BOON LAY SECONDARY SCHOOL

PRELIMINARY EXAMINATION

2021

Name	( )
Class	

Subject	:	**PHYSICS**
Paper No	:	**2**
Subject Code	:	**6091/02**
Level	:	**SECONDARY FOUR EXPRESS**
Date/Day	:	**16 SEPTEMBER/ THURSDAY**
Time	:	**0815 – 1000**
Duration	:	**1 HOUR 45 MINUTES**

READ THESE INSTRUCTIONS FIRST

Do not open until you are told to do so.

Before you start your exam, check that you have received the correct paper and the number of printed pages are correct.
Write your name and index number on all the work you hand in.
Do not use staples, paper clips, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your workings or if you do not use appropriate units.

INFORMATION TO CANDIDATES

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

Section B
Answer **all** questions.
Write your answers in the spaces provided.
Question 12 has a choice of parts to answer.

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

This question paper consists of 19 printed pages.

For Examiner's Use

Section A [50 marks]
Answer **all** the questions.

1 Fig. 1.1 shows a bungee ride which launches people upwards using elastic cords. Each cord applies a force of 1000 N and the cords are at 60° from each other.

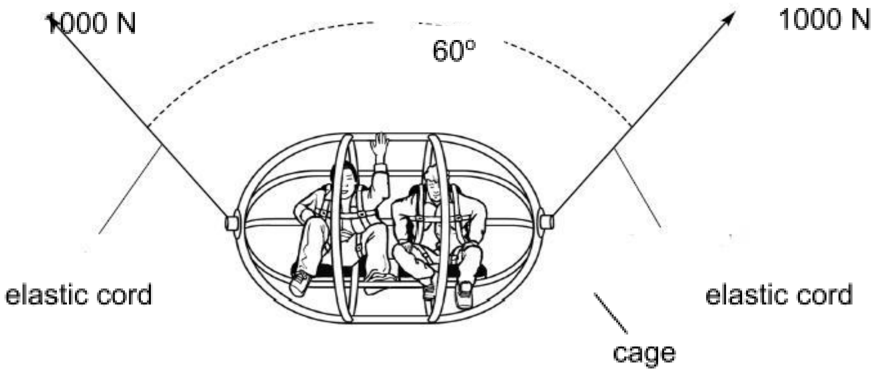

Fig. 1.1

Draw a suitable scale diagram to determine the magnitude and direction of the resultant of these two forces.

scale = ……………………………..

resultant force = …………………………….

direction of resultant force = ……………………………. [5]

For Examiner's Use

2 A uniform rod AB of length 3.0 m weighs 10 N. It is suspended by two identical strings at points X and Y as shown in Fig. 2.1. T_1 and T_2 are the tension in the strings.

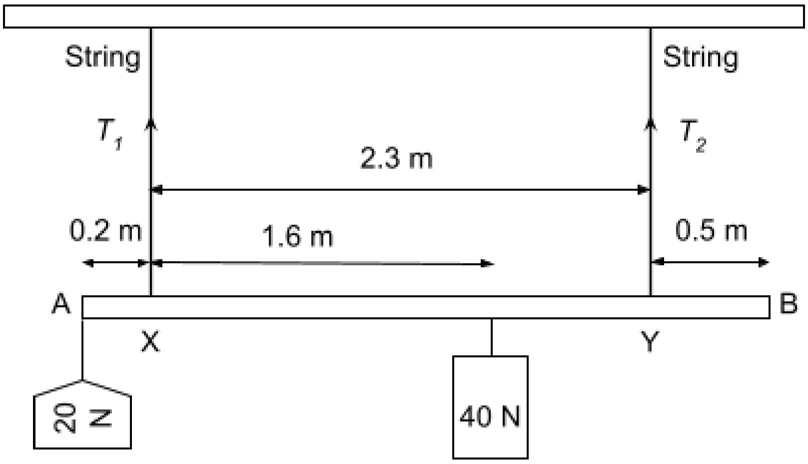

Fig. 2.1

Two weights, 20 N and 40 N, are hung from the rod at point A and 1.6 m from X respectively.

(a) Draw the weight of the rod in Fig. 2.1 and label it W.
Indicate clearly its distance from point A. [1]

(b) Determine T_2, the tension of the string at Y.

T_2 = ……………………………. [2]

(c) Hence, or otherwise, determine T_1, the tension of the string at X.

T_1 = ……………………………. [2]

For Examiner's Use

3 A student measures the pressure inside a bicycle tyre using a pressure gauge he has constructed. Fig. 3.1 shows the apparatus he uses. The piston and rod move along the smooth cylindrical tube.

