ **C** 3.0 ℃ **D** 20.0 ℃

19 Some wax in a test tube was heated and then allowed to cool. The temperature-time graph is shown below.



Which of the following statement is correct?

A Along PQ, molecules are losing internal energy.

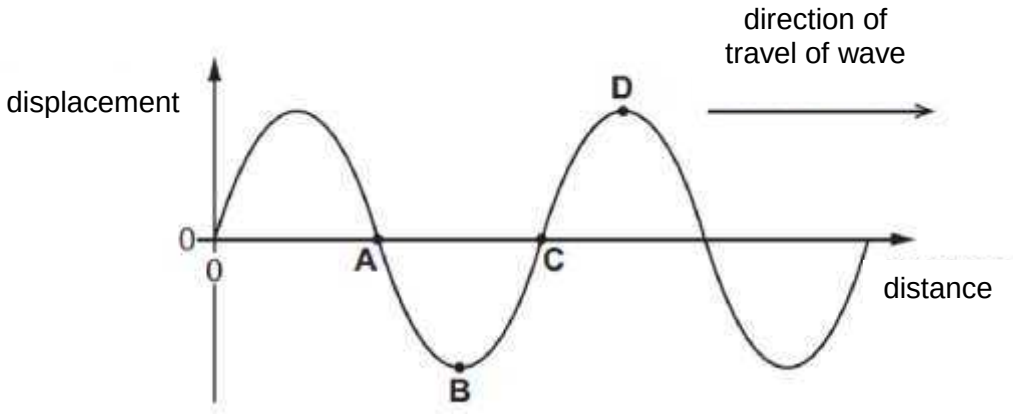
B Along QR, latent heat is given out and molecules are gaining potential energy.

C Along QR, molecules are losing kinetic energy.

D Along RS, latent heat is further lost

20 The graph shows the variation of the displacement of particles with distance along a transverse wave at an instant in time. The wave is moving to the right.

Which position along the wave corresponds to a point where particles in the wave are travelling the fastest upwards?



21 Ultrasound has a number of uses in engineering and medicine.

What is ultrasound not used for?

A sonar
B medical scanning of soft tissue
C quality control
D sterilising medical equipment

22 The echo sounder of a ship transmits a pulse of sound which is reflected back to the ship by a shoal of fish directly below the transmitter. The time between the transmission and the reception of the pulse by the ship is 0.10 s. The speed of sound in sea water is 1200 m/s.

At what depth is the shoal of fish found?

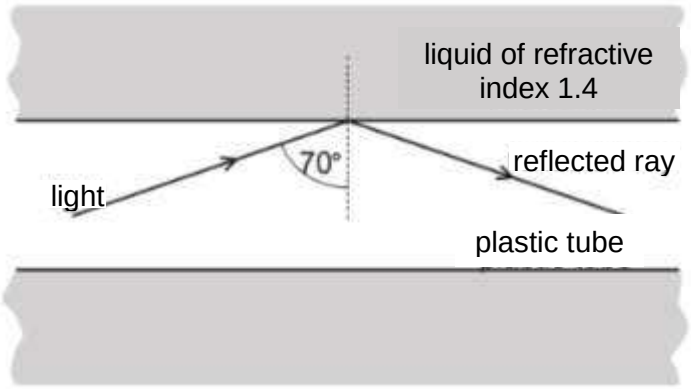
A 60 m
B 120 m
C 600 m
D 1200 m

23 Ultraviolet radiation, radio waves and X-rays are part of the components of the electromagnetic spectrum.

Which of the following shows these components arranged in order of increasing frequency?

A radio waves, ultraviolet, X-rays
B radio waves, X-rays, ultraviolet
C X-rays, radio waves, ultraviolet
D X-rays, ultraviolet, radio waves

24 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

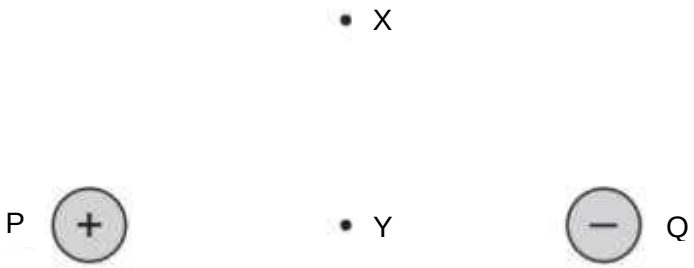
25 Four processes are used to charge an isolated metal sphere.

P The sphere is earthed by touching it.
Q The earth connection is removed from the sphere.
R A charged rod is brought close to the sphere.
S The charged rod is removed.

In which order should these processes be carried out to charge the sphere?

	First ----------> Last			
A	P	Q	R	S
B	P	R	S	Q
C	R	P	Q	S
D	R	S	P	Q

26 An electric field is formed by two isolated, equal and opposite charges P and Q.



How does the field at X compare with the field at Y?

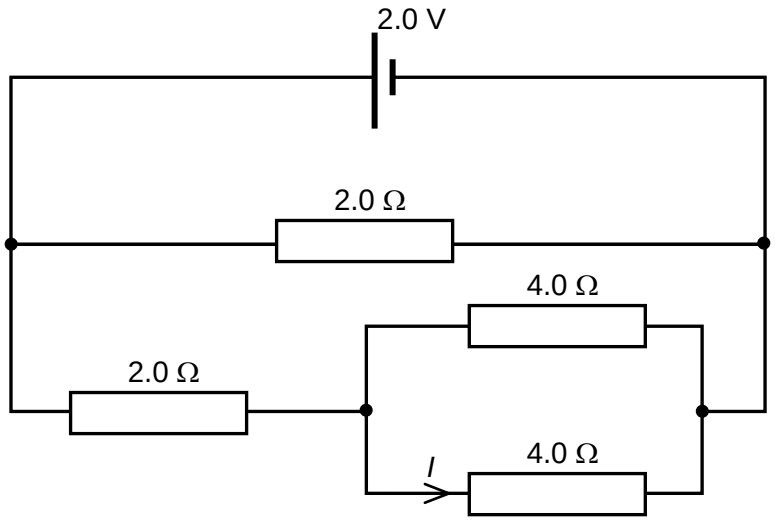
A It is stronger at X than at Y and is in the opposite direction.
B It is stronger at X than at Y and is in the same direction.
C It is weaker at X than at Y and is in the opposite direction.
D It is weaker at X than at Y and is in the same direction.

27 A student plots a graph of current, *I* against potential difference, V of a filament bulb. He obtains a curve passing through the origin.

What should the student observe to find out the change in the resistance of the filament?

A How the gradient of the tangent to the curve changes along the curve.
B How the inverse of the gradient of the tangent to the curve changes along the curve.
C How the ratio of V/*I* changes along the curve.
D How the ratio of *I*/V changes along the curve.

