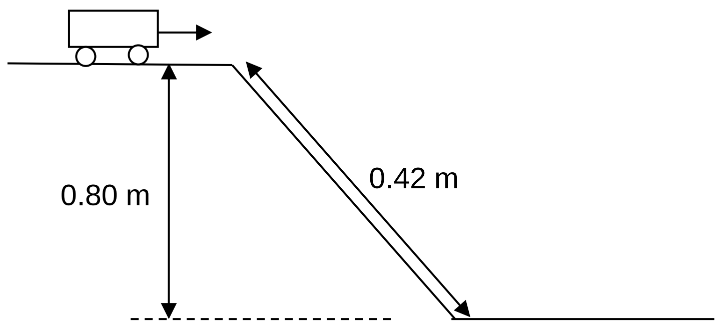
Section A (70 marks)

Answer **all** the questions in the spaces provided.

1 The diagram shows a model car with a mass of 0.25 kg. The car is travelling at a constant speed of 1.70 m/s as it approaches the rough ramp. The average friction opposing the motion of the car down the ramp is 0.15 N. Assume air resistance is negligible.



(a) Calculate the work done against friction as it moves down the rough ramp.

work done against friction = ………………………… [1]

(b) Calculate

(i) the loss in gravitational potential energy as the car moves down the ramp,

loss of gravitational potential energy = ………………………… [1]

(ii) the speed of the car at the bottom of the rough ramp.

speed of the car = ……………………………… [2]

(c) Draw a free body diagram of the car moving down the ramp, labelling the forces acting on the car. [2]

[Total: 6]

2 Fig. 2.1 shows a lorry accelerating along a straight road. The driving force exerted on the lorry in the forward direction is D and the total backward force acting on the lorry is B.

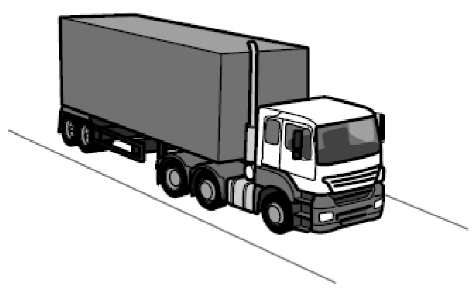


Fig. 2.1

The gravitational field strength is 10 N/kg.

(a) Compare the magnitude of the forces D and B. Give a reason for your answer.

…………………………………………………………………………………………………

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

(b) The lorry subsequently turns a corner at a constant speed of 12 m/s.

(i) Express the speed of the lorry in km/h.

speed = …………………………[1]

(ii) State and explain whether the lorry is accelerating when it turns the corner.

……………………………………………………………………………………

…………………………………………………………………...………[1]

[Total: 3]

3 Fig. 3.1 shows a uniform plank of mass 5.0 kg and length 2.0 m resting horizontally on two trestles, P and Q.

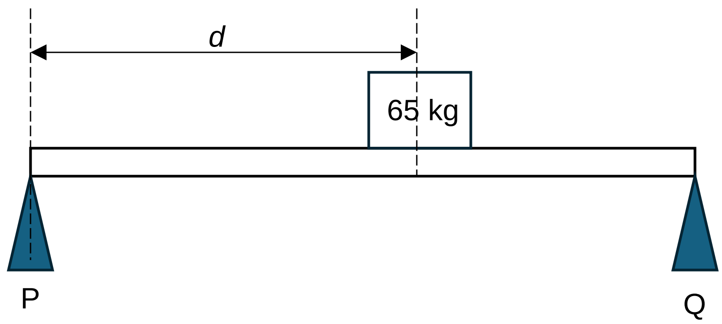


Fig. 3.1

Trestle Q exerts a force of 440 N on the plank when an object of mass 65.0 kg is placed at a distance, *d*, from P. The gravitational field strength, *g* = 10 N/kg.

(a) Calculate the moment due to the weight of the plank.

moment due to weight of plank = ……………………………..[1]

(b) Define *principle of moment*.

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

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

(c) Determine the distance *d*, of the object from P.

d = ……………………………….[2]

[Total: 4]

4 **(a)** Fig. 4.1 shows a ray of light XY being directed at the surface AB of an irregular-shaped glass block ABCDE.