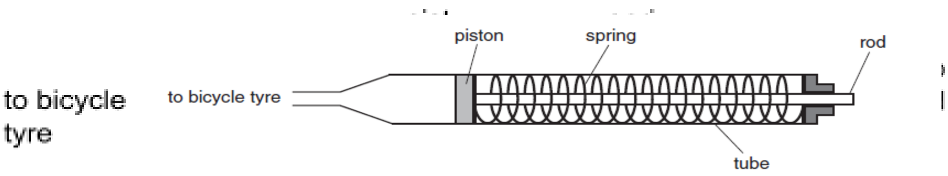

Fig. 3.1

The change in length of the spring is proportional to the force applied to the spring. A force of 2.8 N compresses the spring by 2.0 cm.

The student connects the pressure gauge to the tyre. Air from the tyre exerts a force on the piston. As the piston moves, the spring is compressed. The piston moves 10 cm to the right and then stops.

(a) Calculate the force exerted on the piston by the spring.

force exerted = ……………………………. [1]

(b) The cross-sectional area of the piston is 3.0×10^{-5} m^2. Calculate the pressure of the air inside the tyre.

pressure = ……………………………. [2]

(c) Suggest one change to the apparatus so that the piston is able to measure a wider range of pressure without changing the length of the apparatus.

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

(d) Each time that the pressure gauge is used, the pressure in the tyre falls slightly. The volume of the tyre and temperature stay constant. Describe, using ideas about molecules, why the pressure falls.

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4 **(a)** Fig. 4.1 shows the arrangement of atoms in a solid block. End X of the block is heated. Energy is conducted to end Y, which soon becomes warm.

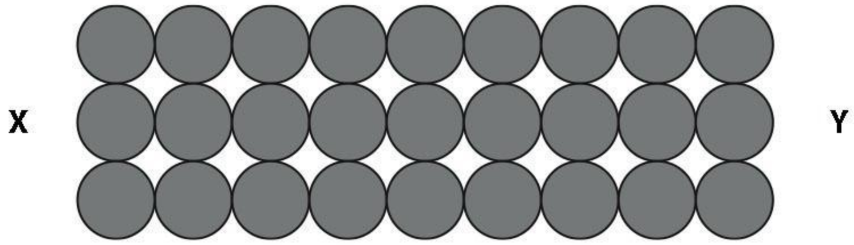

Fig. 4.1

The block is heated and becomes a liquid. Describe the changes that occur to the arrangement and the motion of the atoms.

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(b) Explain the main difference between conduction and convection by making reference to the different mechanism involved for the heat transfer processes.

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For Examiner's Use

5 **(a)** Fig. 5.1 shows the heating curve of a substance X.

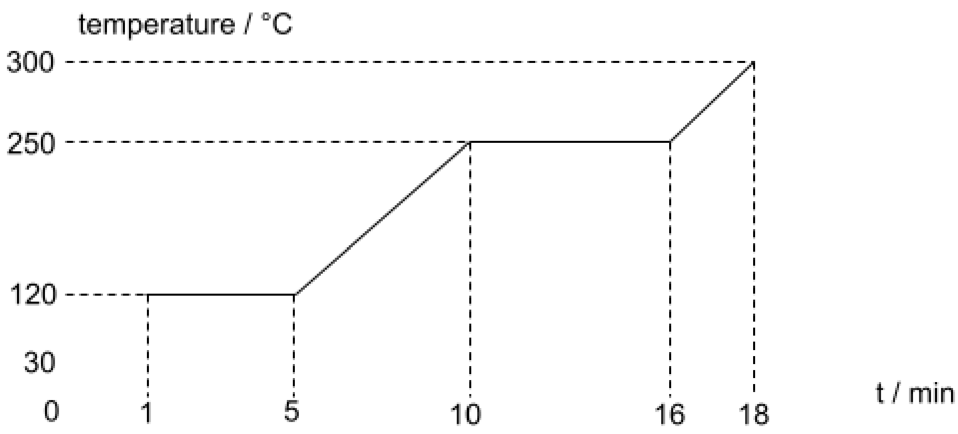

Fig. 5.1

The amount of X used in the experiment was 400 g. The heater used was rated at 200 W. Calculate

(i) the amount of energy required for melting substance X,

amount of energy = …………………………… [2]

(ii) the specific latent heat of vaporisation for substance X.

specific latent heat of vaporisation = …………………………… [2]

(b) Fig. 5.2 below shows a liquid-in-glass thermometer that is not calibrated.