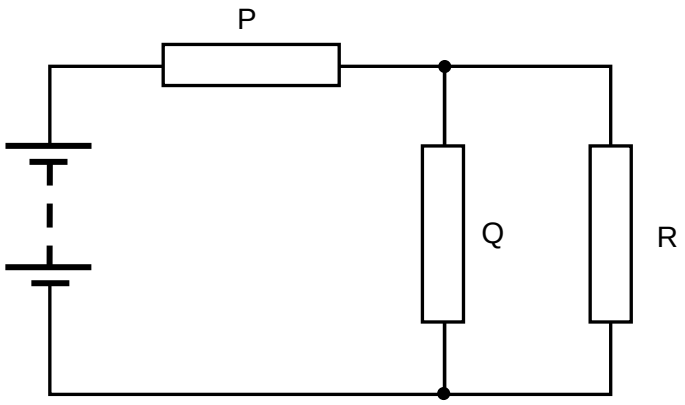
28 A cell of e.m.f. 2.0 V is connected to a network of resistors as shown.



What is the current *I* ?

A 0.25 A **B** 0.33 A **C** 0.50 A **D** 1.5 A

29 The resistors P, Q, and R in the circuit have equal resistance. The battery supplies a total power of 12 W.



What is the power dissipated in resistor R?

A 2.0 W **B** 3.0 W **C** 4.0 W **D** 6.0 W

30 A wire of length 0.50 m and cross-sectional area $1.0 \times 10^{-6}\ m^2$ has a resistance of 0.75 Ω.
Another wire of the same material has a length of 2.0 m and a cross-sectional area of $0.50 \times 10^{-6}\ m^2$.

What is the resistance of the longer wire?

A 0.094 Ω **B** 0.38 Ω **C** 1.5 Ω **D** 6.0 Ω

31 The cost of 1.0 kWh of electricity is 80 cents. The table shows the power ratings of the electrical appliances.

electrical appliance	rating
television	135 W
air-conditioner	2.75 kW
lamp	100 W

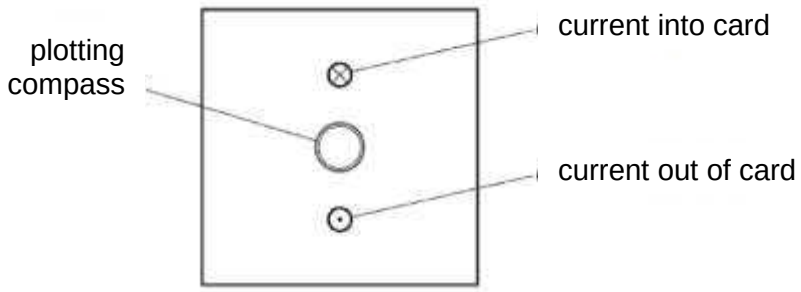
What is the total cost of operating the above electrical appliances for three hours?

A $7.16 **B** $12.24 **C** $73.40 **D** $429.80

32 It can be deduced that a piece of metal is already a magnet if

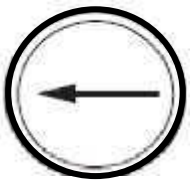
A both ends of a compass needle are attracted to it.
B a copper wire is attracted to it.
C one end of a compass needle is repelled by it
D a copper wire is repelled by it.

33 Two vertical wires pass at right-angles through a piece of card. There is a large current in each wire in the direction shown



A plotting compass is placed on the card.

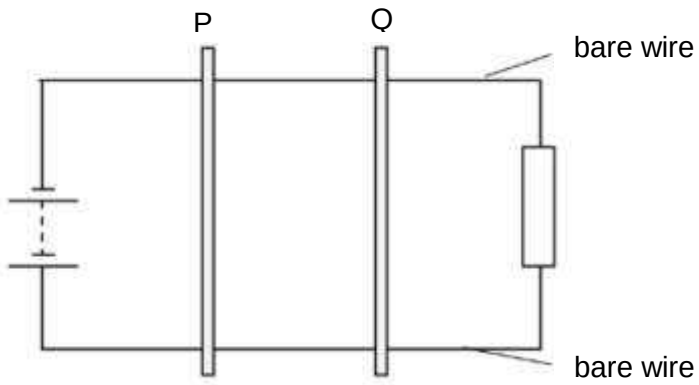
Which diagram shows the direction in which the needle of the plotting compass points?

A 
B 
C 
D 

34 What is the main purpose of the split ring commutator in the direct current motor?

A to create a change in magnetic flux linkage in the coil
B to prevent the wires from entangling
C to reverse the direction of the current in the coil every 180°
D to reverse the magnetic field in the coil

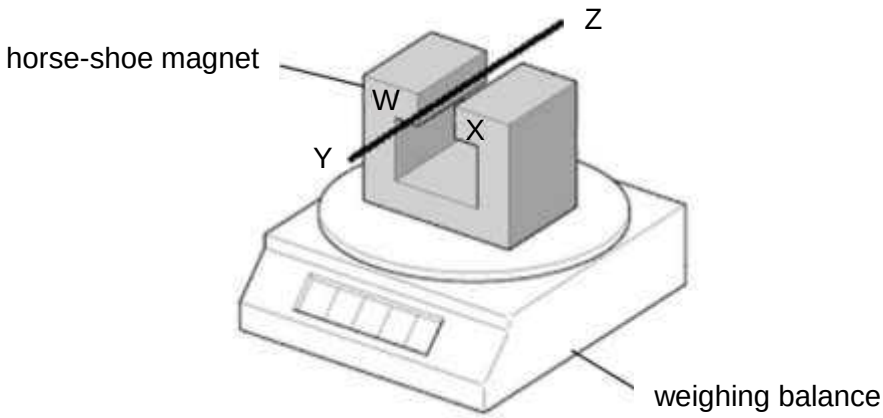
35 Copper rods P and Q are placed on top of the bare wires as shown.



What happens to both rods?

A Both rods attract each other.
B Both rods rotate anti-clockwise.
C Both rods rotate clockwise.
D Both rods repel each other.

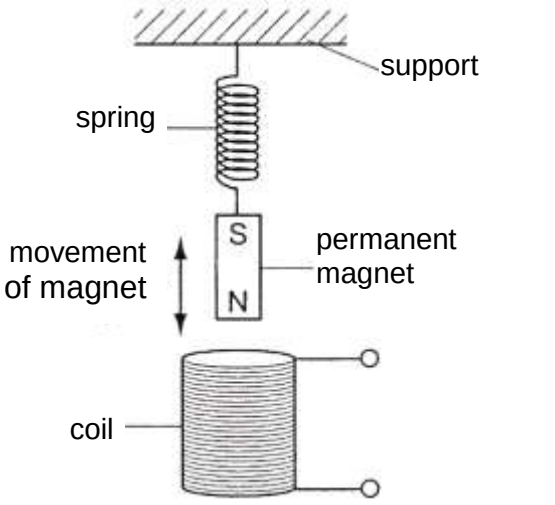
36 The diagram shows a current-carrying conductor YZ between the poles W and X of a magnet. The weighing balance shows the mass of the horse-shoe magnet before a current starts to flow in the conductor YZ.



When a current flows in the conductor YZ, the weighing balance reads a mass that is greater than the mass of the horse-shoe magnet.
What should be the magnetic poles of W and X of the horse-shoe magnet and the potential of the terminals of conductor Y and Z?

