O

FAJAR SECONDARY SCHOOL
2021 PRELIMINARY EXAMINATIONS
SECONDARY 4 EXPRESS

11

CANDIDATE NAME

CLASS

INDEX NUMBER
N / O LEVEL INDEX NUMBER

PHYSICS
Paper 2

6091/02

No Additional Materials Required

Date: 1 September 2021
Duration: 1 hour 45 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen.
You may use pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions in the spaces provided

Section B
Answer all **three** questions, the last question is in the form either/or.
Answer **all** questions in the spaces provided.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
In calculations, you should show all steps in your working, giving your answer at each stage.
The use of an approved scientific calculator is expected, where appropriate.

For Examiner's Use	
Paper 1	**40**
Paper 2 Section A	**50**
Paper 2 Section B	**30**

Do not open this document till permission is given.

This document consists of **20** printed pages and 0 blank pages.

Total	120

For Examiner's Use

Section A [50 marks]

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

1 Fig. 1.1 shows a horizontal force *F* pulling a cart towards the right. A pendulum bob is hanging from a retort stand on the cart.

As the cart moves, the pendulum remains tilted at an angle of 20° to the vertical. The weight of the bob is 7.0 N.

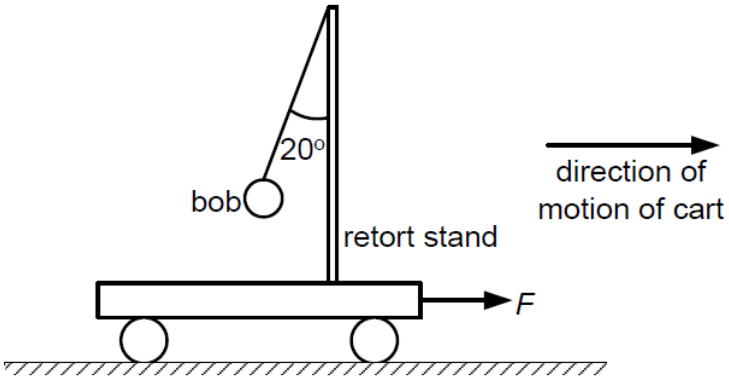

Fig. 1.1

Draw a scaled diagram to determine the net force acting on the pendulum bob when the cart is moving horizontally towards the right.

net force = …… [3]

[Total: 3]

For Examiner's Use

2 A man pushes a box of mass 40 kg along a straight horizontal path.

Fig. 2.1 shows how the force exerted by the man varies with the distance moved by the box.

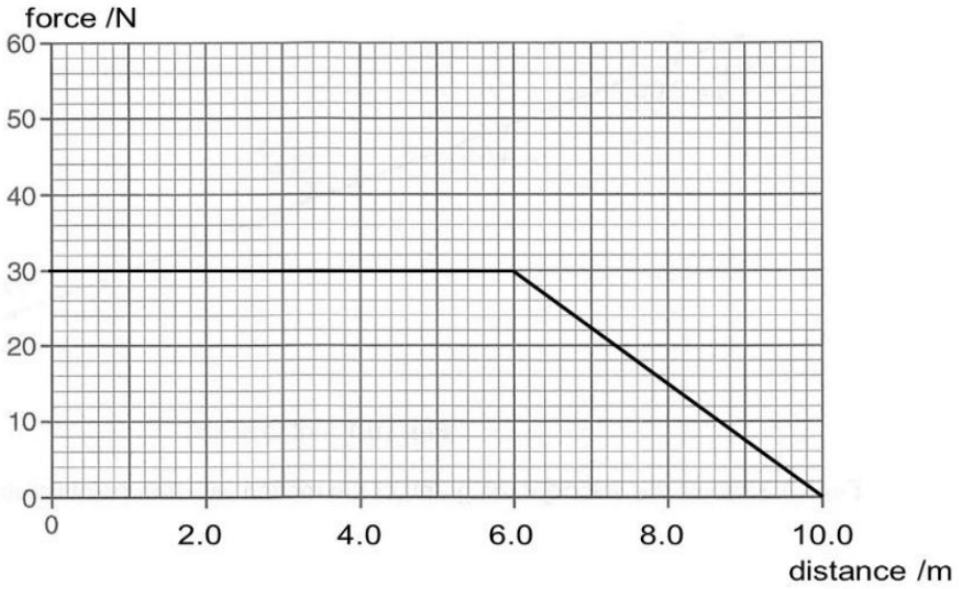

Fig. 2.1

(a) The box starts from rest and reaches a velocity of 1.5 m/s after it travels a distance of 6.0 m.