For Examiner's Use

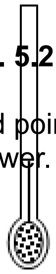

Fig. 5.2

Describe steps to obtain the lower fixed point for the thermometer.
You may include a diagram in your answer.

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For Examiner's Use

6 **(a)** A parallel beam of light making an angle of 30° with the principal axis is incident on the lens as shown in the Fig. 6.1.

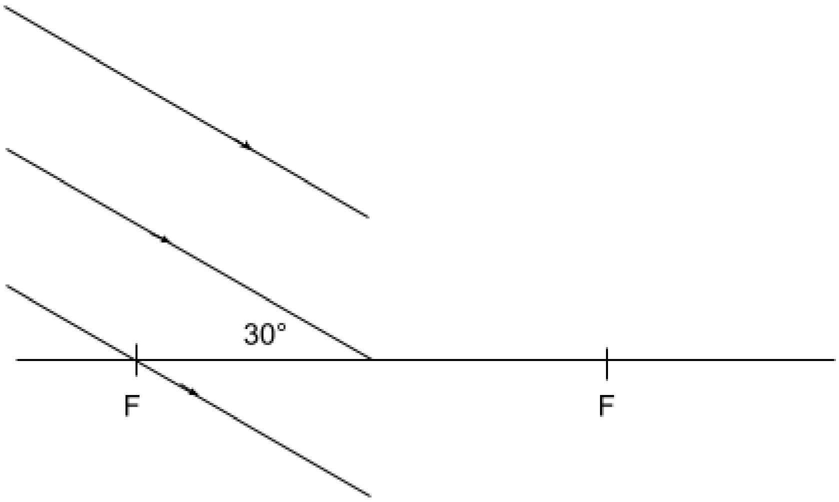

Fig. 6.1

(i) Complete the ray diagram in Fig. 6.1 to locate the image of the tree. [2]

(ii) Define the term focal length of the lens.

……………………………………………………………………………….. [1]

(b) Fig. 6.2 shows three light rays emitted from a ray box. The light rays from the slit of the box shines on the liquid surface XY at different angles. [2]

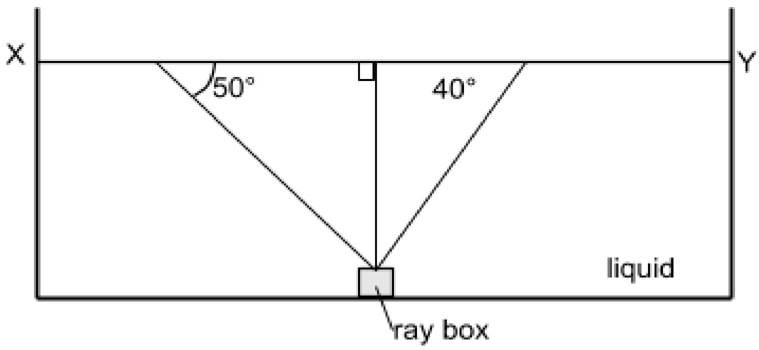

Fig. 6.2

(i) If the refractive index of liquid is 1.43, calculate the critical angle for the liquid.

critical angle = …………………………… [2]

(ii) Complete the ray diagram using the above diagram to show the subsequent path of the three light rays after meeting the liquid surface XY. Show your working and indicate all the angles clearly in Fig. 6.2. [3]

For Examiner's Use

7 When moving from position G to L, a ship sends pulses of ultrasonic waves at a frequency of 45 000 GHz continuously towards the bottom of the sea. The variation of the time interval, *t,* between the emission of a pulse and the reception of its reflection is shown in Fig. 7.1. Take the speed of sound in water as 1350 m/s.

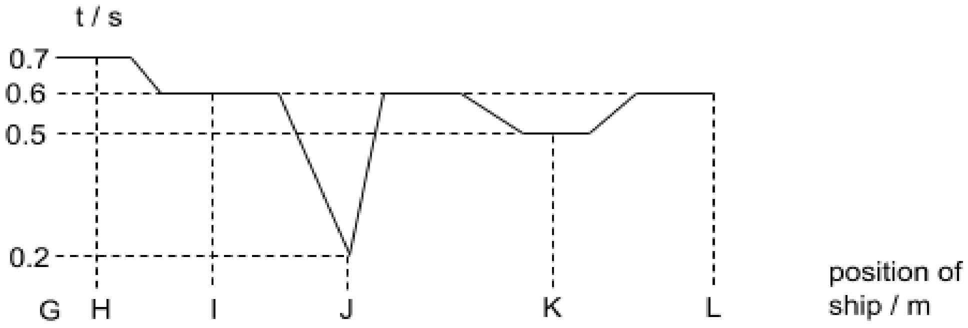

Fig. 7.1

(a) Calculate

(i) the depth difference between position J and L

depth difference = …………………………… [2]

(ii) the wavelength of the ultrasound waves in water.

wavelength = …………………………… [2]

(b) State one reason why the depth of the seabed changes abruptly within a few metres from I to J.

