West Spring Secondary School

PRELIMINARY EXAMINATION 2021

Physics **6091/02**

Paper 2 Theory

SECONDARY 4 EXPRESS

Name ________________________ (   ) **Date** 01 SEP 2021

Class ____________ **Duration** 1 h 45 min

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions.

Candidates are reminded that **all** quantitative answers should include appropriate units.
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.

Information for Candidates

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

FOR EXAMINER'S USE	
Section A	**/50**
Section B	**/30**
Total	**/80**

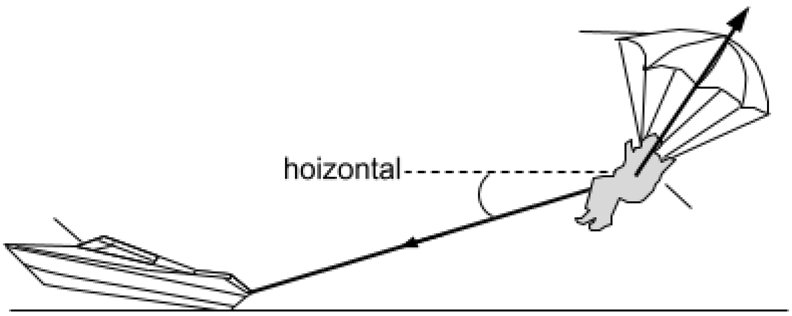
This document consists of **16** printed pages including the cover page.

Setter Mr Prakash s/o Radakrishna **[Turn over]**

Section A (50 Marks)

Answer **all** questions in this section.

1 Fig. 1.1 shows a motorboat used to pull a 900 N paraglider at a constant speed and height. A rope exerts a force of 1200 N on the paraglider at an angle of 20º to the horizontal. Another force is exerted on the paraglider by the parasail wing.



The resultant force acting on the paraglider is 0 N.

(a) On Fig. 1.1, draw an arrow to show the direction of the weight. [1]

(b) By using a suitable scale drawing, determine the magnitude (size) of the force exerted on the paraglider by the parasail wing and the direction between this force and the horizontal.

magnitude of force = ...

direction of force = ...

[3]

2 **(a)** Define the *moment of a force* about a point.

....

....

.... [2]

(b) Fig. 2.1 shows a uniform rod of wood suspended from a pivot.

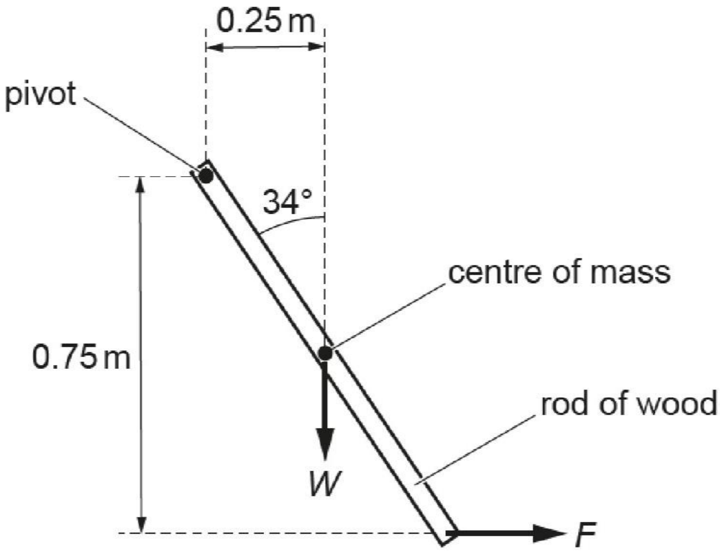


Fig. 2.1

The rod is held stationary by a horizontal force ***F*** acting as shown. The mass of the rod is 80 g. The gravitational field strength is 10 N/kg. **(i)** Calculate the weight *W* of the rod,

weight = ... [1]

(ii) Calculate the force *F*.

Force ***F*** = ... [2]

(c) The angle between the rod and the vertical is increased.

