SINGAPORE CHINESE GIRLS' SCHOOL
END OF YEAR EXAMINATION 2023
YEAR FOUR INTEGRATED PROGRAMME

CANDIDATE NAME

CLASS	4				REGISTER NUMBER					
CENTRE NUMBER					INDEX NUMBER					

PHYSICS

Thursday **28 September 2023** **1 hour 45 mins**

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Section A

Answer **all** questions.

Section B

Answer **all** questions. Question 11 has a choice of parts to answer.

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.

Take g = 10 ms^{-2} or 10 Nkg^{-1} unless stated otherwise.

For Examiner's Use	
Section A	**50**
Section B	**30**
Total	**80**

This question paper consists of 21 printed pages and a blank page.

SECTION A

Answer all the questions in this section.

1 Fig. 1.1 shows a toy helicopter. It can hover and travel through the air.

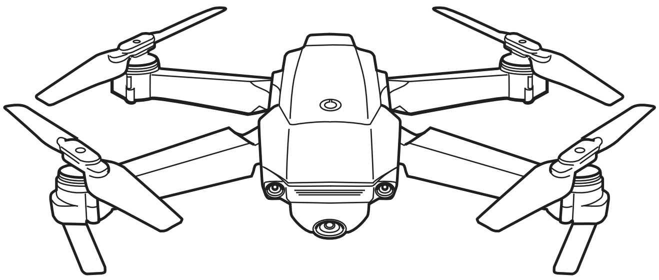

Fig. 1.1

A student flies the toy helicopter on a journey from A to B to C to D at a constant height. The toy helicopter makes the journey in 40 s.

Fig. 1.2 is a scale drawing of the path of the helicopter, viewed from above.

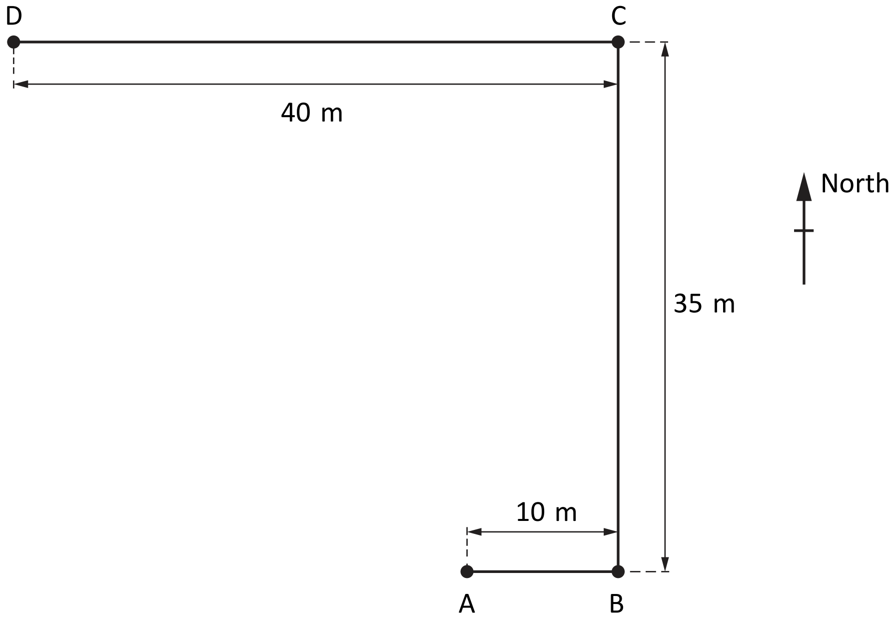

Fig. 1.2 (to scale)

(a) **(i)** State the difference between distance and displacement..

....

....[1]

(ii) Determine the average speed of the toy helicopter.

Average speed = ... [2]

(iii) Another toy helicopter flies directly from point A to point D in 40 s. Explain why the magnitude of the average velocity of this toy helicopter is smaller than the answer in **(a)(ii)**.

……

……..

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

(b) When the toy helicopter hovers at D, its motor fails and it falls. It reaches terminal velocity as it falls. Explain, in terms of the forces and acceleration, what happens as the helicopter falls and reaches terminal velocity. You may draw a diagram to illustrate your answer if you wish.