……………………………………………………………………………………

…………………………………………………………………………………… [1]

(c) State one other application of ultrasound.

…………………………………………………………………………………… [1]

For Examiner's Use

8 Fig. 8.1 below shows an uncharged metal sphere hung on an insulated thread between two metal plates X and Y, which are connected to a circuit. The sphere is brought to touch plate X momentarily and then released.

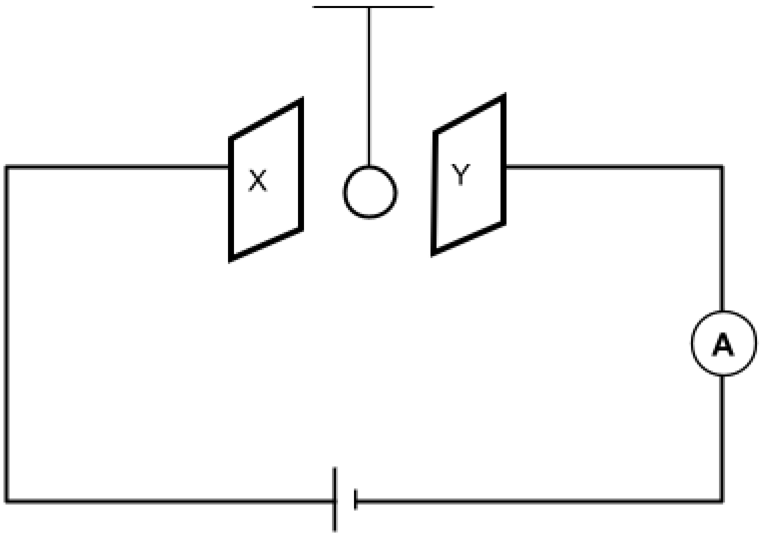

Fig. 8.1

(a) State whether the metal sphere is positively charged or negatively charged after it was first brought to touch X.

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

(b) Describe and explain the subsequent motion of the sphere after being released.

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

(c) Explain why the ammeter shows a periodic current with the subsequent motion of the sphere.

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For Examiner's Use

9 **(a)** Fig. 9.1 shows apparatus that can be used to make an electromagnet or a permanent magnet.

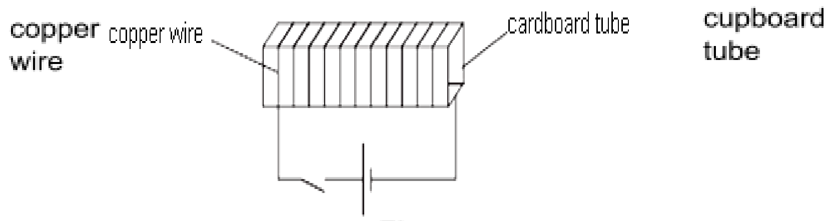

Fig. 9.1

Describe and explain how the apparatus is used to make a permanent magnet.

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

(b) A computer component is shielded from external magnetic fields by placing it in a box, as shown in Fig. 9.2.

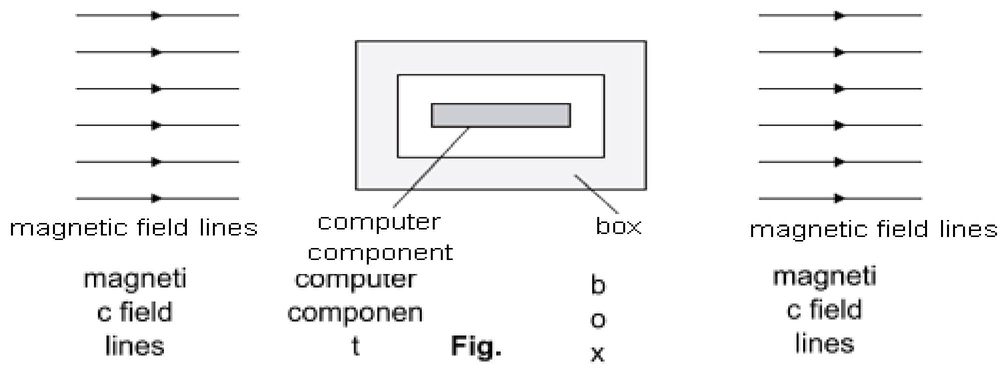

Fig. 9.2

(i) State the best choice for the material of the box

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

There is a strong magnetic field outside the box. The magnetic field lines have not been drawn near the box.