(i) Calculate the gain in kinetic energy of the box.

kinetic energy gained = …… [1]

(ii) Calculate the resistive force experienced by the box as it travels a distance of 6.0 m.

resistive force = …… [3]

(b) The man pushes the box for a total duration of 10 s. Calculate the average power exerted by the man.

average power = …… [2]

[Total: 6]

For Examiner's Use

3 Fig. 3.1 shows the interior of a spray can. It is first filled with a liquid and then injected with gas. The spray cap traps the highly compressed gas within the can. When used, some of the liquid leaves it and the pressure decreases.

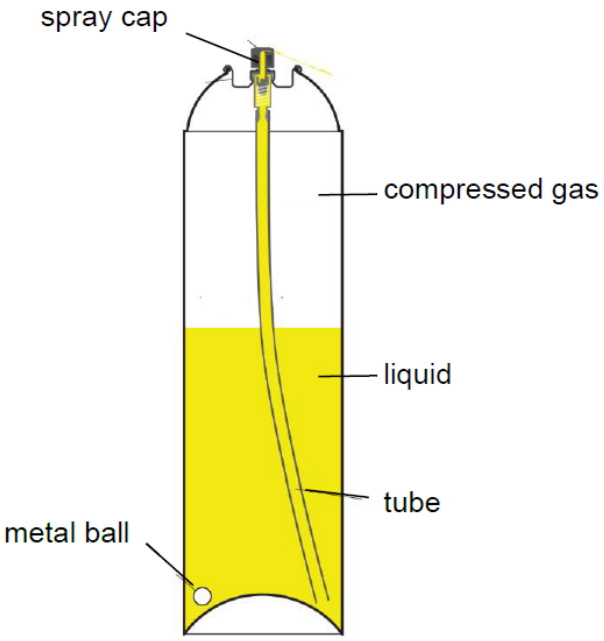

Fig. 3.1

(a) Explain, using motion of molecules, how the gas exerts a pressure on the spray can.

……

……

…… [2]

(b) After using much of the liquid, the rate at which the liquid is sprayed out decreases.

(i) Using ideas about molecules, explain why this happens.

……

……

……

…… [2]

(ii) Explain why the temperature inside the spray can decreases.

……

..... [1]

[Total: 5]

For Examiner's Use

4 Fig. 4.1 shows a woman of mass 60 kg pushing herself up from the ground. The gravitational field strength is 10 N/kg.

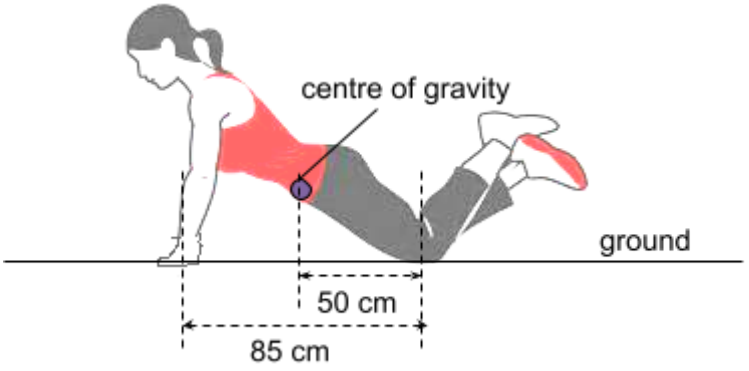

Fig. 4.1

(a) On Fig. 4.1, mark and label the following three forces.