State whether the force *F* needed to hold the rod stationary must be increased, decreased or stay the same. Explain your answer.

....

....

....

.... [2]

3 Fig. 3.1 and Fig. 3.2 shows two different views of a man of mass 75 kg doing a bungee jump. The gravitational field strength is 10 N/kg and air resistance is assumed to be negligible.

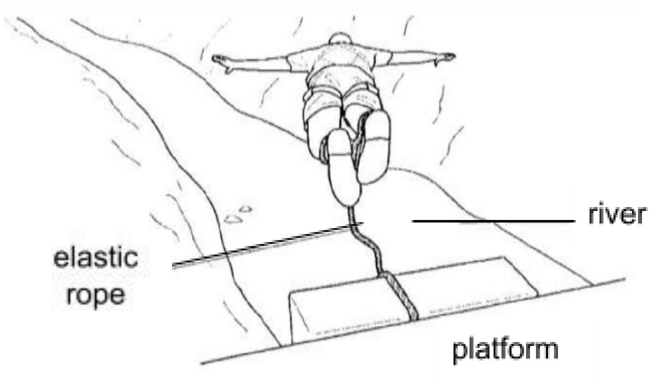


Fig. 3.1

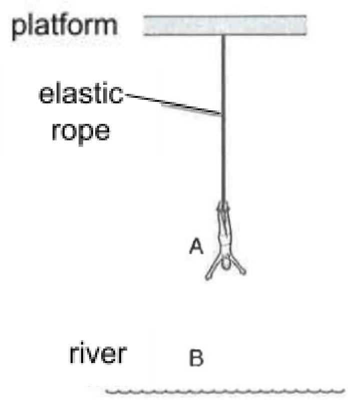


Fig. 3.2

(a) To get to the platform, the man takes a lift that brings him through a vertical distance of 100 m in 8.5 s. The efficiency of the lift is 85%,

Calculate the minimum power input of the engine of the lift.

power =.. [2]

(b) The man reaches the platform and an elastic rope is secured to his feet. He leans over the platform and drops vertically downwards towards the river below.

Calculate the speed of the man when he has fallen 41 m below the platform (position A), just before the elastic rope exerts any force on him.

speed =.. [2]

(c) The total distance of fall for the man before he stops for the first time is 73 m (position B).

(i) Describe the energy changes taking place from the instant the man reaches 41 m below the platform (position A) until the elastic rope is fully stretched (position B).

....

....

.... [2]

(ii) Assuming that the temperature of the rope did not increase during the stretching, determine the elastic potential energy in the fully extended elastic rope.

energy = ... [1]

4 A U-shaped tube of constant cross-sectional area contains water of density 1000 kg/m^3. Both sides of the U-tube are open to the atmosphere.

Fig. 4.1 shows that the water levels in the two sides of the tube are equal.

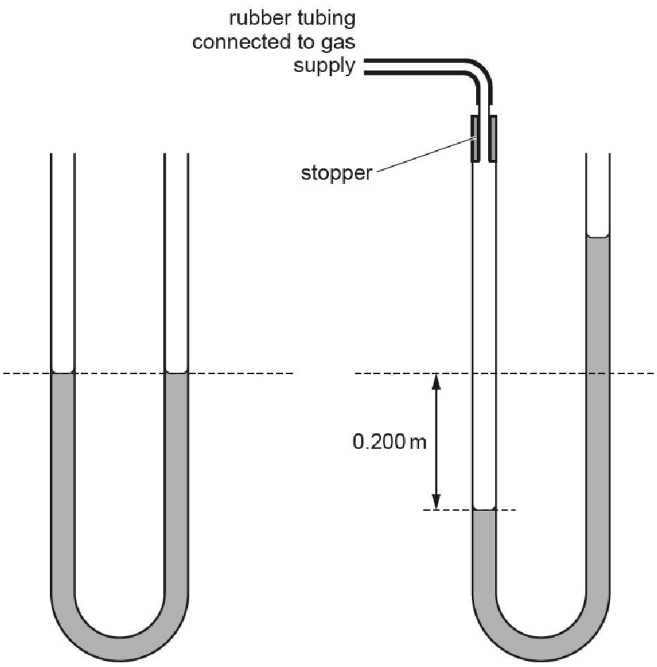


Fig. 4.1 **Fig. 4.2**

The atmospheric pressure is 1.00×10^5 Pa.