	Pole W	**Pole X**	**Terminal Y**	**Terminal Z**
A	north	south	negative	positive
B	north	south	no current	no current
C	south	north	negative	positive
D	south	north	no current	no current

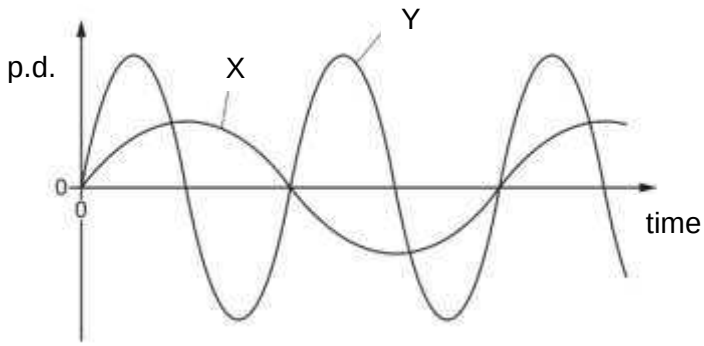
37 A permanent magnet moving up and down on the end of a spring induces e.m.f. in a coil.



Which factor, on its own, would decrease the maximum value of the induced e.m.f.?

A increasing the number of turns in the coil
B increase the strength of the magnet
C raising the coil
D raising the support of the spring

38 Graph X shows the output from an alternating current generator.



Which change can be made so that the generator produces graph Y?

A Decrease the magnetic field strength and decrease the speed of rotation only.
B Increase the magnetic field strength and decrease the number of turns of the coils only.
C Increase the number of turns of coils only.
D Increase the speed of rotation only.

39 Which statement about gamma rays is correct?

A They are deflected by both electric and magnetic fields.
B They are deflected by magnetic fields but not by electric fields.
C They are deflected by electric fields but not by magnetic fields.
D They are not deflected either by electric fields or by magnetic fields.

40 Which equation represents the **β**-decay of lead-209?

A $^{209}_{82}\mathrm{Pb} + {}^{0}_{-1}\mathrm{e} \longrightarrow {}^{209}_{83}\mathrm{Bi}$

B $^{209}_{82}\mathrm{Pb} + {}^{0}_{-1}\mathrm{e} \longrightarrow {}^{209}_{81}\mathrm{Tl}$

C $^{209}_{82}\mathrm{Pb} \longrightarrow {}^{209}_{83}\mathrm{Bi} + {}^{0}_{-1}\mathrm{e}$

D $^{209}_{82}\mathrm{Pb} \longrightarrow {}^{209}_{81}\mathrm{Tl} + {}^{0}_{-1}\mathrm{e}$

End of Paper 1

CEDAR GIRLS' SECONDARY SCHOOL
Preliminary Examination 2024
Secondary 4

CANDIDATE NAME	
CLASS	INDEX NUMBER
CENTRE/ INDEX NO	/

PHYSICS
Paper 2

6091/02

23 August 2024

Structured Questions

1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number in the spaces at the top of this page.

Write in dark blue or black pen.
You may use a HB pencil for any diagrams, graphs.
Do not use staples, paper clips, glue, or correction fluid.

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

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

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

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

For Examiner's Use		
Paper 1		40
Paper 2		
Section A		
1		4
2		6
3		3
4		8
5		9
6		5
7		8
8		6
9		10
10		11
Section B		
11		10
12		10
Deductions		sf
Total (P2)		80
Overall		
Total		%

Section A (70 marks)

Answer all questions in this section.

1 Fig. 1.1 shows a water wheel used in a farm. Water entering at the top turns the wheel about the hub.

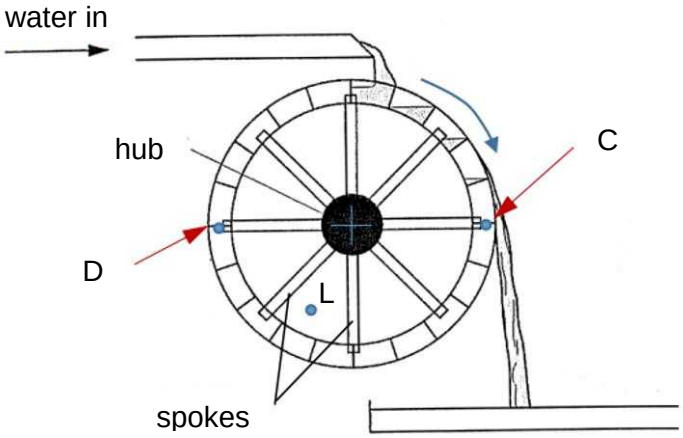


Fig. 1.1

The water wheel moves in a circular path at a constant speed of 2.5 m/s.

(a) **(i)** State the change in speed of point C as it moves to position D.

change in speed = ……. [1]

(ii) Determine the magnitude of the change in velocity of point C as it moves to position D.

change in velocity = …… [1]

(b) A Cedarian suggest that the **water in the wheel** undergoes acceleration. Discuss if she is correct.

……..

……

…… [2]

2 **(a)** A girl of weight 550 N is playing on a see-saw with her brother. Fig. 2.1 shows her brother of weight *W* sitting 1.1 m to the right of the balance point.

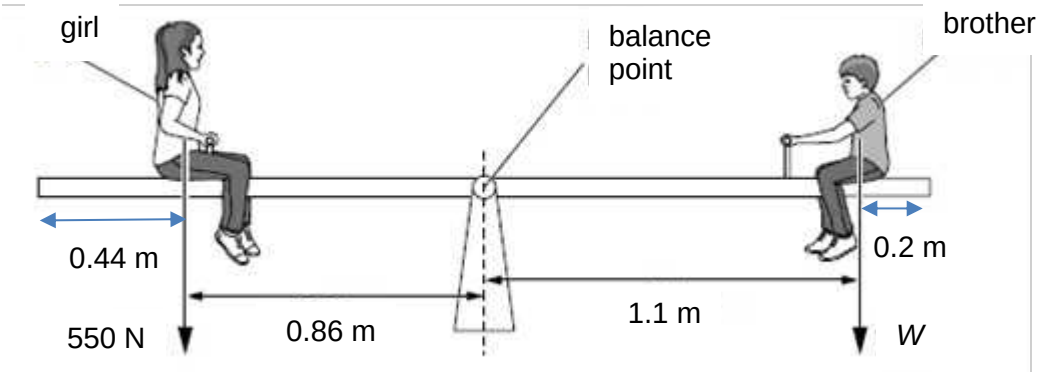


Fig. 2.1 (not to scale)

The see-saw is balanced when the girl sits 0.86 m to the left of the balance point.

(i) Determine the weight of the brother, *W*.

weight = ……..... [2]

(ii) The girl and her brother slide an equal distance along the see-saw away from each other at the same time. Describe and explain what happens.

……

……

…… [2]

(b) Fig. 2.2 and Fig. 2.3 below illustrate the rest position and the displaced position of a toy respectively. G is the centre of gravity of the toy.

Fig. 2.2

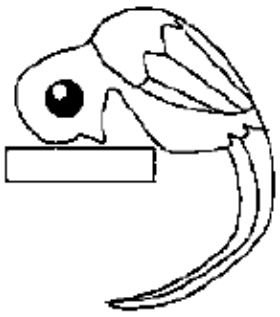


Fig. 2.3

Explain why the toy returns to its rest position when displaced and released from the position as shown in Fig. 2.3.