- weight of the woman, ***W***
- force ***F***, by the ground on both hands
- force ***N***, by the ground on both knees.

Show clearly where each force acts and the direction of each force. [3]

(b) State the *principle of moments*.

.....

.....

..... [1]

(c) Determine the magnitude of force ***F*** when the woman pushes herself up from the ground to the position shown in Fig. 4.1

F = …… [3]

(d) Calculate the force ***N*** acting on both knees.

N = …… [1]

[Total: 8]

5 **(a)** Compare the arrangement and motion of the particles in ice and in liquid water.

For Examiner's Use

arrangement ……

……

motion ……..……

…… [2]

(b) A lake has a layer of ice on its surface. The area of the lake is 1800 m^2. The ice has a thickness of 0.025 m. The density of ice is 920 kg / m^3.

(i) Calculate the mass of ice on the lake.

mass = …… [2]

(ii) At night, the temperature of the ice on the lake falls by 3.5 °C.

The specific heat capacity of ice is 2.1 ×10 J / kg °C.

Calculate the change in energy as the temperature falls.

energy = …… [2]

[Total: 6]

For Examiner's Use

6 During the opening of the 1996 Olympic Games in Atlanta, USA was televised live around the world, including Singapore. The television signal was carried by electromagnetic waves via a satellite positioned 35 700 km above the surface of Earth as shown on Fig. 6.1.

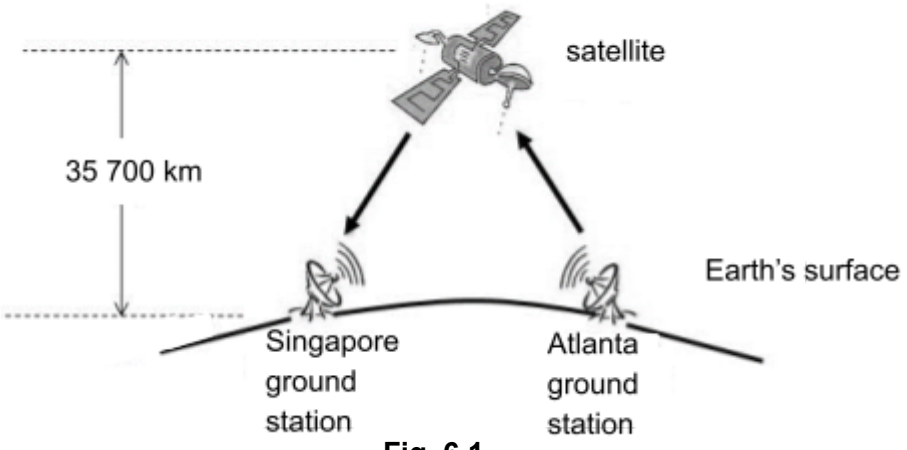

Fig. 6.1

(a) Name the electromagnetic wave used in the signal transmission from Atlanta to Singapore and state another application of this electromagnetic wave.

electromagnetic wave ……

application …… [2]

(b) The frequency of the signal used was 12 GHz.

(i) Determine the period of the television signal.

period = …… [2]

(ii) Calculate the wavelength of the electromagnetic wave used in the transmission.

wavelength = …… [2]

(c) Due to occasional loss in transmission, an upset viewer from Singapore proposed two alternatives to the type of transmission used by the satellite – laser light and ultrasound.

(i) Identify one difference between laser light and ultrasound.

……

…… [1]

(ii) Suggest a reason why using ultrasound in satellite transmissions is not a good idea.

For Examiner's Use

……

…… [1]

[Total: 8]

7 Fig. 7.1 is a circuit diagram.

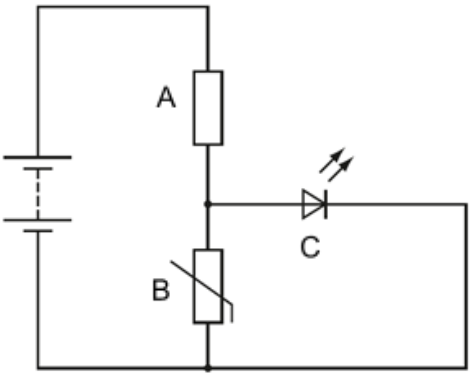

Fig. 7.1

(a) State the names of circuit components **A**, **B** and **C**.