(a) The left-hand side of the tube is now connected to a gas supply using a length of rubber tubing. This causes the level of the water in the left-hand side of the tube to drop by 0.200 m, as shown in Fig. 4.2. The gravitational field strength is 10 N/kg.

Calculate the pressure of the gas supply.

pressure = ... [3]

(b) The gas supply is gradually cooled which causes the gas pressure to decrease until it is lower than atmospheric pressure.

(i) Using ideas of molecules, explain why the gas pressure decreases when cooled.

....

....

....

.... [2]

(ii) State an observable change in the water levels in the U-tube compared to Fig. 4.2.

.... [1]

5 Clara wishes to make a cup of coffee. Her coffee-making machine bubbles steam at 100 °C into 200 g of cold coffee which is initially at 10 °C. The steam condenses and cools down to the 65 °C, the final drinking temperature.

The specific heat capacity of coffee is 4600 J/(kg °C), the specific heat capacity of water is 4200 J/(kg °C) and the specific latent heat of vaporization of water is 2.2 MJ/kg.

(a) Calculate the thermal energy gained by the coffee in rising to its final temperature of 65 °C.

thermal energy = ... [2]

(b) Hence, calculate the mass of steam needed to warm the coffee to 65°C.

mass = ... [3]

(c) People who use the coffee-making machine must be careful not to injure themselves.

Explain why a jet of steam is more dangerous than the same mass of boiling water.

....

....

.... [2]

6 **(a)** Define the principal focus (*focal point)* of a converging lens.

....

.... [1]

(b) Fig. 6.1 shows a ray of light passing from the top of an object to a thin converging lens.

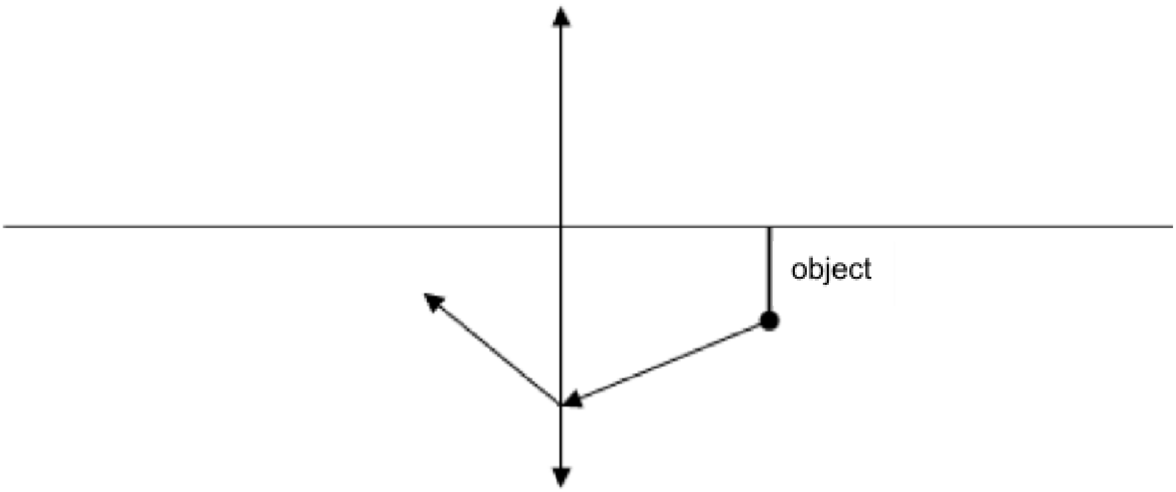


Fig. 6.1

(i) Complete the ray diagram to locate and draw the image. [1]

(ii) Locate the principal focus of the lens and mark it with the letter F. [1]

(iii) Measure the focal length of the lens.