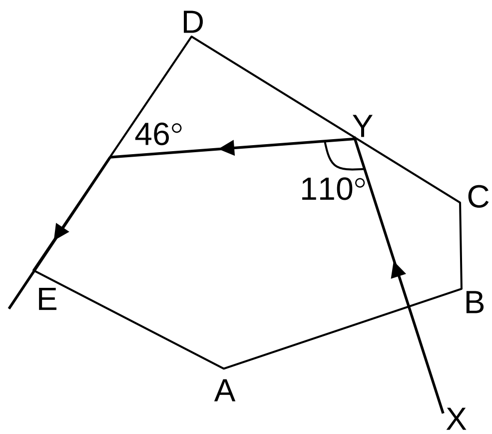


Fig. 4.1

(i) Explain why the ray XY enters surface AB without bending.

………………………………………………………………………………..[1]

(ii) Determine the critical angle of the glass.

critical angle = ... [1]

(iii) Calculate the speed of the light ray in the glass block.

speed = …………………………………….. [2]

(b) Fig. 4.2 shows how a thin converging lens L made of the same glass is used to produce a sharp image of an arrow that is twice the size of the illuminated object.

In the space below, complete a scale diagram of two rays from the top of the object to show how the sharp image in Fig. 4.2 is formed.

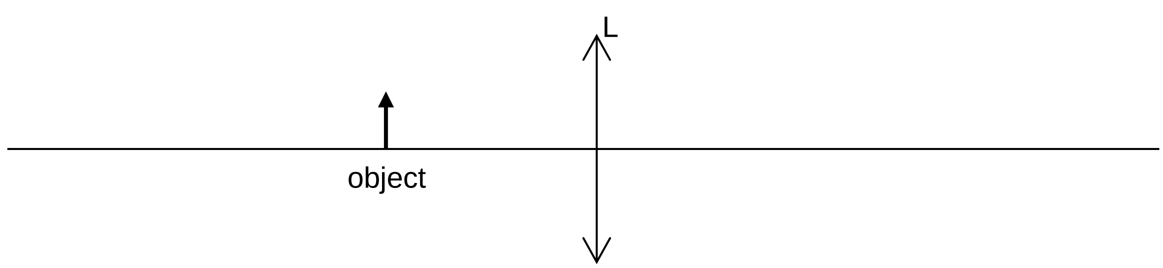
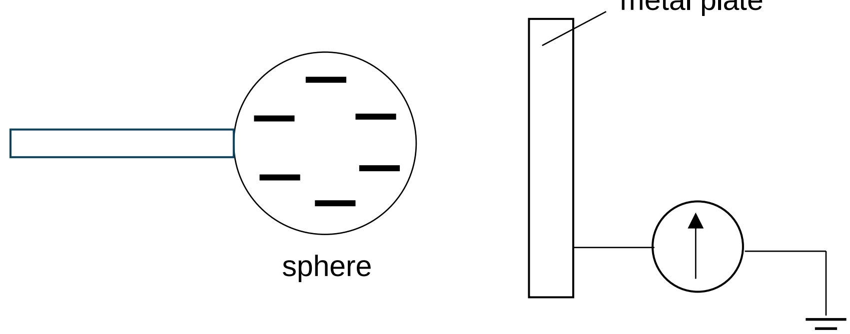


Fig. 4.2

[2]

[Total: 6]

5 The diagram shows a negatively charged metallic sphere held with an insulating handle. When the sphere is brought towards a metal plate, the sensitive galvanometer registers a momentary deflection.



(a) Explain why the galvanometer registered a momentary deflection when the charged sphere was brought near.

....

....

....

....[2]

(b) Draw on the above diagram, the electric field set up between the sphere and the plate when the sphere was brought near. [1]

(c) Describe what would be observed if the charged sphere was held in hand and moved towards the metal plate. Explain your observation.

....