……

……

……

……

……

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………………………………………………………………………………………………… [3]

[Total : 7 m]

2 A child's toy consists of a flexible track and a model car.

Fig. 2.1 shows a diagram of the toy.

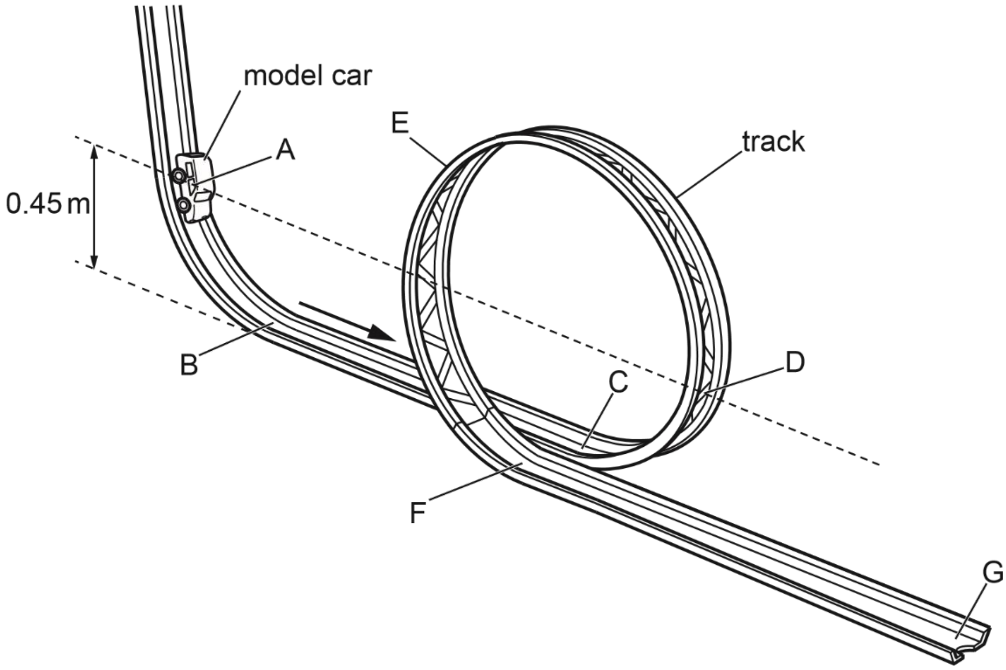

Fig. 2.1

The child first holds the car stationary at point A which is 0.45 m above the horizontal sections of track BC and FG. The mass of the car is 0.12 kg.

The child then releases the car which travels towards point B. Both air resistance and friction between the car and the track are negligible.

The gravitational field strength *g* is 10 N / kg.

(a) Calculate the change in gravitational potential energy (g.p.e.) of the car as it travels from A to B.

change in g.p.e. = ... [2]

(b) Calculate the speed of the car when it reaches B.

speed = ... [2]

(c) After releasing it, the child expects the car to follow the track along the route ABCDEFG. In fact, the model car does not reach F.

(i) Explain, in terms of energy, why the car does not go past D, which is also 0.45 m above the horizontal track.

....

.... [1]

(ii) Immediately after being released at A, the car travels to B, to C and then to D.

Describe the motion of the car after it reaches D.

....

.... [1]

[Total : 6 m]

3 A curved, glass tube is open at one end and sealed at the other. A dense liquid is poured into the tube. The liquid traps air in the sealed end.
Fig. 3.1 shows the tube, the liquid and the trapped air.