.... [1]

(c) It is possible to produce a virtual image using a converging lens.

With reference to your answers in **(b)(iii)**, state a possible distance of the object to the lens which produces a virtual image.

.... [1]

(d) Fig. 6.2 shows a light ray **ABC** from the top of an object passing through a lens.

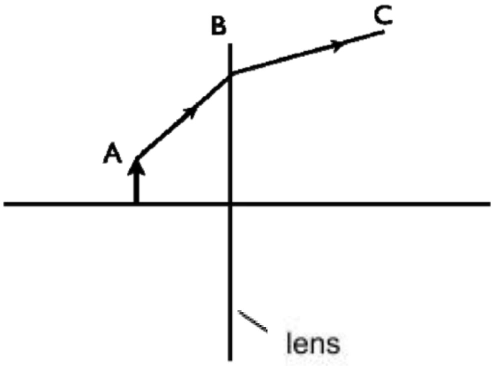


Fig. 6.2

State whether the lens is converging or diverging.

.... [1]

7 Two uncharged conducting spheres, K and L, are mounted on insulating stands.

The two spheres are in contact. Fig. 7.1 shows a positively-charged insulating rod held next to K.

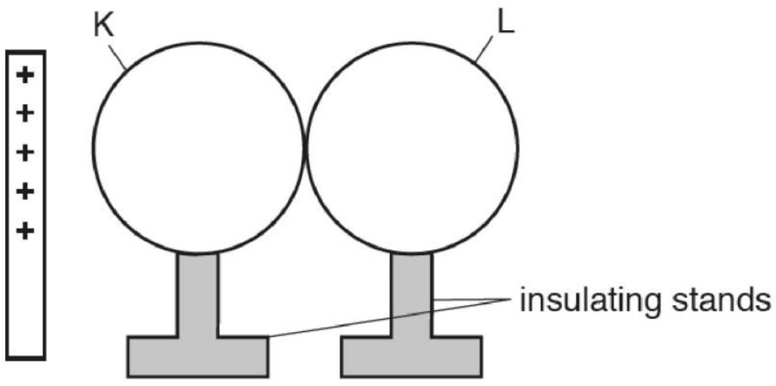


Fig. 7.1

(a)(i) On Fig. 7.1, draw the charges on K and on L. [1]

(ii) Explain your answer to (i).

....

....

.... [2]

(b) Sphere L is moved to the right, a long way from sphere K.

(i) The positively charged rod is moved away.

State what happens to the charge on K.

....

.... [1]

(ii) An earthing wire is connected to sphere L.

State what happens to the charge on L.

....

.... [1]

\

(c) Discharging is a process to neutralise a charged object by removing the excess charges. Placing the positively-charged insulating rod in humid condition is one method to neutralise it.

State another method to neutralise the positively-charged insulating rod.

....

.... [1]

8 A student set up the circuit shown in Fig. 8.1.

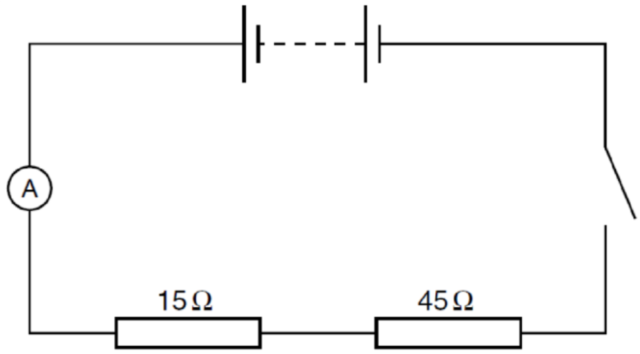


Fig. 8.1

The resistors are of resistance 15 Ω and 45 Ω. The battery is found to provide 1.6×10^5 J of electrical energy when a charge of 1.8×10^4 C passes through the ammeter in a time of 1.3×10^5 s.