……

……

…… [2]

3 Fig. 3.1 shows a mercury manometer. The left arm of the manometer contains some trapped gas. The density of mercury is 13 600 kg / m^3. The gravitational field strength g is 10 N / kg.

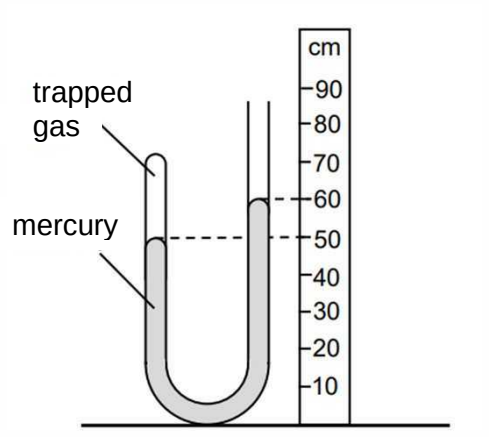


Fig. 3.1

The atmospheric pressure is 76.0 cm Hg.

(a) Calculate the pressure of the trapped gas in SI unit.

pressure = …… [2]

(b) A small hole is made in the left arm of the manometer such that the trapped gas can escape to the surroundings.

In Fig. 3.2 indicate the new mercury levels in both arms of the manometer after some time.

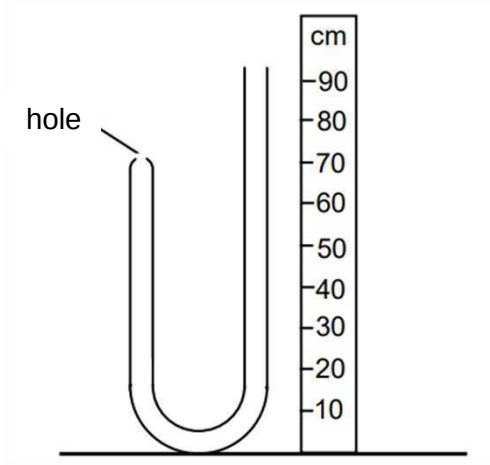


Fig. 3.2 [1]

4 Fig. 4.1 shows a shallow tank viewed from above. The depth of the water is different in the two parts of the tank. Fig. 4.1 shows the crests and the troughs of a wave that pass from left to right. **Diagram is not drawn to scale**.

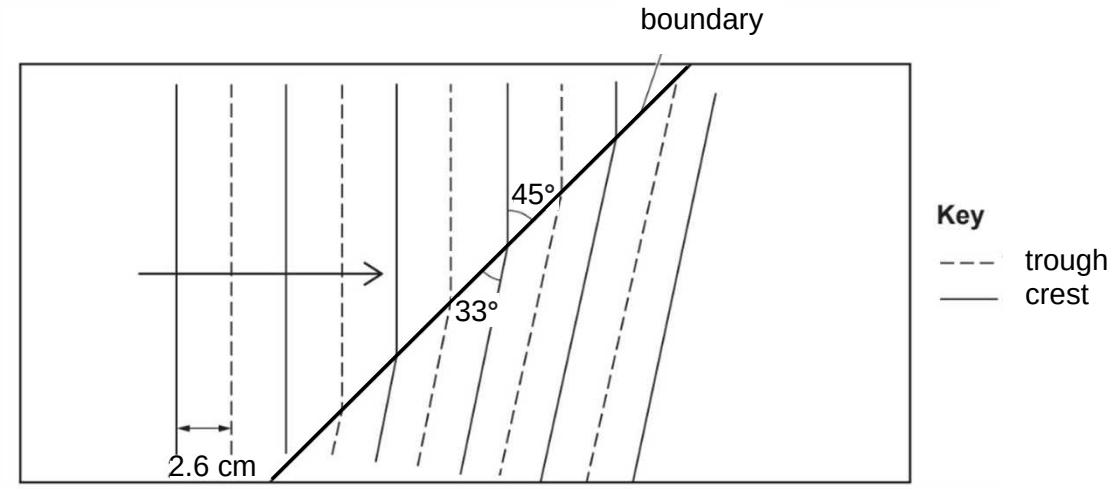


Fig. 4.1

(a) **(i)** Name the phenomenon observed above that is a characteristic of a wave:

…… [1]

(ii) Based on **Fig. 4.1**, state and explain what happened to the speed of the wave as it passes from left to right.

……

……

……

…… [2]

(b) The speed of the wave in the left-hand part of the tank is 0.39 m/s.

(i) Using information from Fig. 4.1, determine the frequency of the wave.

frequency = …… [2]

(ii) Determine the speed of the wave in the right-hand side of the tank.

speed = …… [3]

5 In the circuit shown in Fig. 5.1, a battery of e.m.f. 6.0 V is connected to a 60 Ω resistor, lamp L and a switch.

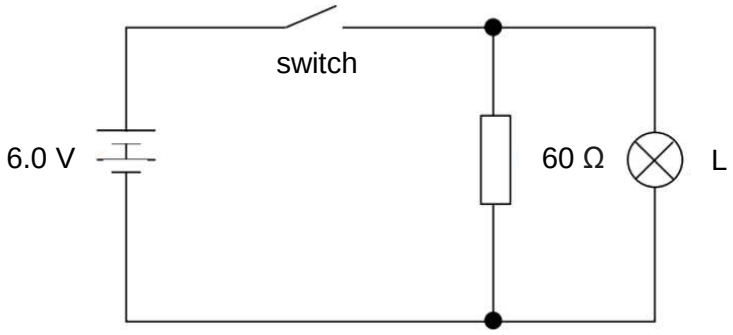


Fig. 5.1

The lamp L is marked 6.0 V, 0.90 W.

(a) When the switch is closed, calculate

(i) the current supplied by the battery,

current=…….. [2]

(ii) the amount of charge supplied by the battery in a time of 1.50 hours.

amount of charge=…….. [2]

(b) A light-dependent resistor (LDR) is added to the circuit where it is in series with the lamp as shown in Fig. 5.2.

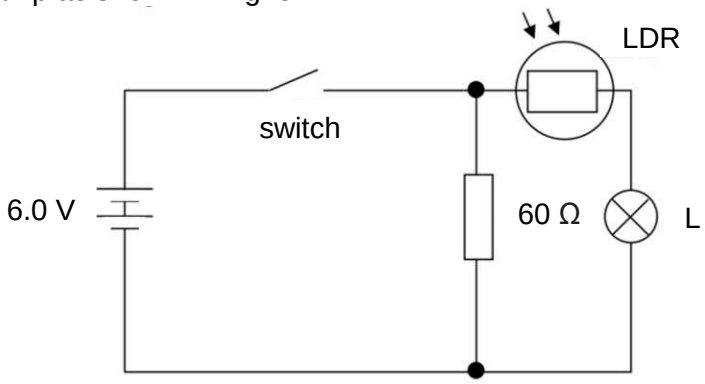


Fig. 5.2

When the switch is closed, light from the lamp falls on the LDR. The current supplied by the battery changes. Describe and explain the changes to the brightness of lamp L when the switch is closed.