(ii) On Fig. 9.2, join the magnetic field lines on the left of the box to those on the right, showing the pattern of the magnetic field. [1]

(c) Fig. 9.3 shows the top view of four conducting wires, P, Q, R and S, which are placed vertically and are parallel to each other. These wires are firmly secured so that they are not allowed to move. The magnitude of current flowing through each wire is the same.

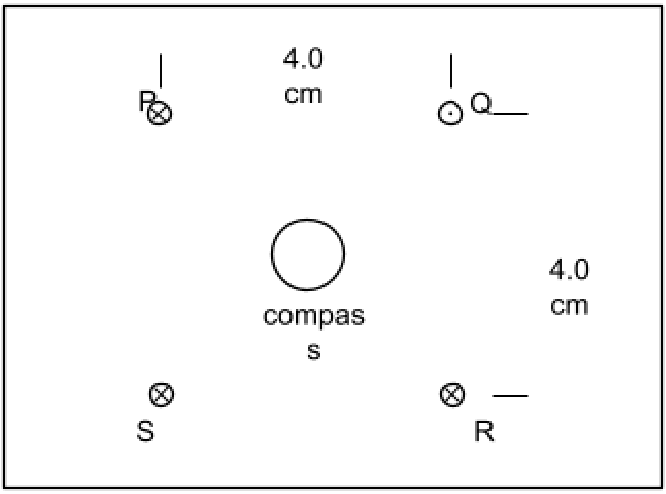

Fig. 9.3

(i) A magnetic compass is placed in the middle of the four vertical wires. On Fig. 9.3, draw clearly the direction of the compass needle. [1]

(ii) The compass is now replaced by a current-carrying conductor as shown in Fig. 9.4. The conductor is also parallel to the other wires and the current is travelling into the paper. With the aid of an arrow, draw clearly the direction of the resultant force acting on this conductor on Fig. 9.4.

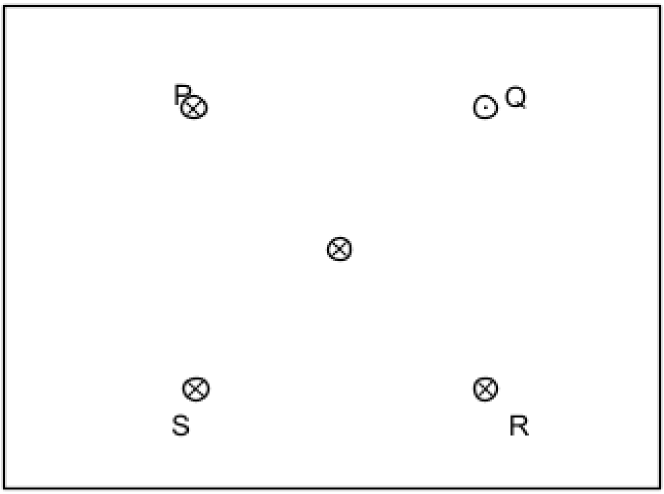

Fig. 9.4 [1]

For Examiner's Use

Section B [30 marks]

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 12**.

10 In an experiment, different sized metal pellets are fired from an air rifle towards an 8.0 kg block of plastic suspended from the top of a ceiling. The initial position of the block is shown in Fig 10.1, and when the pellet hits the plastic block, the block is displaced as shown in Fig 10.2.

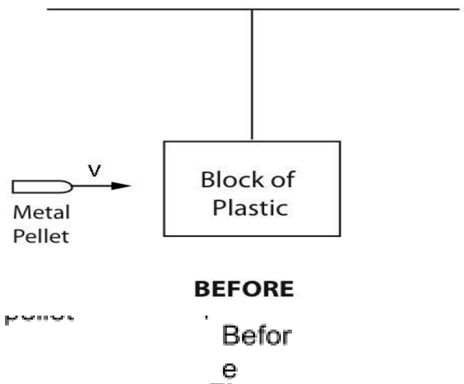

Fig. 10.1

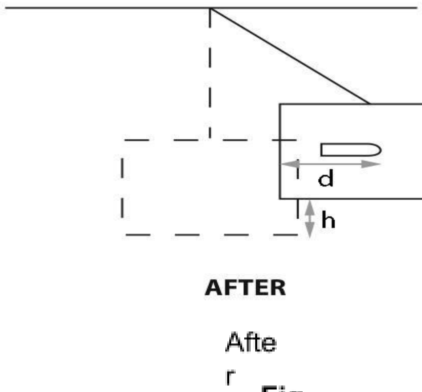

Fig. 10.2

The information obtained from the experiment is shown in the table below.