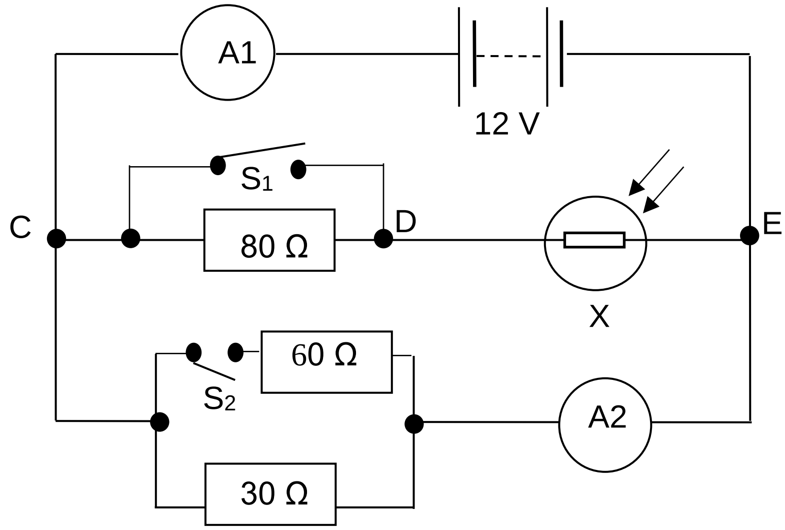
....

....

....[2]

[Total: 5]

6 The diagram shows an electrical circuit with different electrical components. The resistance of X is 2000 Ω and 400 Ω in dark and bright conditions respectively.



(a) State the name of component X ……………………………………...……………..[1]

(b) When S_1 and S_2 are opened in a bright room, calculate

(i) the effective resistance of the circuit,

effective resistance = ………………………..[2]

(ii) the charge flowing through the battery in 2 minutes.

charge = …………………………..[2]

(c) When S_1 and S_2 are closed in a dark room,

(i) calculate the power dissipated in X.

power dissipated in X = …………………………..[2]

(ii) Describe what measurements are taken and how they are used to find the energy produced by the 30 Ω resistor in 2 minutes.

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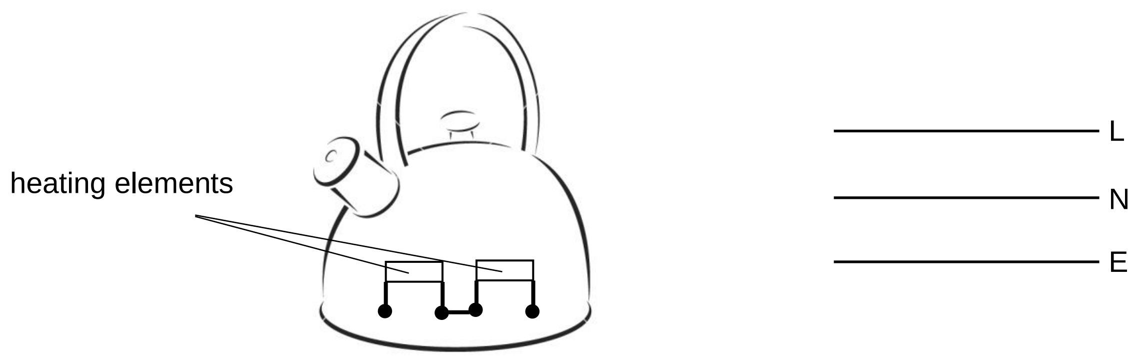
……………………………………………………………………………………...…...

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

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

[Total 9]

7 An electric kettle consists of two heating elements as shown in the diagram. The heating elements can be connected to the electrical mains supply of 240 V in various ways so that the heating power can be varied.



(a) Complete the circuit so that the heating power is the maximum and the kettle is safe to use. [2]

(b) The maximum heating power of the electric kettle is 550 W.
Determine the fuse rating for the kettle.

fuse rating = …………………………[1]

(c) Draw, on the above diagram, the correct position for the fuse and switch. Explain your answer.

………………………………………………………………………………………..

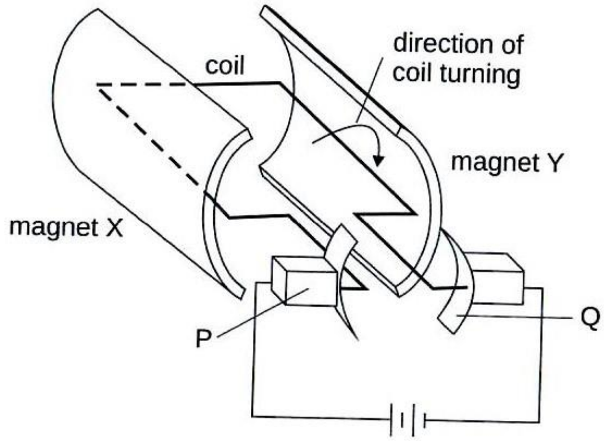
…………………………………………………………………………………..…[2]

(d) Electrical energy costs \$0.27 per kWh. Calculate the cost of using the kettle when switched on for 40 minutes every day in one month (i.e. 30 days).

cost = ……………………………….[2]

[Total: 7]

8 **(a)** The diagram shows a mechanical device.