……

……

…… [2]

(c) A student investigates the use of devices in setting up a fire alarm system. The following components are connected to a d.c. power supply as shown in Fig. 5.3:

- two 10 kΩ resistors,
- a light-dependent resistor with resistance 10 kΩ in the dark and 10 Ω in bright light.
- a negative temperature coefficient (NTC) thermistor with resistance 10 kΩ in low temperature and 10 Ω in high temperature,
- a bell.

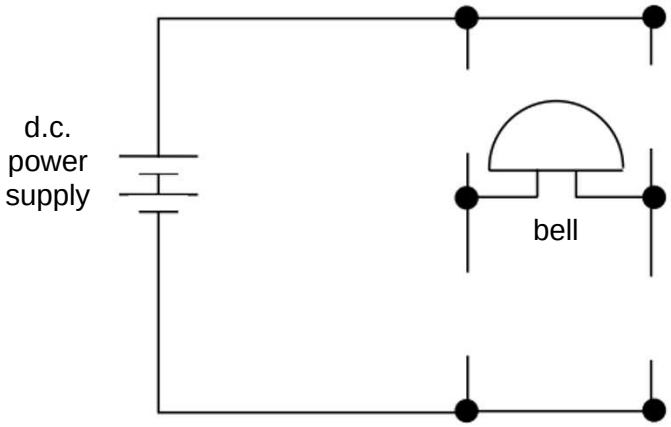


Fig. 5.3

The system is initially in a cold and dark environment. The bell will only sound under high temperature and bright light conditions.

(i) On Fig. 5.3, draw in two resistors, one light-dependent resistor and one thermistor in the spaces. [1]

(ii) Using your answer to **(c)(i)**, describe and explain the operation of the fire alarm system.

……

……

……

…… [2]

6 Fig. 6.1 shows a solenoid connected to an ammeter.

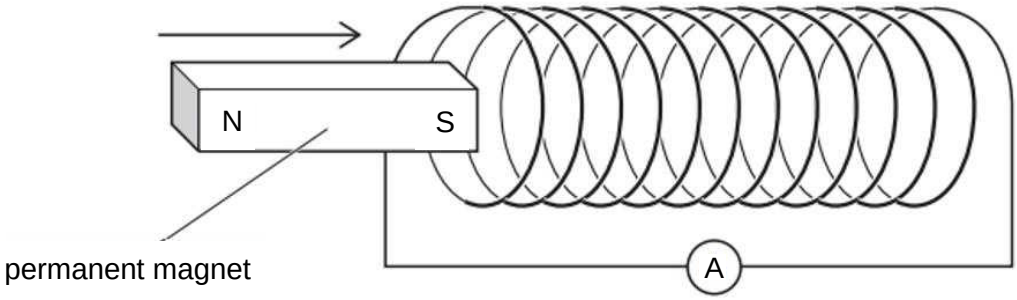


Fig. 6.1

The S-pole of a permanent magnet moves into the left-hand end of the solenoid.
The ammeter reading shows that there is a small positive current in the circuit.

(a) Explain why there is a current in the circuit when the magnet moves.

……

……

……

……

…… [3]

(b) When the magnet is inside the solenoid, it stops moving. It is then pulled back out of the solenoid.

State and explain what happens to the ammeter reading as the magnet moves out of the left-hand end of the solenoid.

……

……

…… [2]

7 A loudspeaker is made from a coil of wire fixed to a cardboard tube. The tube is attached to a cardboard cone.

Fig. 7.1 shows part of the arrangement of the loudspeaker.

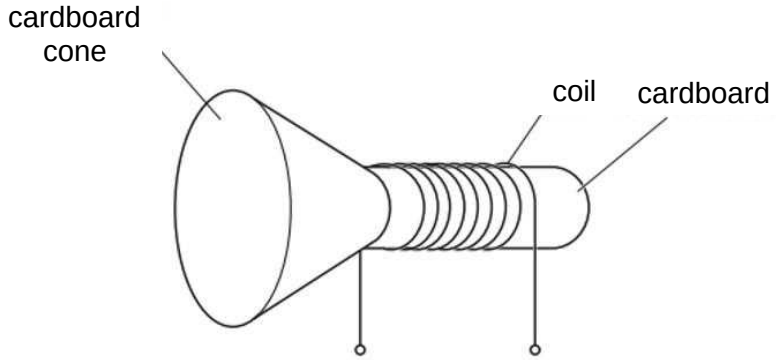


Fig. 7.1

When there is a current in the coil, the coil experiences a force.

(a) State what else is needed in a loudspeaker to make a current-carrying wire experience a force.

…… [1]

(b) A student connects the coil to the output of an alternating current (a.c.) generator. Fig. 7.2 shows how the electromotive force (e.m.f.) produced by the generator varies with time.

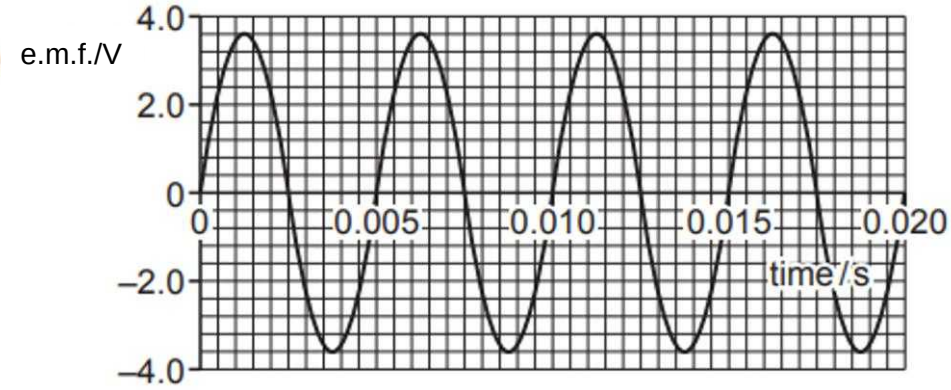


Fig. 7.2

The coil, tube and cone vibrate backwards and forwards.

(i) Explain why the e.m.f. shown in Fig. 7.2 makes the coil vibrate.

……

……

…… [2]

(ii) The vibrating cone produces sound in the surrounding air.
Explain, in terms of molecules, how the cone produces a sound wave that travels through the air.

……

……

……

……

…… [3]

(iii) Using Fig. 7.2, determine the number of times that the cone reverses its direction of motion in 1.0 s.

number = …..……. [2]

8 **(a)** Electrical power is produced in a power station by an alternating current (a.c.) generator. The output of the generator has a voltage of 22000 V. The electrical power is transmitted at a voltage of 400 000 V.

Explain why electrical power is transmitted at a voltage of 400000 V and not 22 000 V.

……

……

……

……

…… [3]

(b) A computer contains a transformer. The input voltage to the transformer is 240V. The output voltage from the transformer is 20V and the output current is 2.3A.
The efficiency of the transformer is 90%.

Calculate the input current to the transformer.