mass of pellet, m	speed of pellet just before it hits plastic block, v	depth of penetration by pellet, d	time taken for pellet to come to a stop, t	maximum increase in height of plastic block, h
0.050 kg	40 m/s	0.15 m	0.025 s	0.348 m
0.025 kg	56 m/s	0.12 m	0.020 s	0.292 m
0.020 kg	62 m/s	0.11 m	0.018 s	0.274 m

Take gravitational field strength as 10 N/kg.

(a) Calculate the kinetic energy of the 0.025 kg pellet just before it hits the block of plastic.

kinetic energy = …………….…………………….. [2]

(b) Calculate the deceleration and hence the resistive force acting on the 0.025 kg pellet.

deceleration = …………………………… [2]

resistive force = …………………………… [1]

For Examiner's Use

(c) Calculate the work done by the 0.025 kg pellet against friction.

work done = …………………………… [2]

(d) Show that there is a discrepancy between the experimental and theoretical values for the increase in height of the plastic block. [3]

For Examiner's Use

11 Fig. 11.1 shows a rigid rectangular card which has a rectangular hole cut out in the centre. Fig. 11.2 shows the setup which is used to measure the acceleration of the card as it falls freely to the ground. A torchlight which is directed towards the LDR is turned on. A computer is used to measure the potential difference across RS.

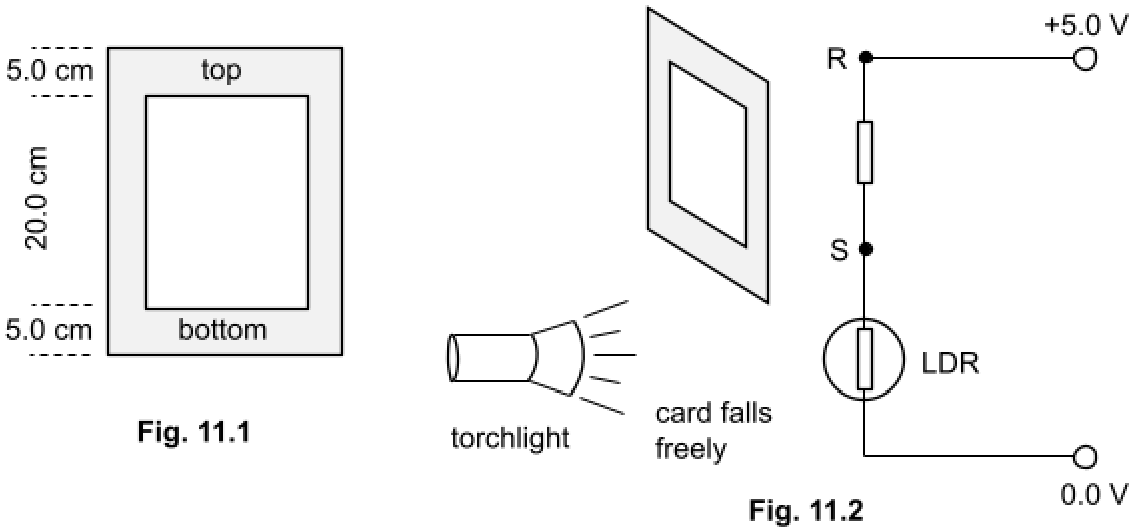

Fig. 11.1 **Fig. 11.2**

Fig. 11.3 shows the graph of potential difference across RS against time.