A……..

B……..

C…….. [2]

(b) The circuit can be used to indicate a change in temperature.

State and explain what would be observed when the temperature changes from hot to cold.

……

……

……

……

…… [4]

[Total:6]

For Examiner's Use

8 Fig. 8.1 shows an electrical wiring in a water heater.

It consists of a heat coil rated '240 V, 2500 W' and an exhaust fan rated '240 V, 300 W'. The mains supply 240 V to the water heater.

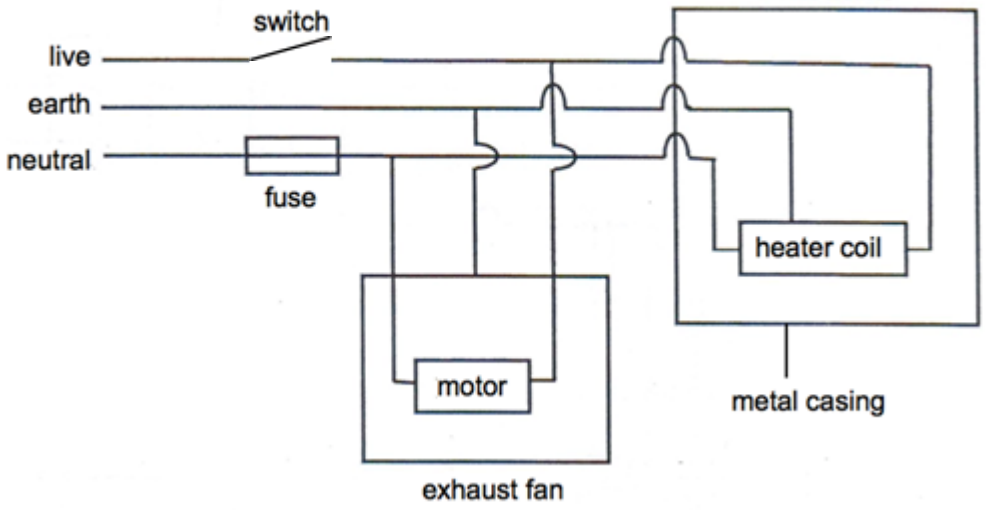

Fig 8.1

(a) Explain how a fuse protects the circuit.

……

……

…… [2]

(b) The fuse rating in Fig 8.1 is 11.0 A. Explain, using suitable calculations, why the fuse is not suitable.

……

…… [2]

(c) Identify two other faults in Fig 8.1 and describe how they should be corrected.

1……

……

2……

…… [2]

(d) Calculate the total resistance of the circuit when both appliances are in use.

For Examiner's Use

total resistance = …… [2]

[Total:8]

For Examiner's Use

Section B [30 marks]

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

9 The focal length of a converging lens is dependent on its shape, as well as the refractive index of the material used to make the lens.

The Lens-Maker's Formula is given by the equation

$$P_{lens} = \left(n_{lens} - 1\right)\left(\frac{2}{R}\right) = \frac{1}{f}$$

where

P_{lens} is the power of the lens

n_{lens} is the refractive index of the lens material

R is the radii of curvature of the lens in m

f is the focal length of the lens in m

(a) (i) A lens made of glass has refractive index of 1.5 and the radii of curvature of the lens is 20 cm.

Using the equation given above, show that the focal length of the lens is 20 cm. [1]

(ii) Fig. 9.1 shows an object **O** placed 15 cm in front of the lens of focal length 20 cm.
On Fig. 9.1, mark with the letter **F** one focal point of the lens. Complete the ray diagram to locate the image and draw an arrow to represent the image.

