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.

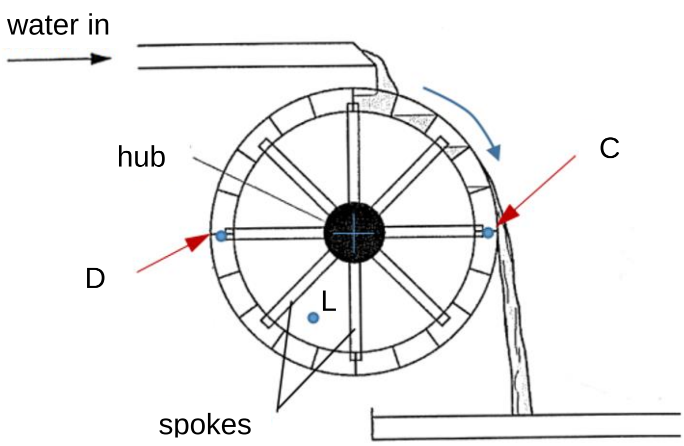

Fig. 1.1

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.

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…………………………………………………………………………………………… [2]

For Examiner's Use

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.

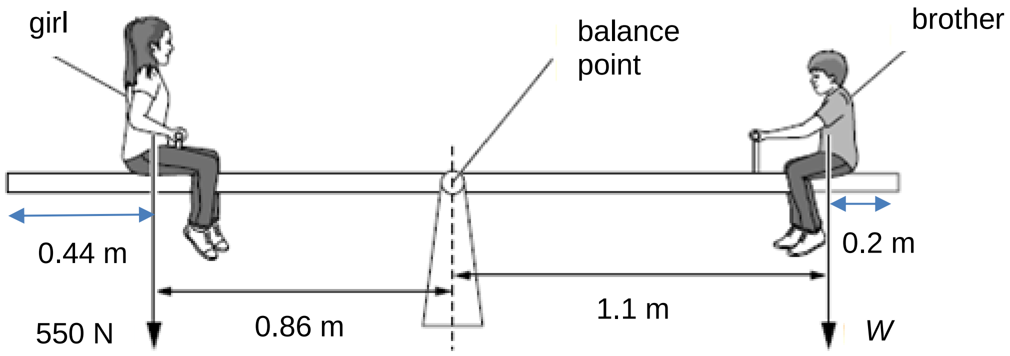

Fig. 2.1 (not to scale)

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.

……………………………………………………………………………………………..……

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…………………………………………………………………………………………… [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.

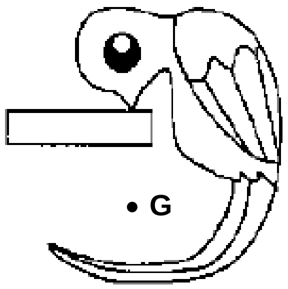

Fig. 2.2

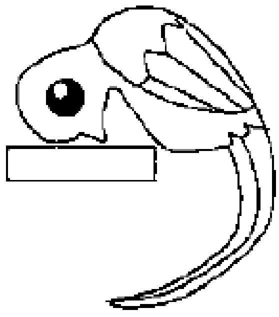

Fig. 2.3

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.

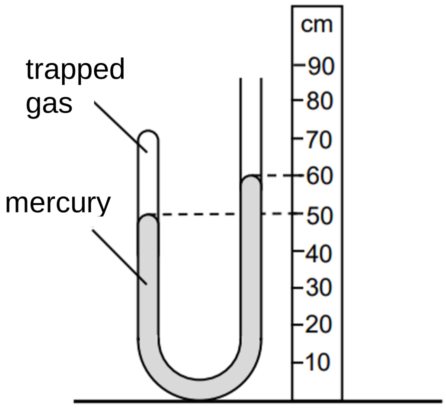

Fig. 3.1

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.