(i) State the name and function of part Q.

……………………………………………………………………………………..

……………………………………………………………………………………..

……………………………………………………………………………………..

…………………………………………………………………………………….[2]

(ii) Suggest one modification to the above set-up so that coil will rotate faster in the opposite direction.

……………………………………………………………………………………..

…………………………………………………………………………………….[1]

(b) The diagram shows a beam of positively-charge particles passing between the poles of a powerful U-shaped electromagnet.

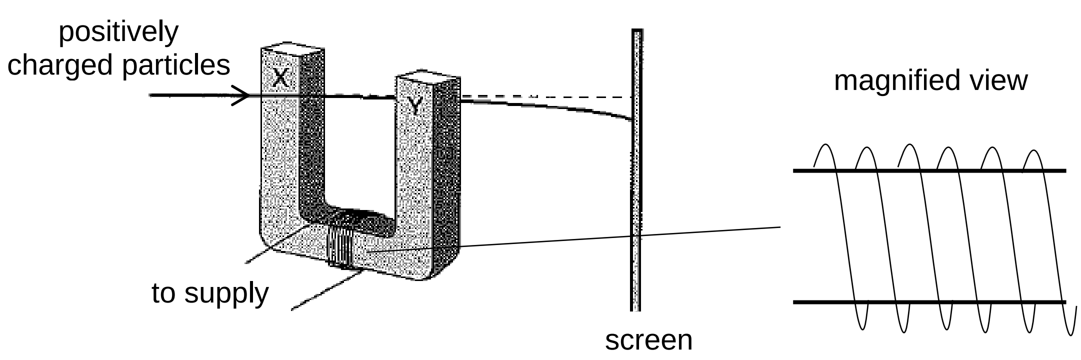


Fig. 8.1

(i) State the polarity of the magnet at X and Y.

…………………………………………………………………………………….[1]

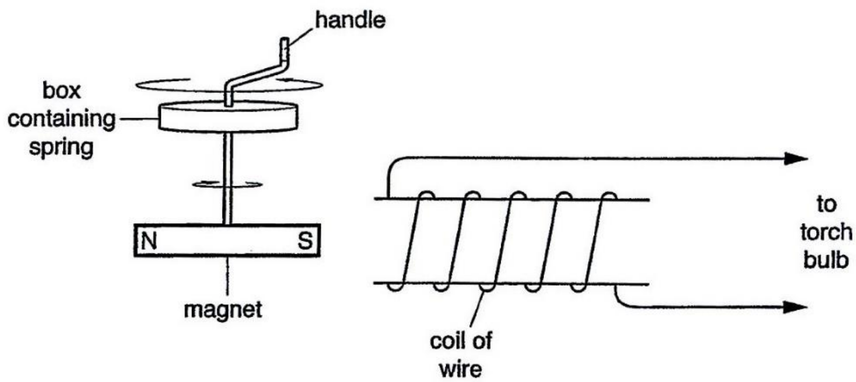
(ii) State the type of current provided by the supply and show the direction of the current flowing in the coils using Fig. 8.1.

…………………………………………………………………………………………..

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

[Total: 6]

9 A 'wind-up' torch does not have batteries. It uses the energy stored in a wound-up spring to generate the electricity needed. The diagram shows a simplified version of the arrangement.



(a) Explain why an e.m.f. is induced in the coil.

……………………………………………………………………………………………

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……………………………………………………………………………………………

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

(b) As the spring unwinds, the force in the spring decreases. Explain what happens to the light emitted by the torch.