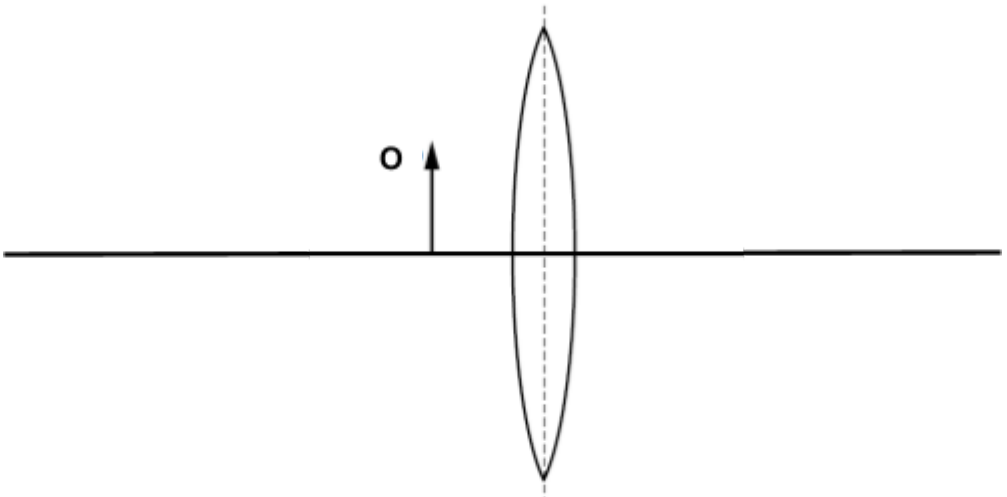

Fig. 9.1 [3]

For Examiner's Use

(iii) Fig. 9.2 shows two examples of such lens made from the same glass but with different radii of curvatures.

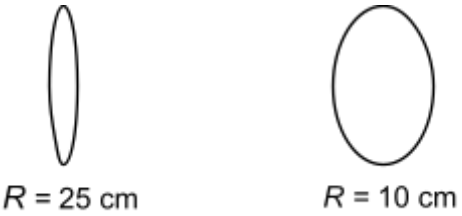

Fig. 9.2

Describe the relationship between R and f for lens.

……

…… [1]

(b) Table 9.3 shows the refractive indices of different materials.

Table 9.3

material	refractive index (n_{lens})
hi-index glass	1.88
low-index glass	1.50
plastic glass	1.74

(i) Explain why the refraction of light occurs.

……

…… [1]

(ii) Using the Lens-Maker's Formula, describe the relationship between the refractive index of a material and the focal length of the resulting lens.

……

…… [1]

(iii) Using ideas on refraction, explain the relationship in **(b)(ii)** for the lens.

……

……

……

…… [2]

(iv) Suggest one benefit of using hi-index glass compared to other materials.

For Examiner's Use

……

…… [1]

[Total: 10]

For Examiner's Use

10 During a game of cricket, a player hits a ball with a bat. The ball then travels vertically upwards, as shown in Fig. 10.1.

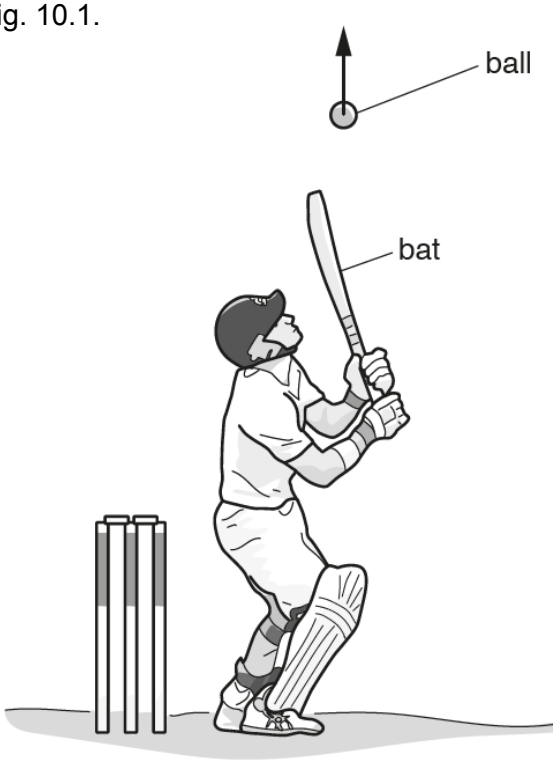

Fig. 10.1

Fig. 10.2 is the velocity-time graph for the ball immediately after being hit.