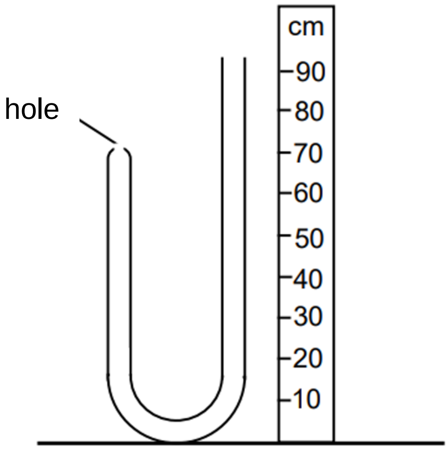

Fig. 3.2 [1]

For Examiner's Use

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.**

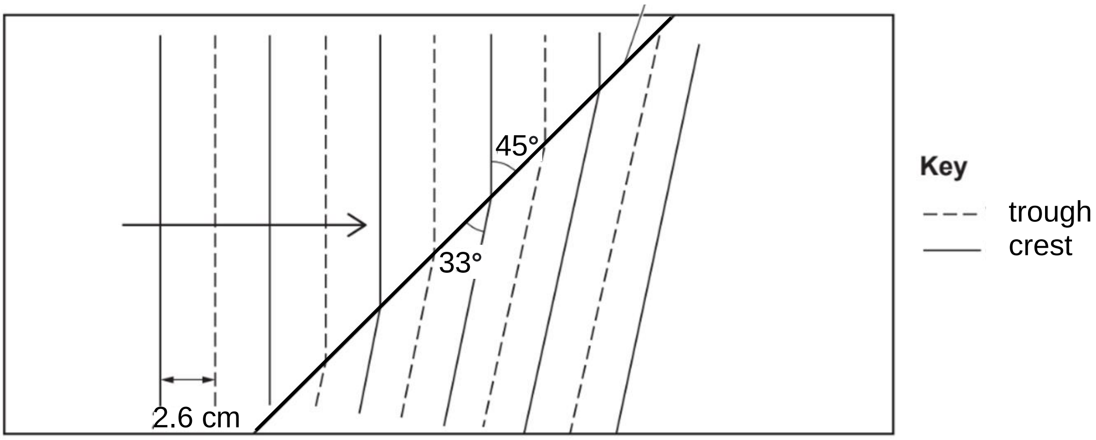

Fig. 4.1

(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]

For Examiner's Use

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.

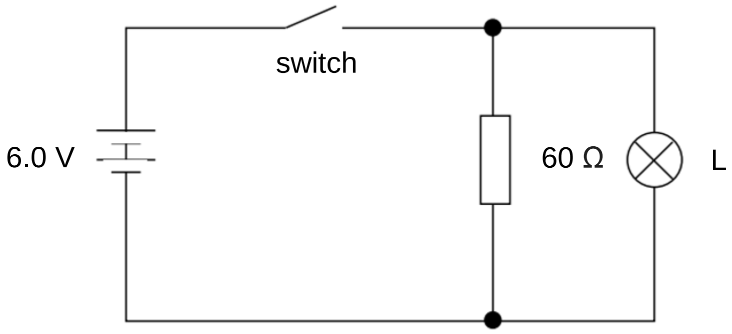

Fig. 5.1

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.

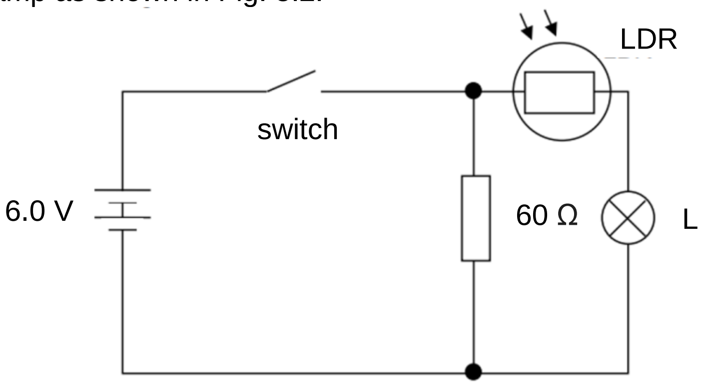

Fig. 5.2

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.

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……………………………………………………………………………………………… [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.

