O

CONVENT OF THE HOLY INFANT JESUS SECONDARY
Preliminary Examination in preparation for
the General Certificate of Education Ordinary Level 2022

CANDIDATE NAME			
CLASS		INDEX NUMBER	

PHYSICS

6091/02

Paper 2 Theory

15 September 2022

1 hour 45 minutes

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

READ THESE INSTRUCTIONS FIRST

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

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 12 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.

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.

Section A

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

1 A ball rolls down a slope as shown in Fig. 1.1.

The metre rule shows the position of the ball at times, t = 0 s, 1.0 s, 2.0 s and 3.0 s.

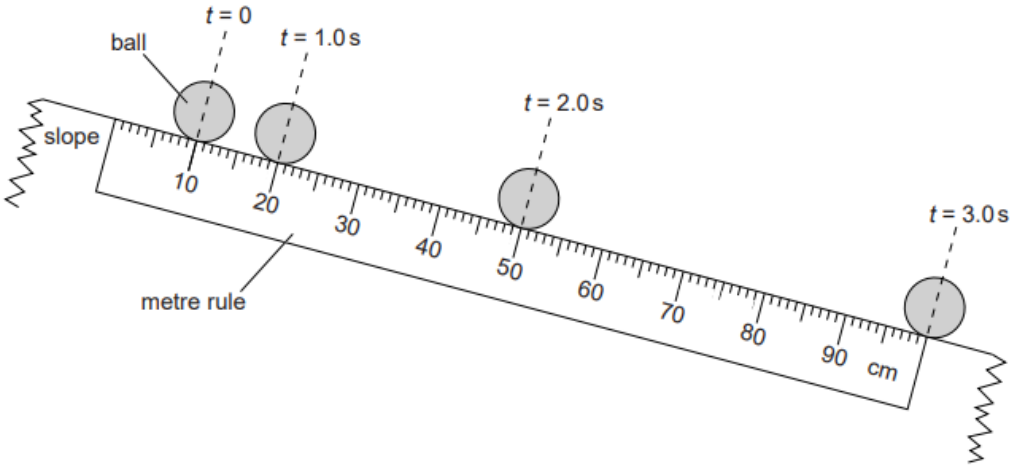

Fig. 1.1

(a) Explain how Fig. 1.1 shows that the ball is accelerating.

……

…… [1]

(b) Calculate the average speed of the ball between t = 1.0 s and 3.0 s.

average speed = …… [2]

(c) Two of the forces that act on the ball are air resistance and weight.
The ball accelerates as it rolls down the slope.

State what, if anything, happens to

(i) air resistance, ……

(ii) weight, …… [2]

2 Two trains P and Q travel between the same two stations on parallel tracks.
Fig. 2.1 shows the distance-time graphs of the two trains.