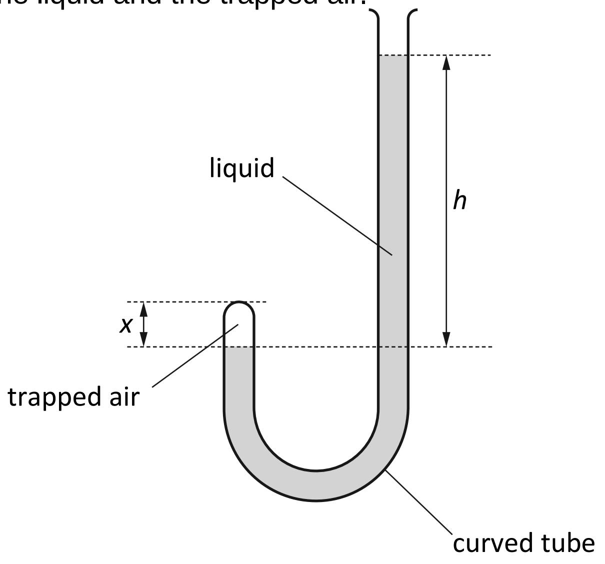

Fig. 3.1

(a) The difference between the liquid levels is h. At room temperature, h is 0.57 m. The density of the liquid is 1.4×10^4 kg / m^3.
The gravitational field strength g is 10 N / kg and the atmospheric pressure is 1.0×10^5 Pa.
Calculate the pressure of the trapped air.

pressure = ... [2]

(b) The trapped air in the tube is heated.

(i) The height of the trapped air in the tube is x.
Explain, in terms of molecules, why x changes when the air is heated.

....

....

....

....

....[3]

(ii) The trapped air reaches a constant temperature that is greater than its initial temperature.
Describe and explain the change in h in terms of the pressures involved.

....

....

....

.... [2]

[Total : 7 m]

4 Fig. 4.1 shows a model of the human arm. The rubber band represents the muscle that moves part of the arm XY up.

A mass is suspended from XY, as shown in Fig. 4.2. The weight of section XY is negligible and the model is at rest.

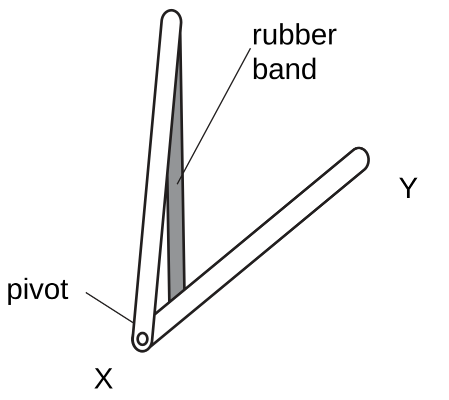

Fig. 4.1

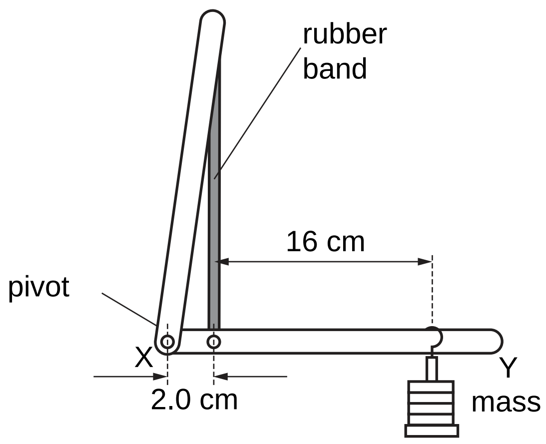

Fig. 4.2 (not to scale)

(a) State **two** ways in which the dimensions of the rubber band change as the mass is added to section XY.

....

.... [2]

(b) **(i)** Explain why the force that the rubber band exerts on section XY is larger than the weight of the mass.

....

....[1]

(ii) The mass suspended from section XY in Fig. 4.2 has a weight of 4.0 N.

Calculate the force that the rubber band exerts on section XY.

force = ... [2]

(iii) Explain how your answer to **(b)(ii)** is different if the weight of section XY is **not** negligible.

....

....

.... [1]

[Total : 6 m]

5 A negatively charged metal ball X is suspended from an insulating thread. An uncharged metal plate Y is mounted on an insulating stand. When X is brought near to Y, it is attracted towards Y as shown in Fig. 5.1.