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

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

[Total: 4]

10 The nuclide ${}^{184}_{78}\mathrm{Pt}$ emits an alpha α-particle and decays to another nuclide Osmium, Symbol Os.

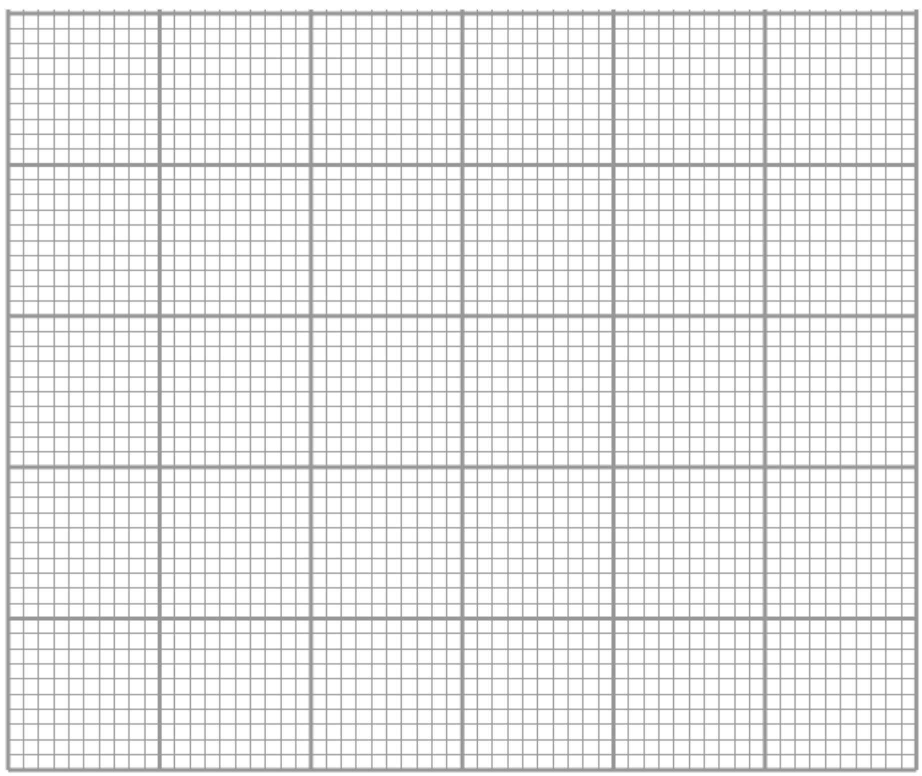
(a) Write an equation which represents the decay of the ${}^{184}_{78}\mathrm{Pt}$ nucleus.

[1]

(b) A sample of ${}^{184}_{78}\mathrm{Pt}$ emitting α-particle produced the following results when its emission was measured at a fixed distance from it.

count rate/minutes	510	330	210	138	102
time/minute	0	15	30	45	60

(i) The count rate from background radiation was taken and found to be 20 per minute. Taking the background radiation into consideration, plot a graph of the count rate due to α-emission against time.



[3]

(ii) Using the graph, determine the half-life of the sample.

half-life = ……………………………..[2]

(iii) Suggest the origin of the background radiation.

………………………………………………………………………………………..

……………………………………………………………………………..……[1]

(iv) State one safety precaution which should be taken when handling radioactive materials.

………………………………………………………………………………………..

……………………………………………………………………………..……[1]

[Total: 8]

11 Fig. 11.1 shows two of the towers that support a single cable of total length 5.0 km, which links a factory to the electrical grid.