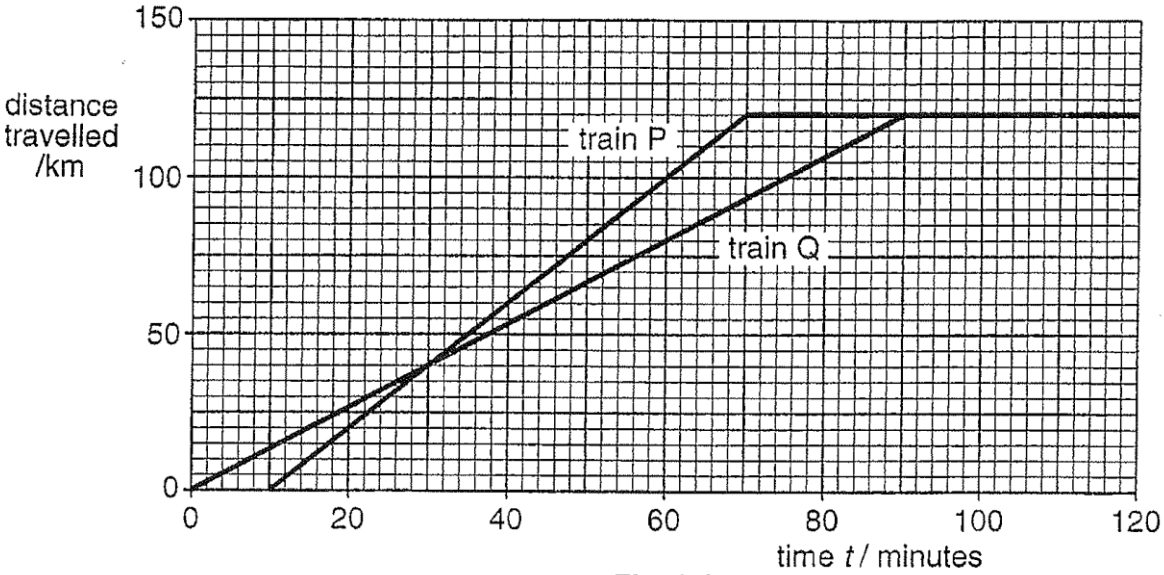

Fig. 2.1

Train Q starts its journey at time t = 0 minutes and train P starts its journey at t = 10 minutes.

(a) Explain how Fig. 2.1 shows that, when moving, train P has a greater speed than train Q.

……

……

..... [2]

(b) What is the distance between the two stations?

distance = …….. [1]

(c) Calculate the speed of train Q when it is moving. Give your answer in km/h.

speed = …….. [2]

(d) Another train R makes the same journey. It travels at the same speed as train P.
Train R leaves 30 minutes later than train P.

On Fig. 2.1, draw the distance-time graph for the train R. [1]

[Turn over

3 Two tugboats are pulling a ship in a harbour. Fig. 3.1 represents the view from above and shows the directions of the forces on the ship.

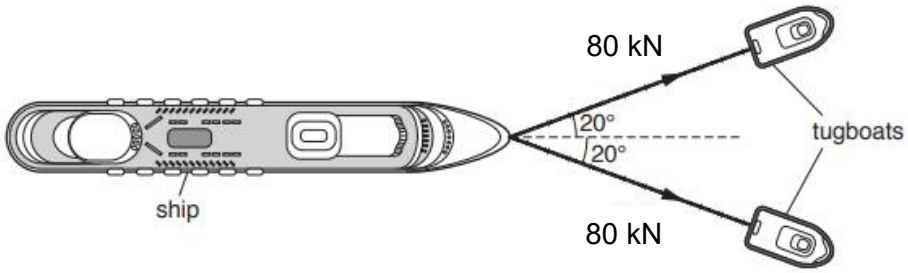

Fig. 3.1 (not to scale)

The pulling force exerted by the two tugboats are 80 kN each.

(a) In the space below, draw a labelled diagram to show the resultant of these two forces.

Determine the magnitude of the resultant force.
State the scale used.

scale: ……..

resultant force = ……
[3]

(b) The engines of the ship are not operating and the water in the harbour is stationary. The ship is moving in a straight line in the direction of the resultant force exerted by the two tugboats. It is traveling at a constant speed.

Explain, in terms of the forces acting, why the ship is moving in a straight line at constant speed.

……

……

…… [2]

4 Fig. 4.1 shows a painter standing on a wooden plank, directly above the right-hand support.

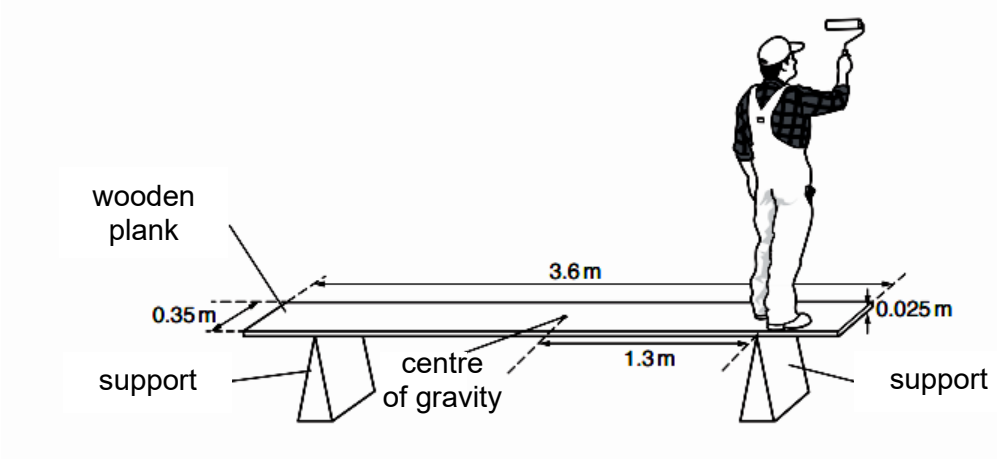

Fig. 4.1

The plank has length 3.6 m, width 0.35 m and thickness 0.025 m.