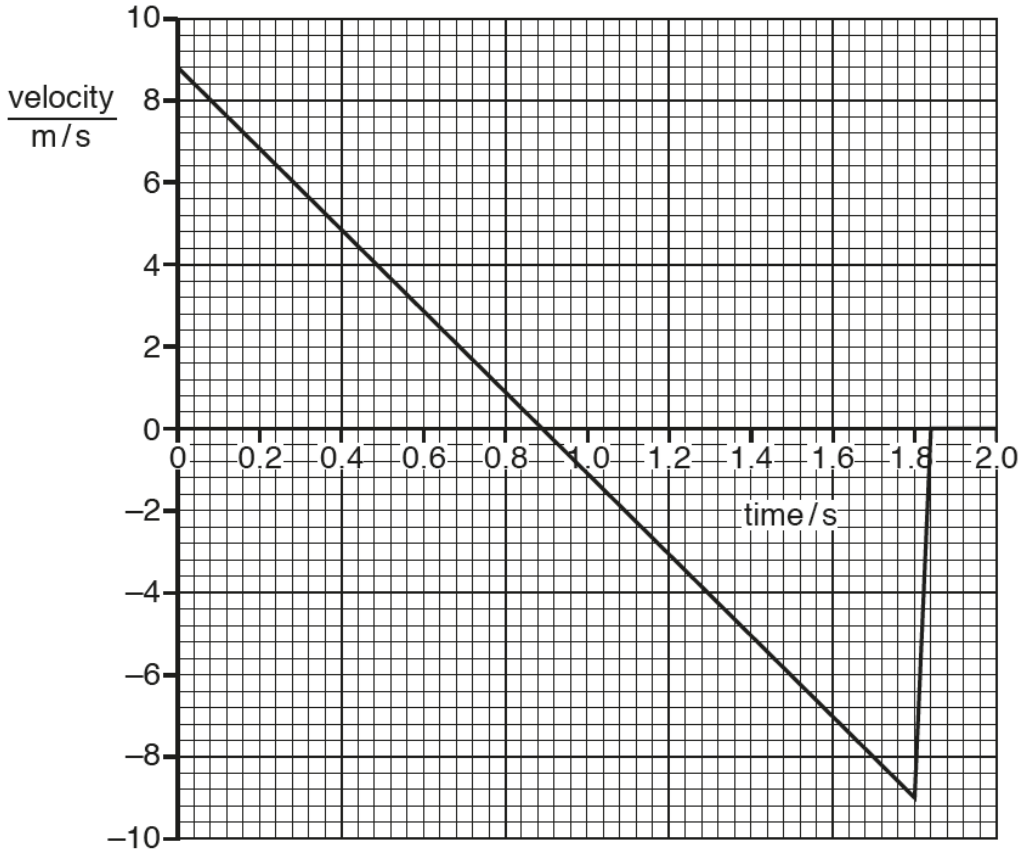

Fig. 10.2

(a) State one difference between *velocity* and *speed*.

For Examiner's Use

……

…… [1]

(b) Describe the motion of the ball from $t = 0$ to $t = 1.8$ s.

……

……

…… [3]

(c) Using Fig. 10.2, determine

(i) the time at which the ball stops moving upwards,

time = …… [1]

(ii) the distance travelled before the ball stops moving upwards.

distance = …… [1]

(d) Suggest why the graph, in Fig. 10.2, is almost vertical from t = 1.80 s to t = 1.84 s.

……

…… [1]

(e) Fig. 10.2 shows that the ball remains stationary after a time of 1.84 s.