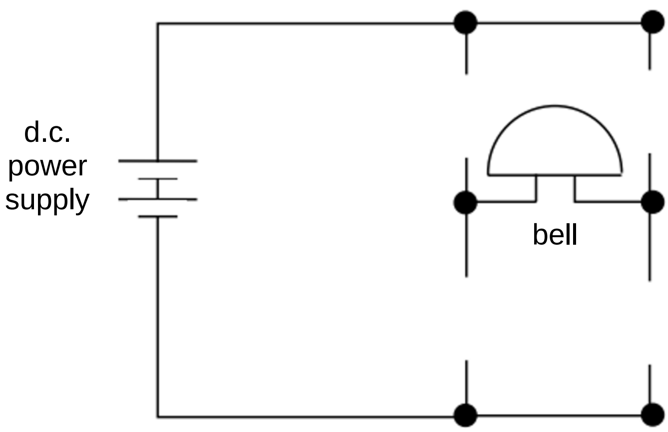

Fig. 5.3

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.

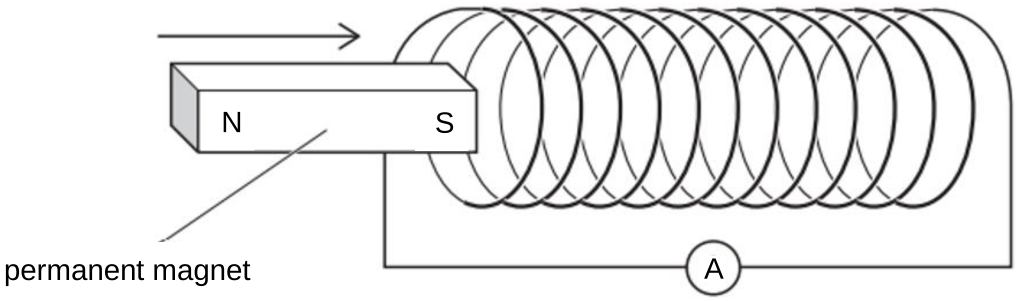

Fig. 6.1

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.

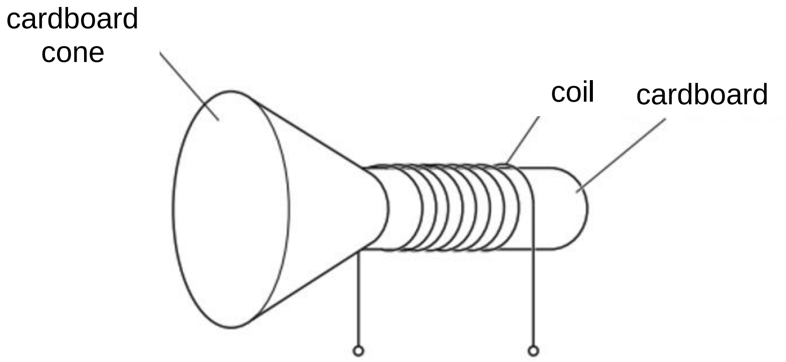

Fig. 7.1

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.

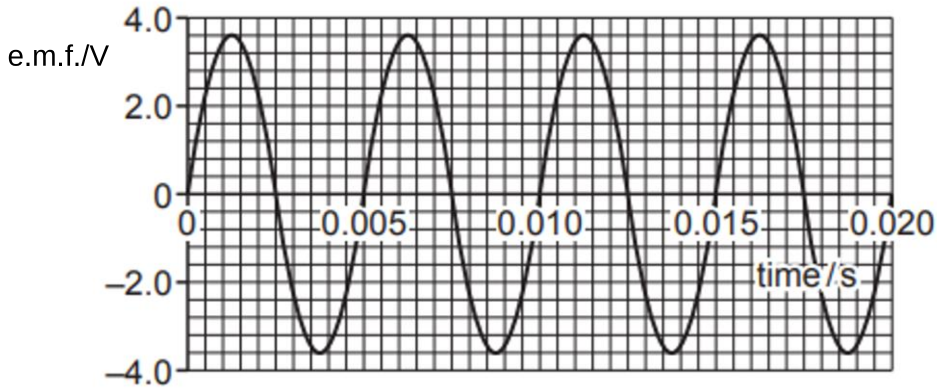

Fig. 7.2

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.