The gravitational field strength g is 10 N/kg and the mass of the plank is 23 kg.

(a) Calculate the density of the wood from which the plank is made.

density = ... [2]

(b) The centre of gravity of the plank is in the middle of the plank at a distance of 1.3 m from each of the supports.

Calculate

(i) the weight of the plank,

weight = ... [2]

(ii) the moment due to the weight of the plank about the right-hand support.

moment = ... [2]

(c) The painter moves further to the right along the plank and the plank starts to rotate clockwise about the right-hand support.

Explain why the plank rotates clockwise.

.....

.....

..... [2]

5 Fig 5.1 shows the journey of a cyclist from point A to B. Point A and B are at the same height.

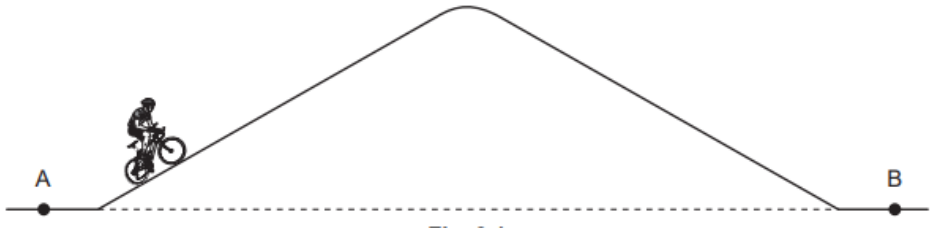

Fig 5.1

The cyclist starts from rest at A and pedals up and over a hill. Near the bottom of the hill, she starts to brake and come to rest at B.

(a) Describe the energy changes that take place as she pedals up the hill at constant speed.

……

…… [2]

(b) Explain how the law of conservation of energy applies to the complete journey from A to B.

……

…… [1]

(c) At one point in the journey, the gravitational potential energy of the cyclist has increased by 5700 J. The total mass of the cyclist and bicycle is 60 kg.
The gravitational field strength is 10 N/kg.

Calculate the height above A of the cyclist at this point.

height above A = …….. [2]

[Turn over

6 Fig. 6.1 shows a syringe that contains a gas at the same pressure as the air outside. The piston moves freely along the cylinder without any friction. The mass of gas remains constant.

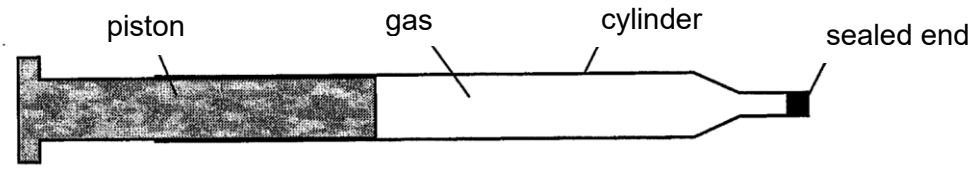

Fig. 6.1

As the syringe is cooled from 90 °C to 10 °C, the piston moves inwards. It stops moving when the temperature is steady.

State how the physical quantities of the cooled air have changed when the piston stops moving at 10 °C, compared to the initial temperature of 90 °C.

Complete Table 6.1, using the terms "*greater"*, "*the same"* or "*less"*.

Table 6.1

the average distance between the gas molecules	
the pressure of the gas after the piston stops	
the average speed of the gas molecules	
the frequency of the collision between the gas molecules and the piston	
the average diameter of the gas molecules	

[5]

7 **(a)** Fig. 7.1 shows part of a page from a student's notebook. The student attempted to list out all the components of the electromagnetic spectrum.

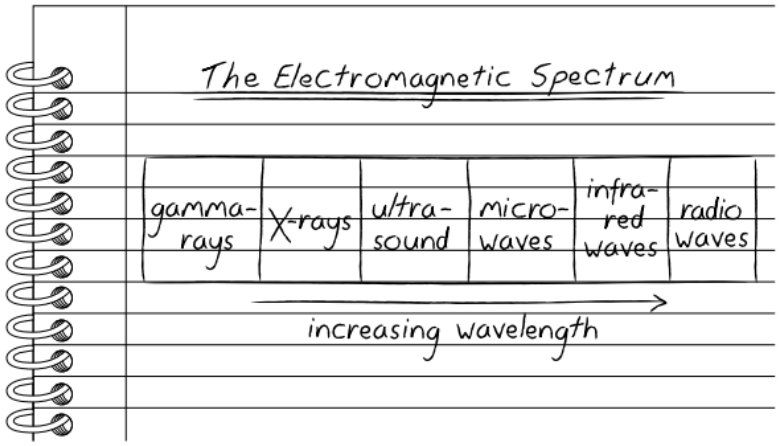

Fig. 7.1

List three errors in the student's notes and state how it should be corrected.