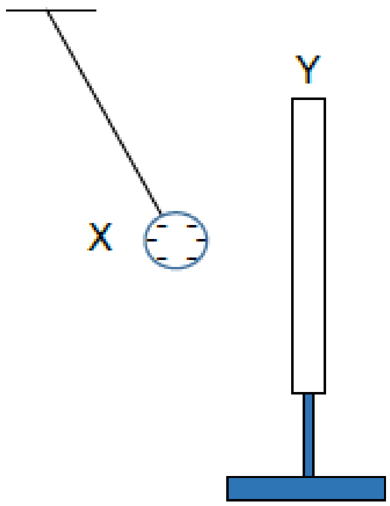

Fig. 5.1

(a) On Fig. 5.1, draw

(i) the resulting charges on Y, and [1]
(ii) the electric field in the space between the two conductors. [1]

(b) Explain why X is attracted to Y.

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

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

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

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

(c) Y is earthed momentarily as shown in Fig. 5.2. State and explain whether X will move closer, further or remains unchanged with respect to Y.

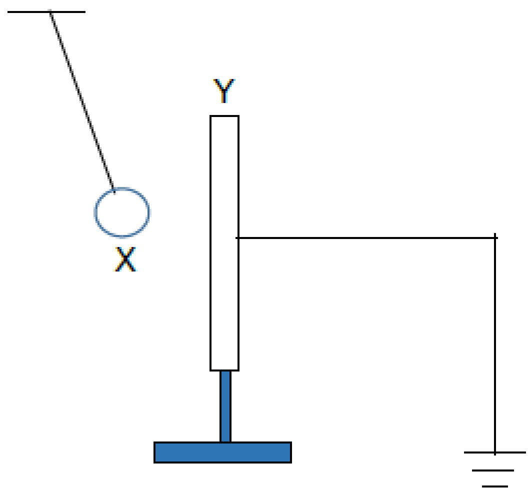

Fig. 5.2

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

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

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

[Total : 6 m]

6 Fig. 6.1 shows a vertical solenoid of steel wire connected in series with a battery and a switch.

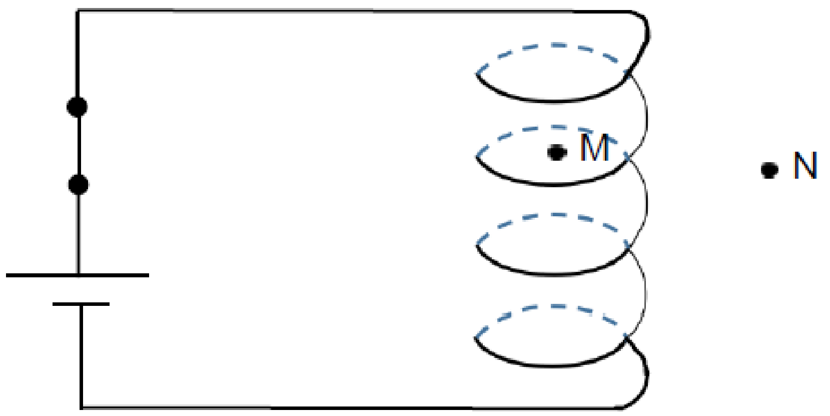

Fig. 6.1

(a) Describe two ways in which the magnetic field at M differs from the magnetic field at N.

1. ……………………………………………………………………………………......

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

2.……………………………………………………………………………………..........

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

(b) A student holds a steel paper clip and touches the bottom of the solenoid. When he releases the paper clip, it stays in contact with the solenoid.

(i) Explain why the paper clip does not fall upon release.

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

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

(ii) The switch is now opened.
State and explain whether the paper clip would remain in contact with the solenoid.

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

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

[Total : 6 m]

7 A student sets up the circuit shown in Fig. 7.1.

R is a fixed resistor in the circuit. The filament lamp is marked 12 V, 0.25 A and is operating at its normal brightness.