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………………………………………………………………………………………… [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.

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………………………………………………………………………………………… [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]

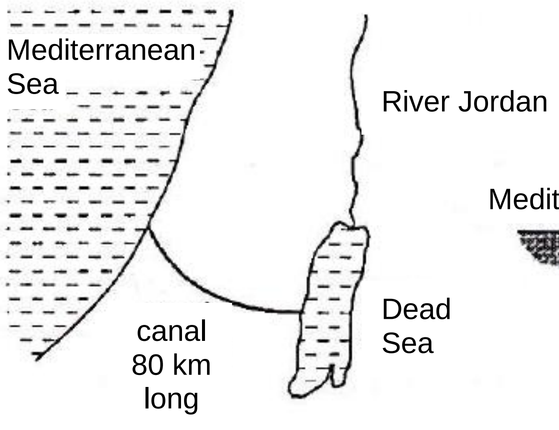
For Examiner's Use

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

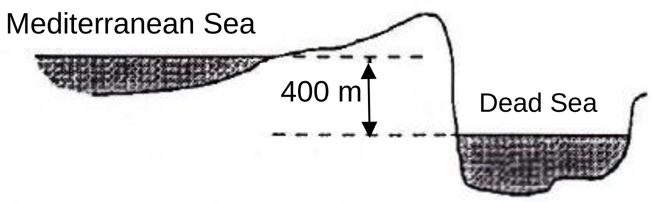
"The World Bank is considering the construction of a vast hydroelectric project to bring fresh water to the surrounding nations. The project could involve building a canal from the Mediterranean Sea to the Dead Sea, which lies 400 m below sea level. The canal would have hydroelectric plants to generate 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]

For Examiner's Use

(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.

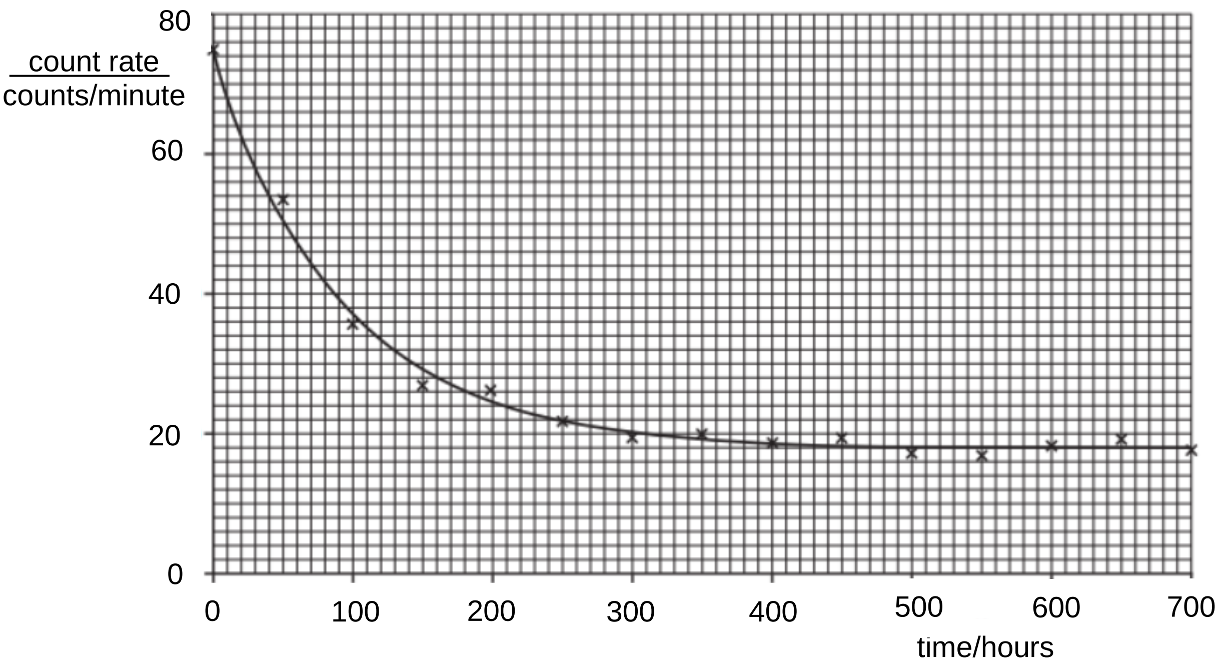


Fig. 10.1

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

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

For Examiner's Use

(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.