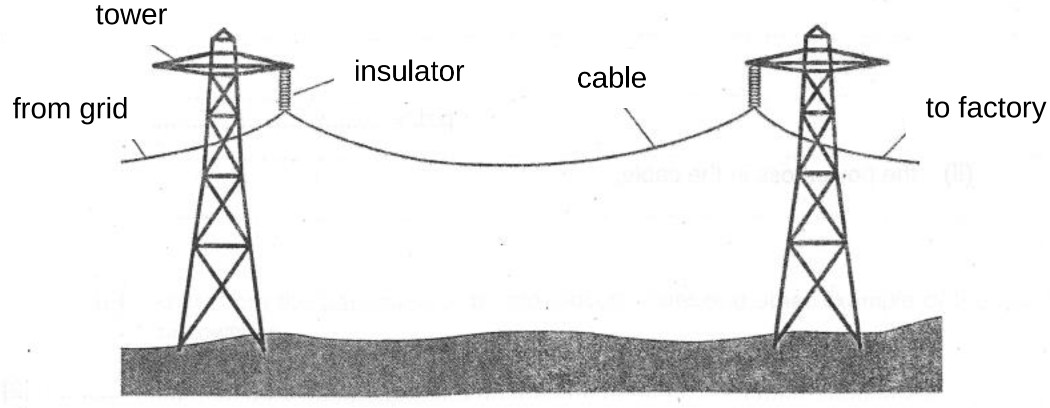


Fig. 11.1

If the weight of the cable between two towers is larger than a given force *F*, then the cable breaks. The value of *F* depends on the material from which the cable is made. The table gives the value of *F* and other data for three cables made from different materials.

cable	material	*F* / N	$\frac{\text{cross-sectional area}}{\text{m}^2}$	$\frac{\text{density}}{\text{kg/m}^3}$	$\frac{\text{resistance of 1 km}}{\Omega}$
1	*X*	6 000	3.0×10^{-4}	2 700	0.075
2	*Y*	9 000	3.0×10^{-4}	8 900	0.050
3	*Z*	27 000	3.0×10^{-4}	7 800	210

(a) Assuming that *g* is 10 N/kg, calculate

(i) the mass of a cable made of material *Y* with a length 5.0 km,

mass = …………………………..[2]

(ii) the minimum number of towers needed between the grid and the factory to support this cable.

minimum number of towers = ……………………………..[2]

(b) The cable used is actually made from material *X* and the current in it is 500 A.

For this cable, calculate

(i) the potential difference (p.d.) between the grid and the factory,

potential difference = ……………………………[1]

(ii) the power loss in the cable,

power loss = ……………………………..[2]

(c) Using data from the table, explain why

(i) *X* is a more suitable material than *Y* for the cable,

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………[2]

(ii) *Z* is an unsuitable material for the cable.

…………………………………………………………………………………

…………………………………………………………………………………[1]

(d) State and explain the type of transformer to be connected between the tower and the factory.

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………[2]

[Total: 12]

Section B (10 marks)
Answer **one** question from this section.

12 Fig. 12.1 shows an experimental setup to determine the specific heat capacity of liquid X.

Liquid X in a glass cup is heated by an immersion heater. The energy transferred from the heater to liquid X is measured by a joulemeter.

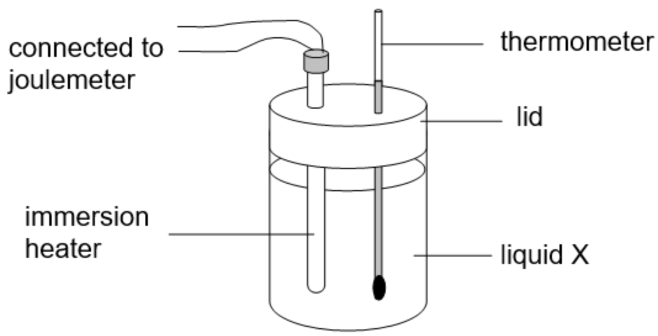


Fig. 12.1

The heater is switched on for a period of time. Table 12.2 shows the information about the experiment. Fig. 12.3 shows how the temperature of liquid X varies with time.

Table 12.2

mass of liquid X	250 g
initial reading on joulemeter	56 300 J
duration of time when heater is switched on	400 s
final reading on joulemeter	66 050 J

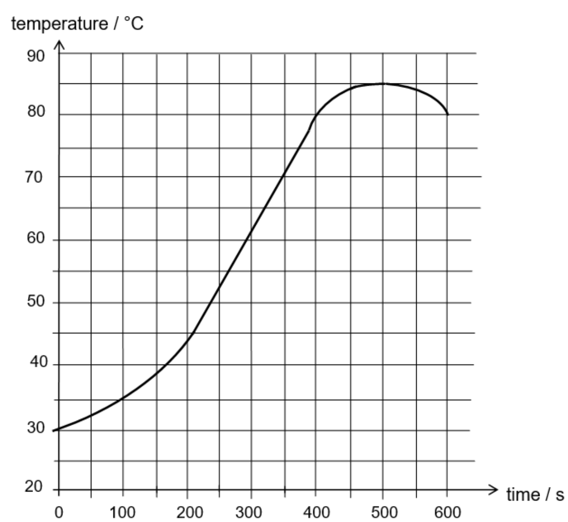


Fig 12.3

(a) After the heater is switched off, the temperature of liquid X continues to rise, remains constant momentarily and then it starts to drop.