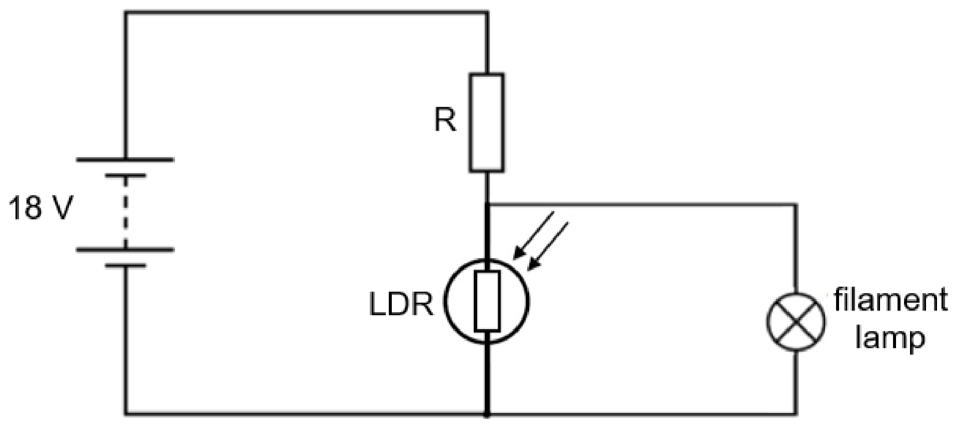

Fig. 7.1

(a) The resistance of the LDR is 50 Ω. Determine
(i) the current in the LDR, and

current = ………………….. [2]

(ii) the resistance of R.

resistance = ………………. [2]

(b) The student shines a torchlight of increasing brightness at the LDR.
State and explain what happens to the potential difference (p.d.) across R and the brightness of the lamp.

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

…………………………………………………………………………………………...

…………………………………………………………………………………………...

………………………………………………………………………………………..

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

[Total : 6 m]

8 Fig. 8.1 shows circular wavefronts produced at the centre of a circular ripple tank.

Two corks, A and B, float on the water in the ripple tank. They move up and down on the surface of the water as the wave passes.

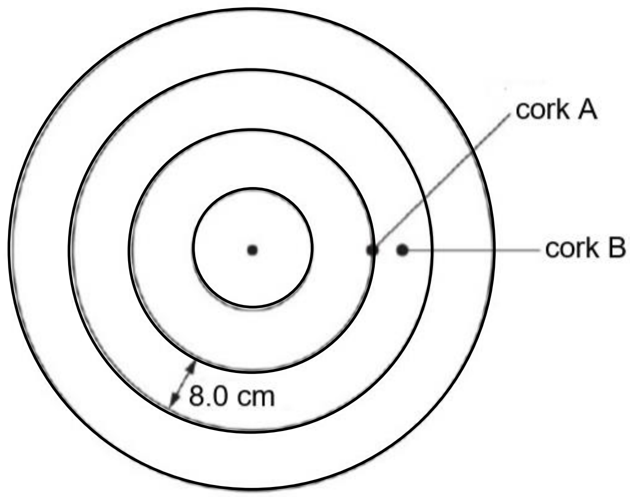

Fig. 8.1

(a) With reference to the information provided in the question, briefly explain why the wave produced in the ripple tank is a transverse wave.

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

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

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

(b) Fig 8.2 shows how the displacement of cork A varies with time.

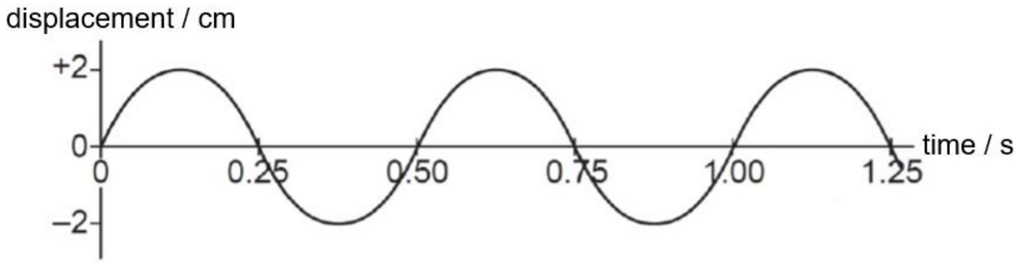

Fig. 8.2

(i) Determine the speed of the wave.

Speed of the wave = ………………….. [2]

(ii) On the axes below draw a second graph to show how the displacement of B varies with time. [2]

(c) State another transverse wave and its use.

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

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

[Total : 6 m]

SECTION B

Answer **all** the questions in this section.
Answer any one of the two alternative questions in Question 11.