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…………...………………………………………………………………………… [1]

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

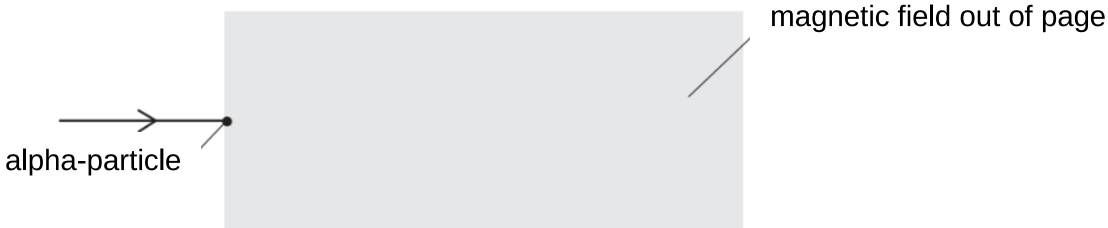

Fig. 10.2

(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).

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…………...………………………………………………………………………… [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.

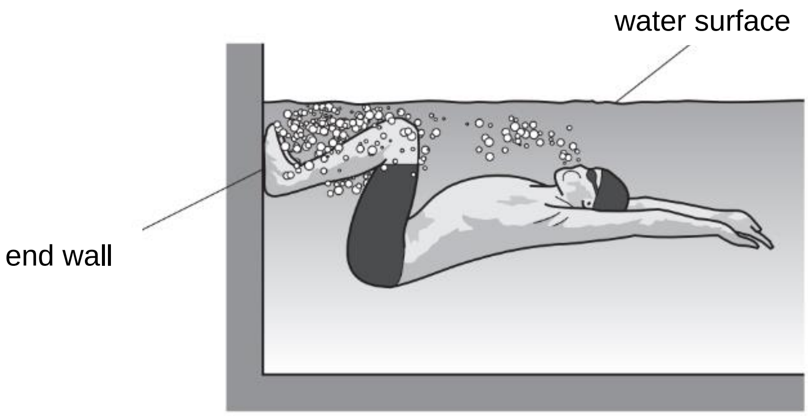

Fig. 11.1

(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]

For Examiner's Use

(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.

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……………………………………………………………………………………………………….........

…………..…………………………………..……………………………………………….. [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.

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……..………………………………………………………………………………………..

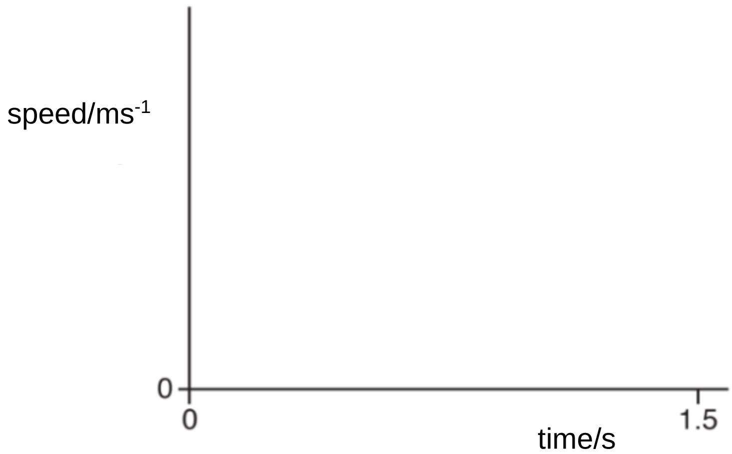
……………………………………………………………………………………… [2]

(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]

For Examiner's Use

(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.

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………………………………………………………………………………….. [2]

END OF PAPER