Suggest and explain this observation.

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……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………[2]

(b) **(i)** With reference to Table 12.2 and Fig. 12.3, determine the specific heat capacity, *c*, of liquid X.

c = ……………………… [2]

(ii) State and explain how the calculated value of *c* would differ, if any, from the actual value of *c*.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………[2]

(iii) Suggest one precaution that can be taken to improve the accuracy of the experiment.

……………………………………………………………………………………

…………………………………………………………………………………[1]

(c) Explain, using kinetic theory of matter, why a kettle of liquid X with a steady supply of energy takes a much longer time to boil off at boiling point than to heat it up close to its boiling point.

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………………………………………………………………………………………………

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

[Total: 10]

13 Fig. 13.1 shows a tuning fork held a distance away from a microphone. When the tuning fork was struck, the microphone was able to detect the sound and displays a signal on the oscilloscope.

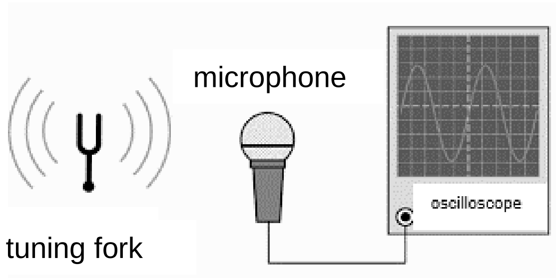

Fig. 13.1

(a) Using ideas about molecules, describe how sound travels from the tuning fork to the microphone.

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....

....

....[2]

(b) Fig. 13.2 shows the positions of 11 air particles, at t = 0 ms, before the tuning fork is struck. After the tuning fork is struck, at t = 10 ms, the positions of the air particles change.

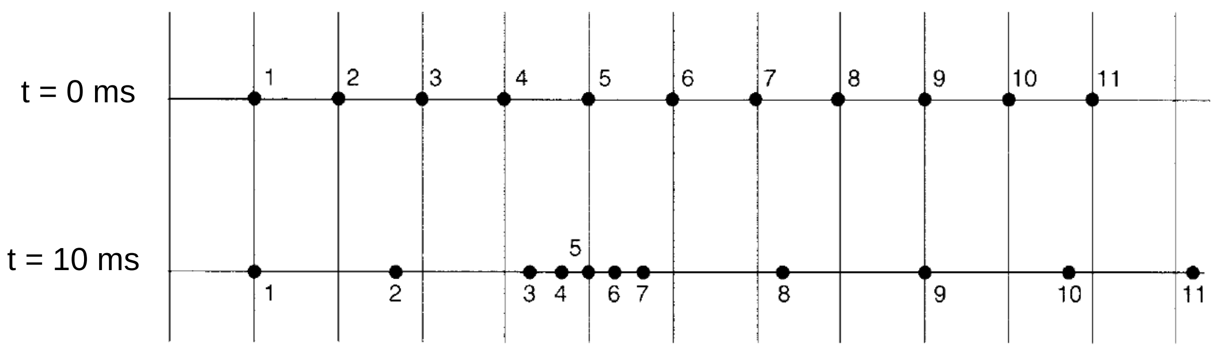

Fig. 13.2

On Fig. 13.2, mark out the amplitude and wavelength of the wave. Label them A and W respectively.

[2]

(c) **(i)** Given that 10 ms is equivalent to 1/4 of a period, determine the frequency of the sound.

frequency = ……………………[1]

(ii) The speed of sound in air is 330 m/s. Calculate the wavelength of the sound wave.

wavelength = ……………………..[1]

(d) The tuning fork was struck harder producing a louder sound. State and explain how the speed, amplitude A and wavelength W would change.

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………...………[2]

(e) State one similarity and difference between the sound produced by the tuning fork and an ultrasound produced.

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………...………[2]

[Total: 10]

End of Paper 2

Setter: Mr Yong Kwong Fui