9 Fig. 9.1 shows a stationary horse and its rider, about to jump over two fences.

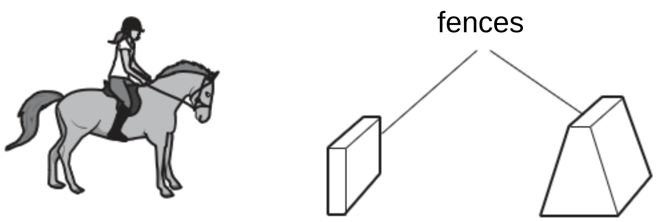

Fig. 9.1

Fig. 9.2 shows a side view of the horse.

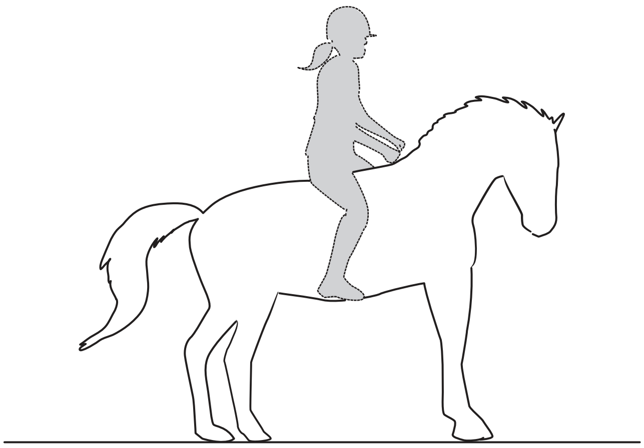

Fig. 9.2

(a) (i) On Fig. 9.2, draw and label the forces acting on the horse.

Include the force that the rider exerts on the horse. Label this force *F*. [2]

(ii) Explain how Newton's third law applies to force *F*.

....

....

.... [1]

(b) Fig. 9.3 shows a side view of the two fences. They both have the same height and a uniform density.

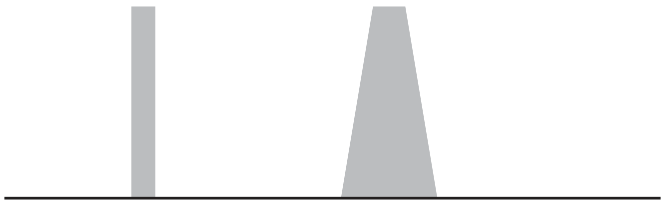

Fig. 9.3

(i) On each fence in Fig. 9.3, mark with a cross the centre of gravity. [2]

(ii) Explain why a wider base makes the fence more stable.

....

....

.... [1]

(c) The total mass of the horse and rider is 520 kg.

(i) As they approach a fence, the horse and rider have a total kinetic energy of 4000 J. Calculate their speed.

speed = ... [2]

(ii) The centre of gravity of the horse and rider is 1.4 m above the ground.

The maximum potential energy gained by the horse and rider as they jump over the fence is 3000 J.

Calculate the maximum height above the ground of the centre of gravity during the jump. The gravitational field strength *g* = 10 N / kg.

height = ... [2]

10 Fig. 10.1 shows a rotating permanent magnet in an alternating current generator ("dynamo"). The dynamo is used to power a lamp.

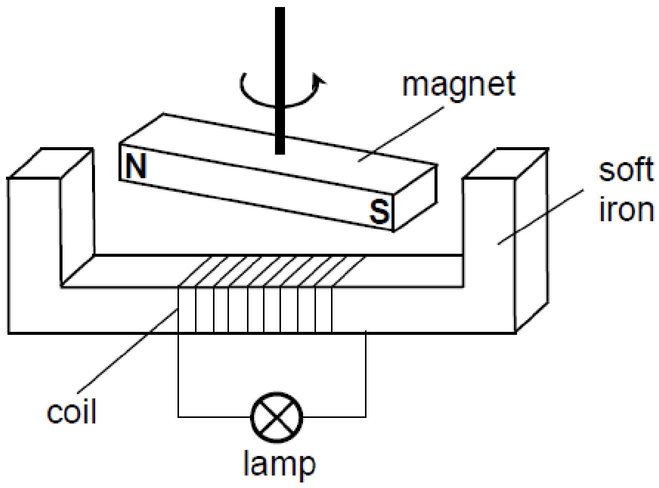

Fig. 10.1

(a) **(i)** State what is meant by an alternating current.