(a) Define *electromotive force* (*e.m.f.*).

....

.... [1]

(b) Determine

(i) the electromotive force (e.m.f.) of the battery,

e.m.f. = ... [1]

(ii) the average current in the circuit.

current = ... [1]

(c) During the time for which the charge is moving, 1.1×10^5 J of energy is dissipated in the 45 Ω resistor.

(i) Determine the energy dissipated in the 15 Ω resistor during the same time.

energy = ………………………………………. [2]

(ii) Suggest why the total energy provided is greater than that dissipated in the two resistors.

……………………………………………………………………………………………………

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

Section B (30 Marks)

Answer **all** the questions in this section.

9 A firework rocket contains a solid fuel inside a cardboard tube. By burning the fuel, a uniform lift force is created that propels the rocket vertically upwards. The fuel burns off in a short time. Eventually the empty rocket falls back towards the ground. Fig. 9.1 shows the diagram of the rocket.

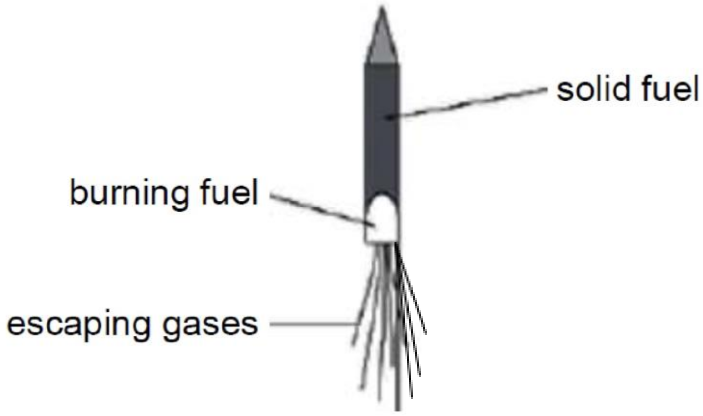


Fig. 9.1

In an experiment using electronic apparatus, a rocket containing fuel is launched *h* cm above the ground. The velocity of the rocket is measured at different times until it hits the ground. The experiment is repeated with a rocket made of a different material but of the same size and contained the same amount of fuel.

Fig. 9.2 shows the results obtained for the two rockets. Air resistance is negligible.

time/s	rocket 1, v_1 / m/s	rocket 2, v_2 / m/s
0	0	0
0.20	0.5	0.8
0.40	1.4	2.0
0.60	3.0	5.0
0.80	6.0	9.0
1.00	4.0	7.0
1.20	2.0	5.0
1.40	0	3.0
1.60	-2.0	1.0
1.80	-4.0	-1.0
2.00	-6.0	-3.0
2.20	-8.0	-5.0
2.40	-10.0	-7.0
2.60	-	-9.0
2.80	-	-11.0
3.00	-	-13.0

Fig. 9.2

(a) Describe the force that is part of the action-reaction pair with the lift force, and state the body on which it acts upon.

....

....

....

.... [2]

(b) Explain how the data in Fig. 9.2 suggests that the fuel only burns for 0.80 s.

....

....

....

....

....

.... [3]

(c) With the same amount of fuel, the maximum velocity of both rockets is different.

State and explain a reason for this.

....

....

....

.... [2]

(d) **(i)** With reference to the data in Fig. 9.2, state the time at which rocket 1 starts to fall.

.... [1]

(ii) Calculate the maximum height reached by rocket 1.

maximum height = ... [2]

10 **(a) (i)** State what is meant by a *wavefront*.

....

.... [1]

(ii) State what is meant by a *wave motion*. Hence, describe how water in a ripple tank provides an example of transverse wave motion.

....

....

....

....

.... [3]

(b) Fig. 10.1 and Fig. 10.2 show the variation with time t of the height of water at the same place in a tank for two waves P and Q respectively. The height is sometimes above and sometimes below the mean level which is marked as 0.