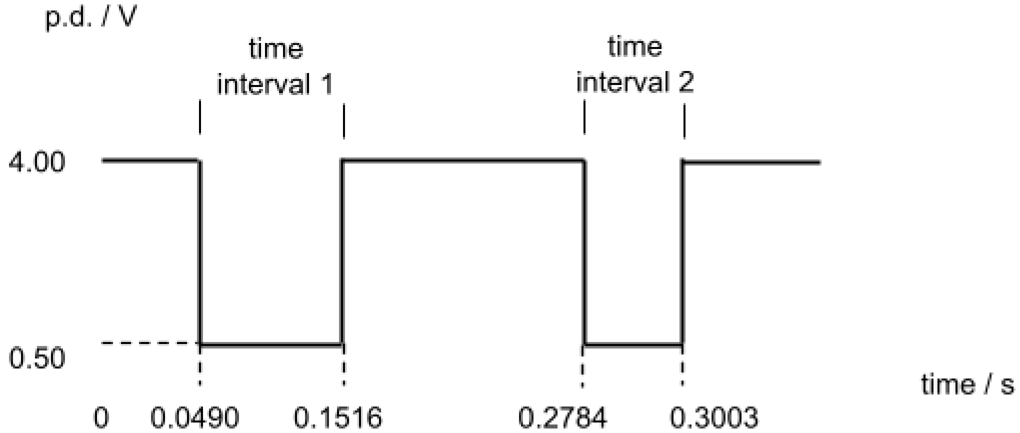

Fig. 12.3

(a) Explain how the resistance of the LDR changes when the card falls through.

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

(b) Explain why the p.d. across the variable resistor drops twice to 0.50 V.

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

(c) Explain why the **time interval 1** is longer than the **time interval 2** (as shown in the graph) when the rigid card falls.

For Examiner's Use

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

(d) Calculate the average acceleration of the card (in cm/s^2).

average acceleration = ………………………. [2]

12 Either

(a) Fig. 12.1 shows a straight wire AB being moved across a magnetic field. A galvanometer is connected across the wire AB.

A

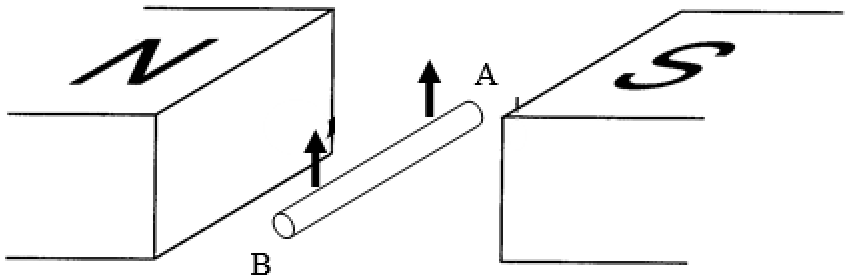

Fig. 12.1

As wire AB is being moved upwards between the magnetic poles, the needle of the galvanometer connected across wire AB deflects to the right.

(i) State what happens to the needle of the galvanometer when wire AB is being moved downwards between the magnetic poles.

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

(ii) State the direction of the induced current on wire AB as it is being moved downwards between the magnetic poles.

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

(iii) Explain what happens to the needle of the galvanometer when wire AB is held stationary between the magnetic poles.

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

(b) The wire AB is then replaced by a single loop of wire, which is rotated at a constant speed between the magnetic poles, as shown in Fig. 12.2.

For Examiner's Use

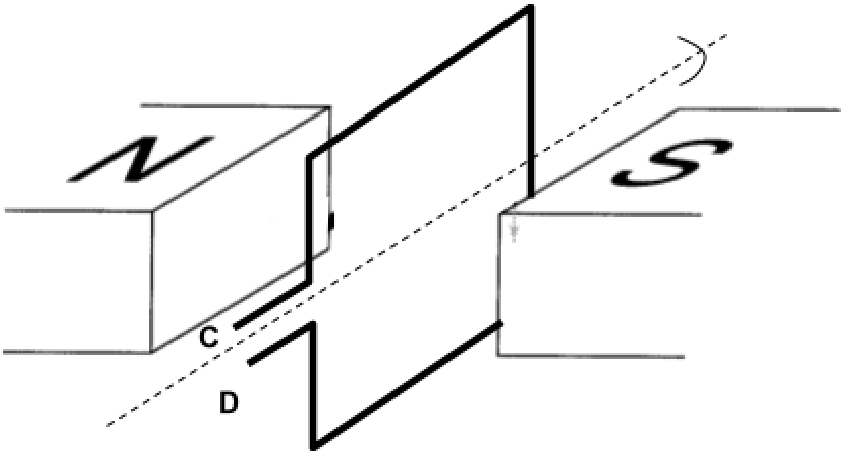
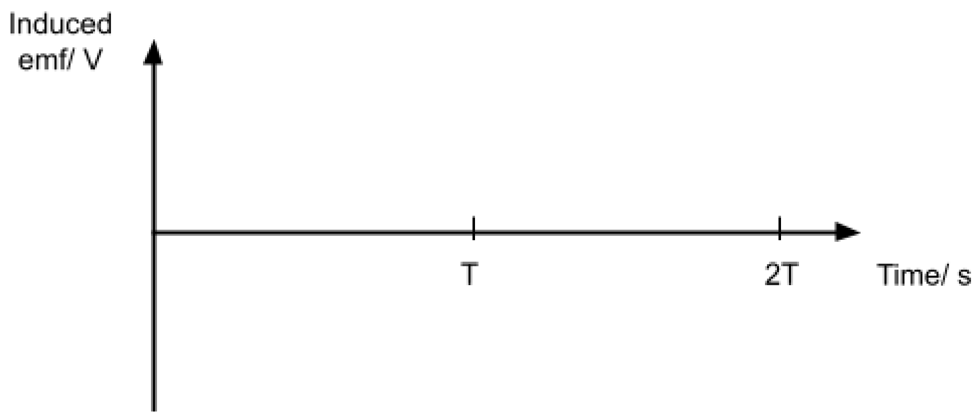