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

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

(ii) Explain why a current is induced in the coil of the dynamo.

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

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

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

[1]

(iii) Explain why the induced current is alternating.

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

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

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

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

(iv) State two ways that the induced current in the lamp might be increased.

1. ……………………………………………………………………………………..……......

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

2. ………...………………………………………………………………………….......…

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

(b) The primary input voltage is 23 000 V, and the secondary output voltage is stepped up to 660 000 V before it is transmitted over long distance.

(i) Explain why the voltage needs to be stepped up for transmission.

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

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

(ii) The current in the primary coil is 100 A. Find the power generated in the primary coil.

primary coil power = ………………… [2]

(iii) Assuming that the transformer is ideal, find the current in the secondary coil.

current = ………………….. [1]

EITHER

11 A small glass measuring cylinder of oil is placed inside a freezer where the temperature is –18 °C. Fig. 11.1 shows how the temperature of the oil varies with time *t*.

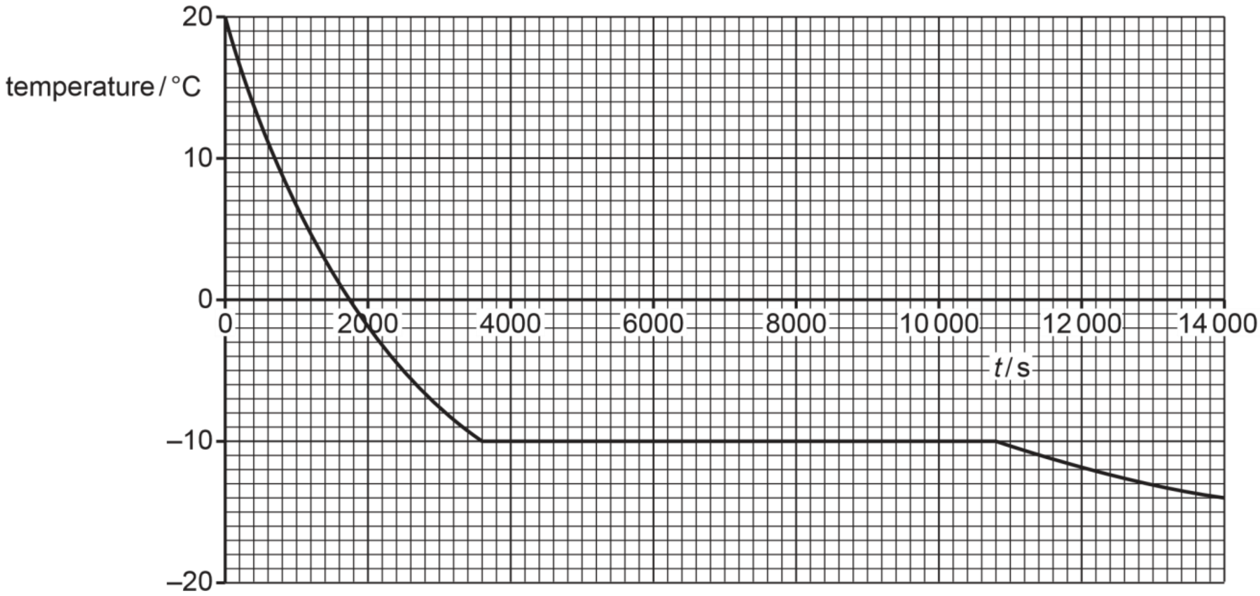

Fig. 11.1

(a) Suggest why the time taken for the temperature to decrease from 20 °C to 10 °C is different from the time taken for the temperature to decrease from 0 °C to –10 °C.

....

....

....

.... [2]

(b) Explain, using ideas of molecules, what happens to the level of the oil in the glass measuring cylinder as the temperature decreases from 20 °C to 0 °C.

....

....

....

.... [2]

(c) Explain, in terms of molecules, why the temperature of the oil does not change between t = 3600 s and t = 10 800 s.