Describe the energy change that is occurring at a time of 1.84 s.

……

…… [1]

(f) For the cricket ball, the effect of air resistance is negligible.

For Examiner's Use

However, when another ball of a much smaller mass is hit vertically upwards at the same speed, air resistance produces a noticeable effect on its motion.

Suggest two ways in which the velocity-time graph for the ball of a smaller mass differs from Fig. 10.2.

1……

……

2……

..... [2]

[Total: 10]

11 EITHER

For Examiner's Use

A vertical solenoid (long coil) with an iron core is held in a wooden clamp above a laboratory bench.

The solenoid is connected in series with a battery, a switch S, an ammeter and a variable resistor. There is a voltmeter in parallel with the solenoid.

Fig. 11.1 represents this circuit set-up.

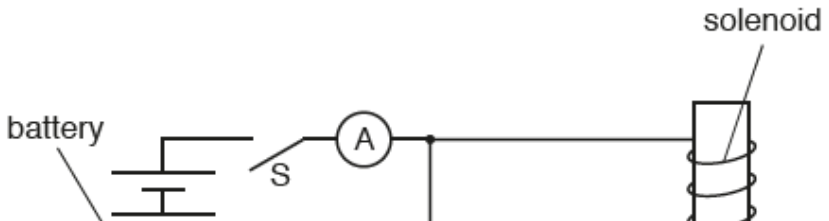

Fig. 11.1

A student closes switch S and a current in the circuit produces a reading on the ammeter.

The battery consists of five 1.5 V cells in series. The reading on the ammeter is 4.0 A.

(a) (i) State the size of the electromotive force (e.m.f.) of the battery.

e.m.f. = …… [1]

(ii) Calculate the total resistance of the series circuit.

resistance = …… [2]

(iii) The reading on the voltmeter is 6.5 V.

Calculate the power dissipated in the solenoid.

power = …… [2]

(iv) The solenoid is made of copper and the student notices that, as time passes, the solenoid becomes extremely warm.

State and explain the effect of this temperature increase on the ammeter reading.

……

…… [1]

For Examiner's Use

(b) The current in the solenoid magnetises the iron core so that the lower end of the core is a N-pole.

On Fig. 11.1, draw the magnetic field pattern in the region surrounding the iron core. [2]

(c) The student holds an iron cylinder against the bottom surface of the iron core in the solenoid. When he releases the iron cylinder, it stays in contact with the iron core.

Explain why the iron cylinder does not fall.

……

……

…… [2]

[Total: 10]

OR

For Examiner's Use

Fig. 11.2 shows an a.c. generator with a rotating permanent magnet. The a.c. generator is used to power a lamp.

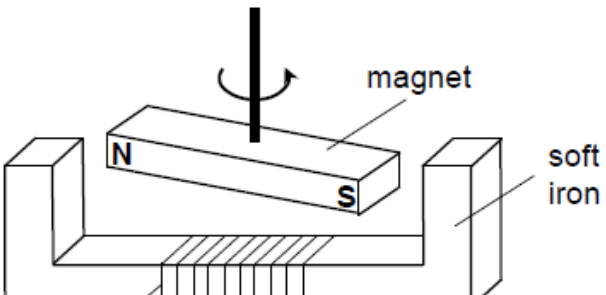

Fig. 11.2

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

……

…… [1]

(ii) Explain why a current is induced.

……

……

…… [1]

(iii) Explain why the induced current is alternating.

……

……

……

…… [2]

(iv) Suggest one way to increase the induced current in the lamp.

……

…… [1]

(v) Suggest one reason for an iron core in the a.c. generator.

……

…… [1]

(b) A transformer in a power station has a primary input voltage of 23 000 V, and the secondary output voltage is stepped up to 660 000 V before power is transmitted over long distance.

For Examiner's Use

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

……

…… [1]

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

Calculate the power generated in the primary coil.

power = …… [1]

(iii) Calculate the current in the secondary coil.

current = …… [2]

[Total: 10]

- End of Paper -