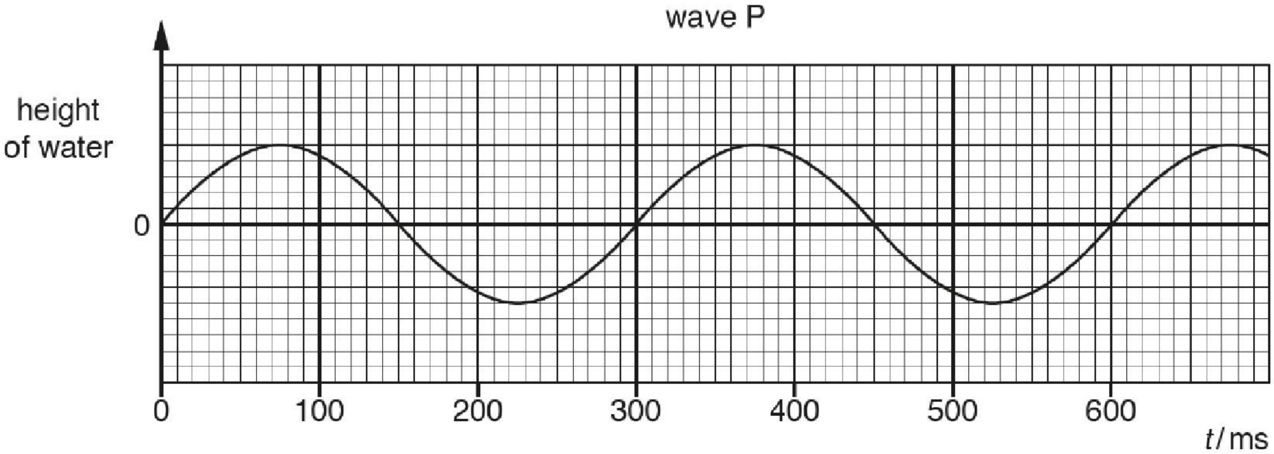


Fig. 10.1

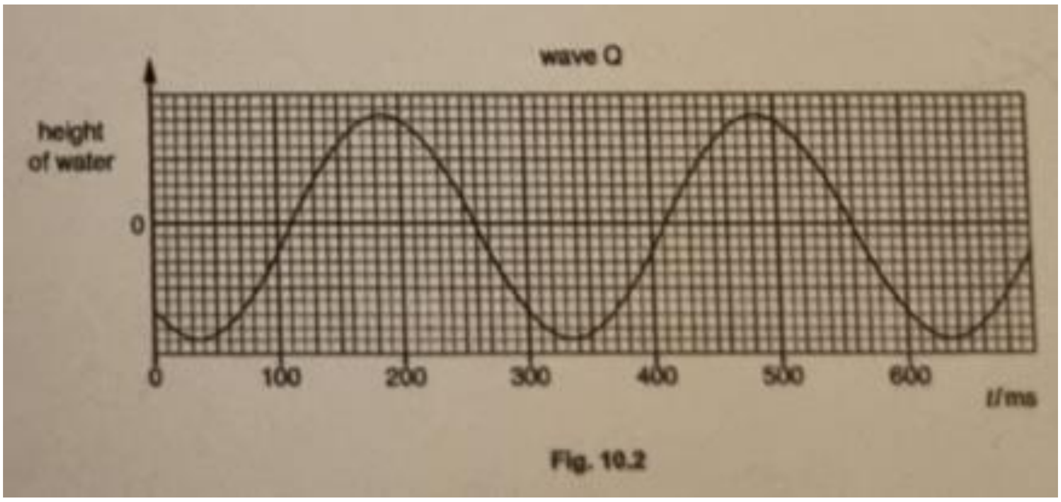


Fig. 10.2

(i) State one difference and one similarity of the two waves.

difference: …………………………………………………………………………………………..