Fig. 12.2

(i) Sketch a graph of the induced e.m.f. across CD, the two ends of the loop, against time when the coil is rotated from the initial position, as shown in Fig. 12.2 when it makes two complete rotations.

Assume that the magnetic field within which the loop rotates in is uniform and the time taken for one complete rotation is "T". [2]



(ii) In the graph drawn above, indicate a new graph in dotted lines when the coil is rotated in the opposite direction and at two times the speed within 2T. [2]

(c) Describe an experiment to check whether an increase in the number of loops of wire will increase the magnitude of the induced current generated.

In your account
- draw a labelled diagram of the experiment,
- describe the procedure to be taken.

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. [3]

12 OR

For Examiner's Use

Fig. 12.3 shows an electric kettle and the live, neutral and earth wires of a household electricity supply. The kettle has a power rating of 2.0 kW.

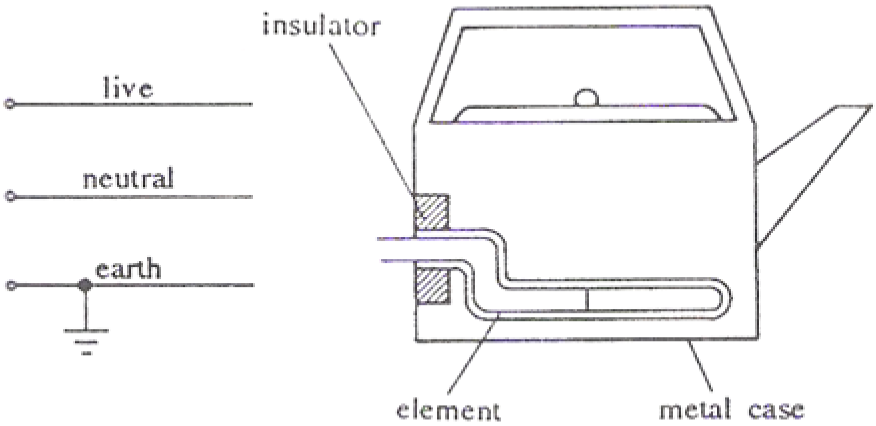

Fig. 12.3

(a) Draw lines on the diagram to show how the kettle should be connected to the supply. Include a switch and a fuse in the diagram. [3]

(b) Explain what is meant by a *power rating of 2.0 kW*. [1]

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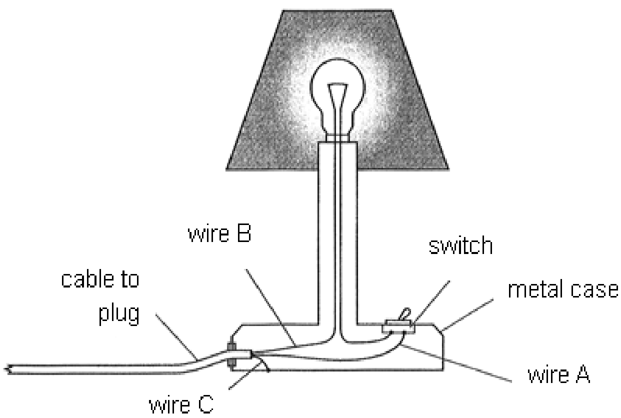
Fig. 12.4 shows the electrical wiring in a table lamp.



swit
ch

metal
case

wire
A

wire
C

Fig. 12.4

(c) Explain why wire A rather than wire B is connected to the live terminal in the plug.

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

(d) Wire A becomes loose and touches the metal case.
Explain why a person who later touches the case feels no shock and is not harmed.

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

(e) There is another lamp with no wire connected to the case. Explain why this lamp is safe to use.

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