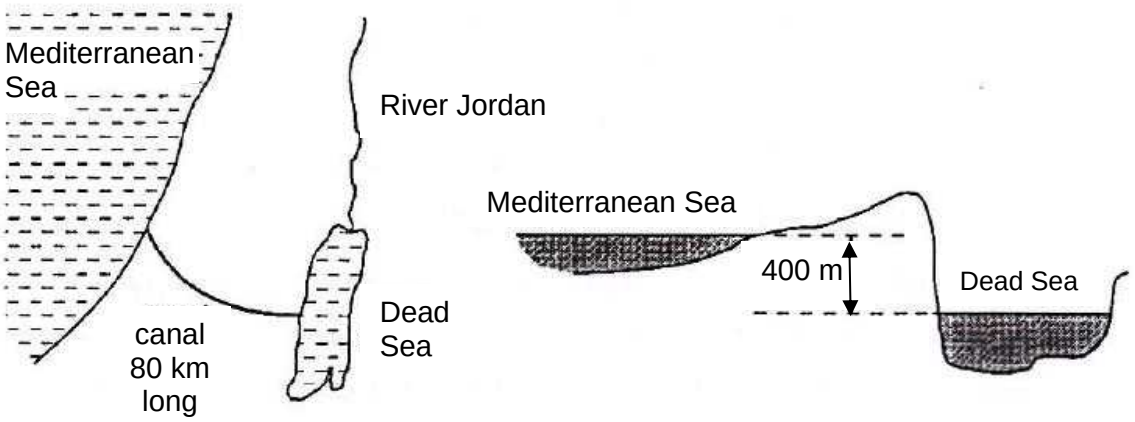
current = ……. [3]

9 The following paragraph is based on an article which was printed in The Sunday Times.

"The World Bank is considering the construction of a vast hydroelectric project to bring fresh water to the surrounding nations. The project could involve building a canal from the Mediterranean Sea to the Dead Sea, which lies 400 m below sea level. The canal would have hydroelectric plants to generate electricity for desalination plants at intervals along its length. The desalination plants could produce up to 100 million cubic metres of fresh water per year. At present, the Dead Sea is fed by the River Jordan, but there has been so much extraction of water for drinking and irrigation that, in summer, the flow of the river has been reduced to little more than a muddy trickle. The Dead Sea, which has a salinity that makes it the densest body of water on Earth, is prone to rapid evaporation and, as more water has been tapped, the level has fallen by 3.0 metres in the last 35 years. The canal project would be a way of stopping this decline."

In carrying out detailed studies on the projects, engineers have the following additional geographical and physical data.

Surface area of the Dead Sea	880 km^2
Specific latent heat of vaporization of water	2.4×10^6 J kg^{-1}
Average power per unit area absorbed by a water surface from sunlight during daylight	300 W m^{-2}
Density of sea water in Mediterranean Sea	1030 kg m^{-3}



sketch map of area cross-section

(a) Calculate the power absorbed by the Dead Sea from the Sun during daylight.

power = …….. [2]

(b) If 60% of the power calculated in **(b)** is used to evaporate water from the Dead Sea, calculate the mass of water which evaporates in 12 hours of daylight.

mass = …….. [3]

(c) Using the overall fall of the level of the Dead Sea, estimate the change during the last 35 years in the mass of water in the Dead Sea.

change in mass = …….. [2]

(d) State the store which energy is transferred from when water falls from the Mediterranean Sea into the Dead Sea producing electricity?

…….. [1]

(e) Assume that the proposed project aims to refill the Dead Sea to its former level in the next 35 years. Estimate the average power available from the water falling from the top of the Mediterranean Sea into the Dead Sea.

average power = …….. [2]

10 The isotope yttrium-90 is radioactive. It is a beta-particle emitter that decays to product Q.

Product Q is stable.

(a) State one feature that is common to all isotopes of yttrium.

…….. [1]

(b) Describe how a neutral atom of Q differs from a neutral atom of yttrium-90.

……..

……..

…….. [2]

(c) A sample of yttrium-90 is placed close to a radiation detector in a laboratory. There are no other radioactive samples in the laboratory. A counter records the count rate. Fig. 10.1 is a graph of the count rate plotted against time.

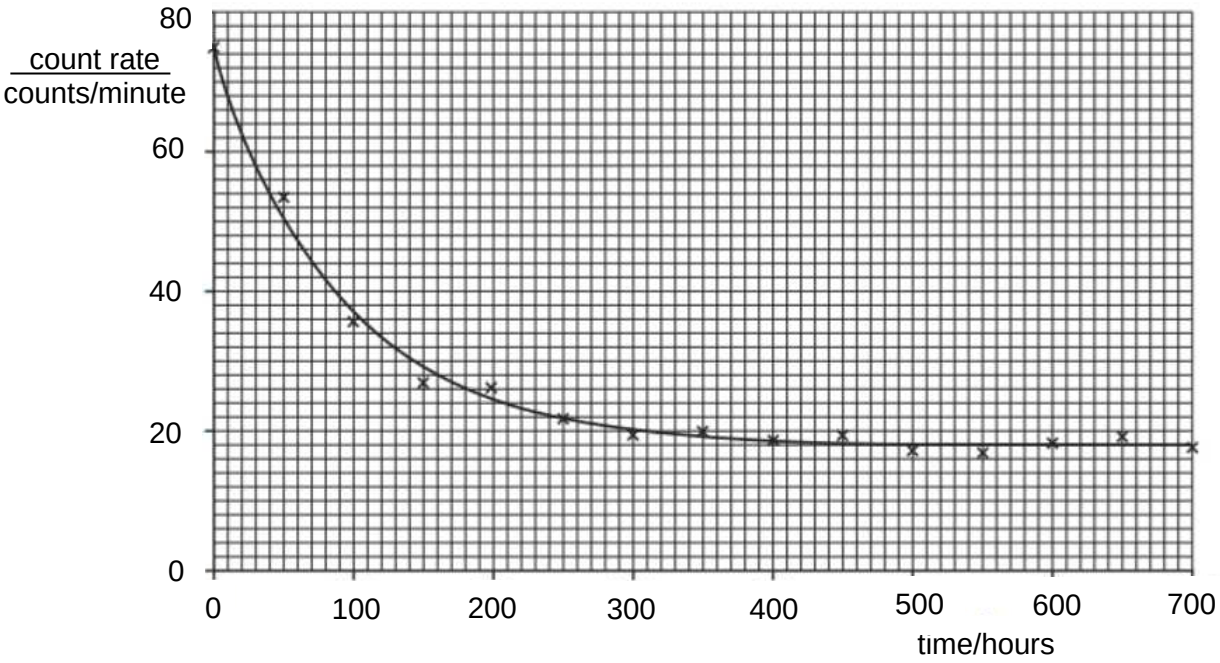


Fig. 10.1

(i) Using Fig. 10.1, determine the average background count rate.

average background count rate =…….. [1]

(ii) Using Fig. 10.1, determine the half-life of yttrium-90. Show how the answer is obtained.

half-life = …….. [3]

(iii) Many of the points plotted in Fig. 10.1 do not lie on the best-fit line. Explain why.

……...

……...…… [1]

(d) Fig. 10.2 shows an alpha-particle entering a uniform magnetic field.