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

similarity. : …………………………………………………………………………………….. ….

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

(ii) The speed of the water wave is 0.20 m/s.

Determine

1. the frequency of wave P,

frequency = ...[2]

2. the wavelength of wave P.

wavelength = ...[2]

11 **(a)** Fig. 11.1 shows the N-pole of a magnet placed in front of the S-pole of a second magnet.

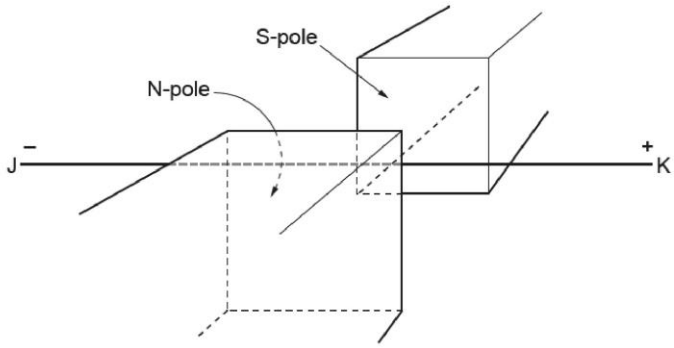


Fig. 11.1

A section of a horizontal, metal wire JK lies in the magnetic field between the two magnetic poles. End K of the metal wire is connected to the positive terminal of a battery and end J is connected to the negative terminal.

The part of JK that is in the magnetic field experiences a force F.

(i) Explain, using ideas of magnetic fields, why the wire experiences force F.

....

.... [1]

(ii) State the direction of force F and describe how this direction is deduced.

....

....

....

.... [3]

(b) The equipment in Fig. 11.2 is used in a **similar** experiment as Fig 11.1.

The part of JK that lies between the poles of the magnets, now passes through a long iron tube that is fixed in position. The tube is shown in Fig. 11.2.

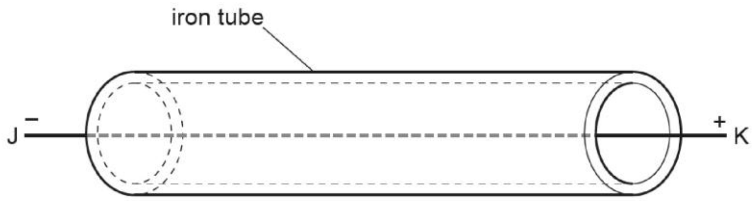


Fig. 11.2

JK is connected to the battery in the same way as before.

State what happens to force F on the wire. Explain your answer.

....

....

....

.... [2]

(c) The iron tube and the wire JK are removed. A square, vertical coil is placed between the poles so that the plane of the coil lies in the magnetic field as shown in Fig. 11.3.

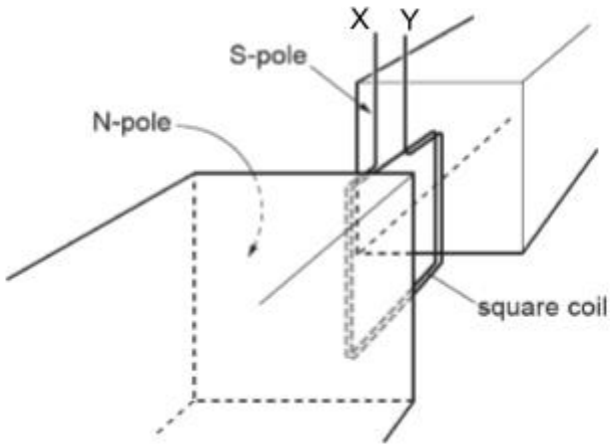


Fig. 11.3

(i) Explain why the coil tries to rotate when there is a current in the coil.

....

....

....

.... [2]

(ii) When there is a current in the coil, the coil tries to turn but is unable to continue turning in the same direction.

The coil rotates continuously when a split-ring commutator and carbon brushes are connected to X and Y.

Explain why.

....

....

....
.... [2]

End of Paper