....

....

....[1]

(d) There is 45 g of oil in the glass measuring cylinder and the specific latent heat of fusion of the oil is 5.7×10^4 J / kg.

(i) Calculate the energy transferred from the oil between t = 3600 s and t = 10 800 s.

energy = ... [2]

(ii) Calculate the average rate at which energy is transferred from the oil between t = 3600 s and t = 10800 s.

Average rate = ……………………[1]

(iii) The graph in Fig. 11.1 is steeper before the horizontal section than it is after.

Use this observation to compare the specific heat capacity of oil in the liquid and solid states. Explain your reasoning.

....

....

....

.... [2]

OR

11 Fig. 11.2 shows a microphone which is attached to a slider and placed in water. A pulse of ultrasound wave is generated by a signal generator and passed into water by a submerged buzzer. As the waves pass through the microphone and reflect off the wall and back to the microphone, two pulses of waves are registered by the detector as shown in Fig.11.3. The time-base (horizontal scale) is set at 10 μs/div.

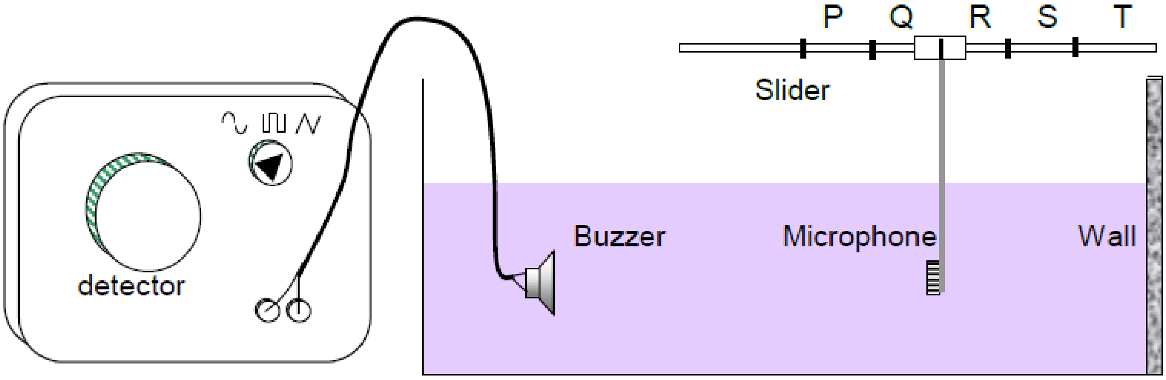

Fig. 11.2

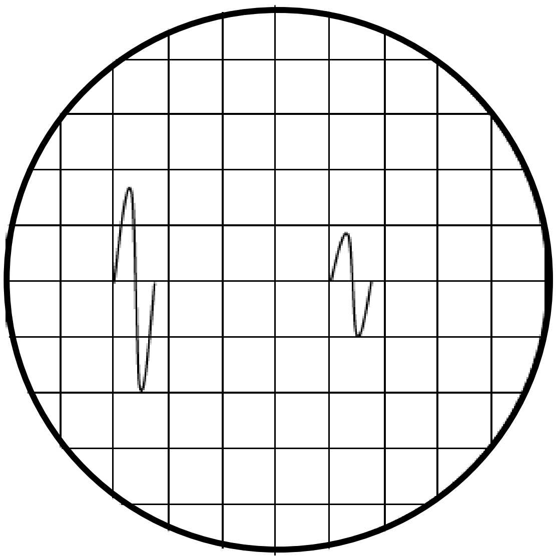

Fig. 11.3

(a) State what is meant by 'ultrasound wave'.

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

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

(b) Describe how ultrasound is transmitted through the water.

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

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

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

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

(c) Calculate the distance between the microphone and the wall if the speed of sound in water is 1500 m/s.

distance = ………………… [2]

(d) Estimate the frequency of the ultrasound.

frequency = …………………….. [2]

(e) Suggest reason(s) why

(i) ultrasound is often used to measure depth instead of sound of other frequencies.

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

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

(ii) the second pulse received is of lower amplitude than the first pulse.

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

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

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

END OF PAPER

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