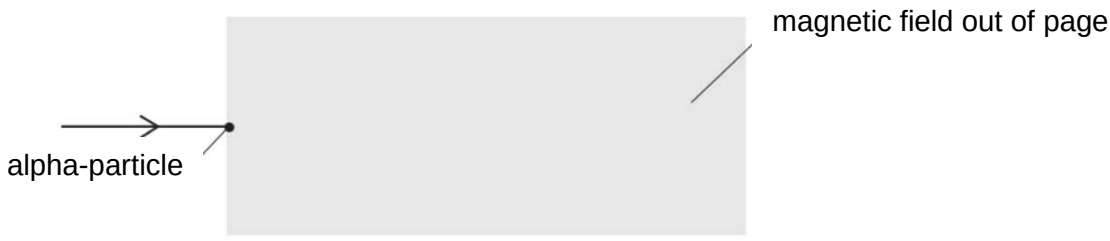


Fig. 10.2

(i) On Fig. 10.2, draw the path of the alpha-particle in the magnetic field. [1]

(ii) Explain why the alpha-particle follows the path you drew in (d)(i).

……...

……...……

……...

……...…… [2]

Section B

Answer **one** question from this section**.**

11 A swimmer reaches the end wall of a swimming pool and turns around under the water.

Fig. 11.1 shows the swimmer immediately after turning around.

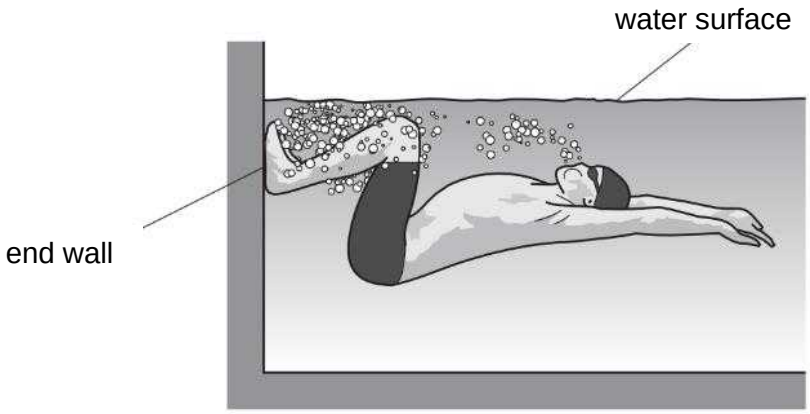


Fig. 11.1

(a) Explain, in terms of Newton's third law, why the swimmer wants to push against the end wall of the pool with his legs with as much force as he can.

……

……

……

…… [3]

(b) State two ways in which two forces in an action reaction pair, as described by Newton's third law are different.

……

……

…… [2]

(c) While swimming, there is a constant forward force on the swimmer. His speed increases until eventually he reaches a constant speed. Explain why he reaches a constant speed.

……

……

……

…… [3]

(d) The earth exerts a force of 800 N on the swimmer. This is one force in an action reaction pair. Describe the other force in the pair.

……

……

…… [2]

12 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 they hit the ground at the same time.

(a) The weight of the hammer is much larger than that of the feather. Explain, in terms of their weights and masses, why their accelerations are equal.

……..……..

……..……..

……..……..

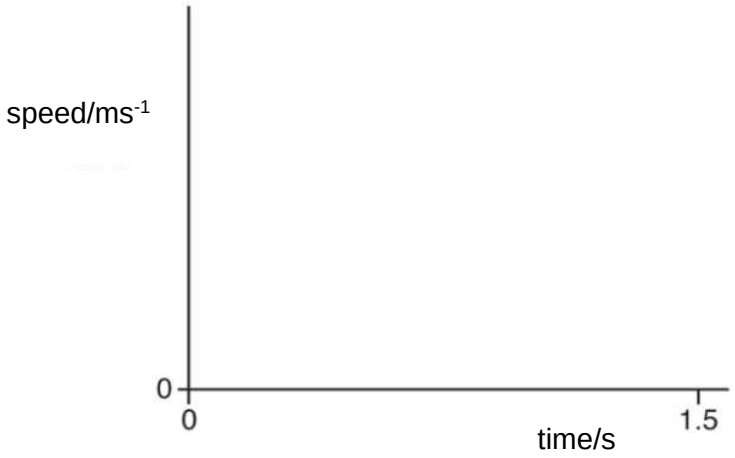
…… [2]

(b) Both the feather and the hammer take 1.5 s to fall to the ground from rest.

(i) Calculate the speed of the objects as they hit the ground.

speed = …….. [2]

(ii) On Fig. 11.2, draw the speed-time graph for the fall. At the correct position on the y-axis, write the value of the speed at time t = 1.5 s.



[2]

Fig. 11.2

(iii) Using the speed-time graph in Fig. 11.2, determine the height from which the objects are dropped.

height =…… [2]

(c) A space vehicle on the moon has a damaged engine. A student suggested that it is easier to push the vehicle than try to airlift it.
Explain why the student is correct or wrong. You may assume friction and air resistance is negligible.

……

……

……

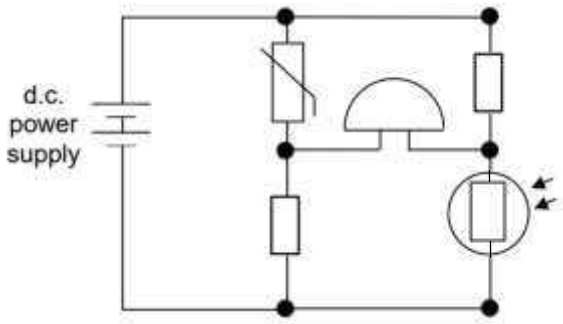
…….. [2]

END OF PAPER

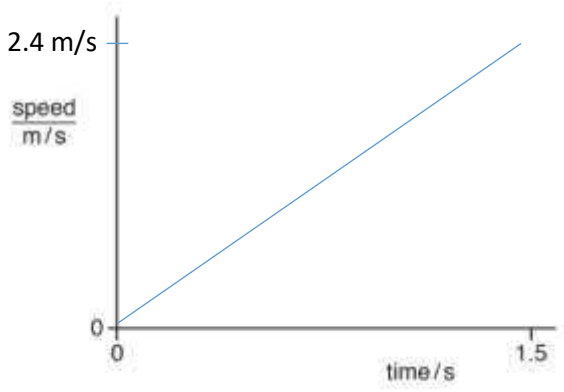
Physics Prelim 2024 P1&2 answers

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

1a(i)	0.0 m/s	1
1a(ii)	5.0 m/s.	1
1b	She is correct, since acceleration is the rate of change of velocity/acceleration exist when velocity changes [1] and the direction of the velocity is continously changing[1], and there is acceleration throughout the motion. OR There is a change of direction of movement, thus there is a net force acting on water in wheel. [1] Since resultant force = ma, there is an acceleration. [1]	2
2a(i)	Taking moments about the balance point, Since its in equilibrium, Sum of anticlockwise moments = Sum of clockwise moments $F_1 (d_1) = F_2 (d_2)$ (550)(0.86) = W(1.1) W = <u>430 N</u>	 1 1
2a(ii)	The see-saw rotates anticlockwise/ girl move down while boy moves up. The anti-clockwise moment <u>increases more</u> than the clockwise moment (at any time)./ The total anticlockwise moment is higher than the total clockwise moment.	1 1
2b	1. When displaced, there is a <u>perpendicular distance</u> between the line of action of weight and the pivot. OR line of action of weight falls on the right of pivot. 2. The <u>weight</u> of the toy thus provides a <u>clockwise</u> moment <u>about the pivot</u>. Cannot discuss anticlockwise because not in existence. 3. The toy <u>returns to the original position eventually where the line of action of the weight passes through the pivot OR c.g. is vertically(directly) below pivot.</u> (Either statement 1 + 2 or statement 2+ 3) O level will require all 3.	 2
3a	$P_{trapped\ gas}$= 10 cm Hg + P_{atm} = 86 cm Hg $P_{trapped\ gas}$ = (86/1 000) x 13600 x 10 = 1.17 x 10^5 Pa	1 1
3b	Equal height drawing at 55 cm	1
4ai	Refraction	1
4aii	The wavelength becomes smaller[1] suggesting that the speed of the wave decreases[1] OR The angle of incidence is larger than the angle of refraction/ wave bends towards the normal[1], therefore the speed of the wave slows down.[1]	1 1

4bi	f=0.39/(0.026*2) =7.5 Hz	1 1
bii	Refractive index = sin(45)/sin(33)=0.39/v allow ecf if error is penalized in bi v = 0.30 m/s OR Sin 45 = 0.052 / H Sin 33 = new wavelength / H New wavelength = (0.052 x sin 33) / sin 45 = 0.040 m v = wavelength x frequency = 0.04 x 7.5 = 0.300 m/s	2 1 1 1
5ai	I=P/V=0.90 W/6.0 V =0.15 A I=0.15 + 0.1 = 0.25 A	1 1
5aii	Charge = 0.25*1.5*60*60 allow ecf from ai =1350 C	1 1
5b	Resistance of the LDR decreases as light from the lamp falls on LDR. Current across the branch increase with LDR. Therefore power dissipated by the lamp increases, brightness increases.	1 1
5ci		1
cii	fire leads to hot and bright conditions, therefore resistance of the LDR decreases and resistance of thermistor decreases. low potential difference across the LDR and thermistor High potential difference across bell + Current flows through bell and Bell sounds	 1 1
6a	The permanent magnet causes a changing magnetic field <u>inside the solenoid/coil</u> or there is a change in magnetic flux linkage (<u>with the solenoid/coil</u>), <u>an e.m.f is induced</u> (requires 1st mark to score.) and since <u>there is a closed loop/circuit</u>, current flows in the solenoid.	1 1 1
6b	The ammeter reads a negative current. (Disallow answers that do not address ammeter directly.) This is (due to Lenz law), which says that current flows to oppose the change causing it. Since the change in magnetic flux is now the opposite of the previous case, the current also flows in the opposite direction. Allow polarity explanation.	1 1
7a	Magnet/magnetic field. Do not accept power source, current, complete loop.	1
bi	The current in the coil continually **<u>reverses direction</u>**, do not allow fluctuating, alternating (terms used in question stem cannot be reused as an explanation).	1

	causing the force acting on the coil to change direction also due to attraction or repulsion with permanent magnet. Only right hand grip rule allowed. FLHR cannot use here.	1
bii	The **cone** moves forward to compress/hit the air molecules, (allow cone displaces air molecules)[1] it then moves backwards to suck back the molecules (through low pressure).[1] **This produces a series of compressions and refractions** (or causes the air molecules to vibrate parallel to wave motion) which makes up a sound wave. [1] OR Cone vibrates and hits particles, causing them to vibrate as well.(Note this vibration is NOT random because it is a wave vibration.)[2] **This produces a series of compressions and refractions [1[**	1 1 1
iii	1/0.0025 = 400 times	2
8a	For the (***same power)*** transmitted, high voltage results in ***low current(P=IV)***[1]. Low current results in ***low power loss*** in transmission cables ***since $P=I^2R$[1], (assuming R is constant)***. (1m) Same power or R constant is measured above is additional one point. OR Allow thinner wires can be used since I is low.	3
b	0.9 x 240 x I_p = 20 x 2.3 [1] I_p= 0.21 A [1]	2 1
9a	P = 300 Wm^{-2} x 880 km^2 = 300 Wm^{-2} x 880 x 1000^2 m^2 [1] = 2.64 x 10^{11} W [1]	 1 1
b	Q= Pt x0.6 = 2.64 x 10^{11} W x 12 x 60 x60 x 0.6 = 6.84 x 10^{15} J [1] Q=ml_v 6.84 x 10^{15} = m * 2.4 x 10^6[1] m = 2.85 x 10^9 kg [1]allow ecf from (a)	 1 1 1
c	Volume = h*A = 3 * 880 x1000^2= 2.64 x 10^9 m^3 [1] m=p*V= 1030 x 2.64 x 10^9= 2.72 x 10^{12} kg [1]	1 1
d	Gravitational Potential store [1]	1
e	P=E/t = mgh/(35x365x24x60x60) = (2.72x10^{12}x10x400)/(35x365x24x60x60)[1] allow h= 397m = 9.86 x 10^6 W [1] allow ecf if exact same conversion done wrongly earlier.	1 1
10a	Same number of protons	1
b	One more proton, one fewer neutron[1] and one more electron[1]	2
ci	18 counts per minute	1
ii	74 -18=56 [1] 56/2 +18 = 46 count/min[1] 65 hours correct reading off graph[1]	3
iii	Radioactive decay is random	1
di	Curve downwards.	1

ii	Using Fleming left hard rule. The current (represented by middle finger) is to the right. the magnetic field (represented by index Finger) is out of the paper. The thumb with indicates the direction of the force is downwards.[2] Bonus mark: 1 mark for suggesting that current is to the right for a max of 2.	2
11a	As the swimmer pushes against the wall to the left, the wall exerts a force on the swimmer to the right. This two forces are equal in magnitude by newton's 3rd law, 3 points: direction, magnitude and bodies mention 2 out of 3 =>1 mark, 3 of 3 => 2 mark. hence if he pushes harder against the wall, he will experience a greater force to give a ***greater*** acceleration	2 1
b	The forces are in opposite direction and act on different bodies.	1 1
c	As his speed increases, water resistance on swimmer increases [1], until his forward force is equal to the water resistance[1], there will be no net force[1] and speed will become constant.	1 1 1
d	The gravitational force exerted by the swimmer on the earth. [1] It is equal in magnitude and opposite in direction.[1] "different" is not accepted.	1 1
12a	The weight of the hammer while larger, has to overcome a larger mass to give the hammer an acceleration. The mass of the hammer in the gravitation force and the mass due to inertia will cancel out, thereforce the acceleration of the hammer will be equal to its gravitational field strength. The same applied for the feather, therefore both bodies have acceleration equal to 1.6 m s^{-2}	1 1
bi	a=(v-u)/t 1.6=v/1.5[1] v=2.4 m/s [1]	 1 1
bii	 1 mark if gradient curves to zero and numbers are there.	2
iii	0.5* 2.4 * 1.5 = 1.8 m	1 1
c	Student is correct as when you lift the vehicle, you have to first overcome it's weight (before you can have acceleration).While if you push the vehicle, there is no weight to oppose you, (the acceleration would be higher for the same force applied) OR Lifting force must be greater than weight. When pushing there is no resistance to your pushing force, there it is easier.	1 1 [2]