1. ……..

2. ……..

3. ……..

[3]

(b) X-rays is used in hospitals for the diagnosis of medical conditions such as fractures or tooth decay.

State one other application of X-rays.

……

…… [1]

[Turn over

8 Fig. 8.1 shows a positively charged rod, an uncharged metal sphere on an insulating stand and a connection to earth.

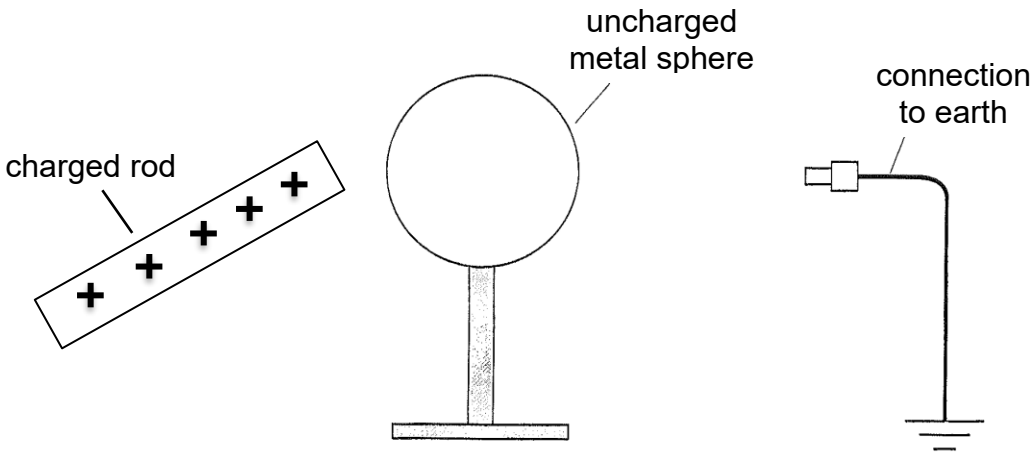

Fig. 8.1

(a) Describe how this apparatus is used to give the metal sphere a negative charge by induction.

……..

……..

……..

……..[3]

(b) State and explain what happens to the free electrons in the metal sphere during the charging process.

……..

……..

……..[2]

(c) At the end of the charging process, the metal sphere has a charge of 2.5 nC.
The charging process takes 4.0 ms.

Calculate the average current during this time.

current = …… [2]

9 Fig. 9.1 shows a design for a simple circuit breaker.

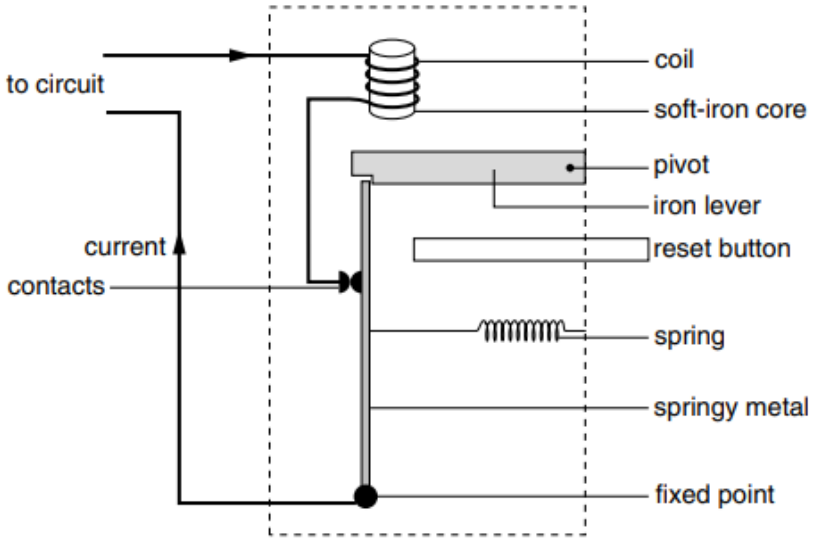

Fig. 9.1

(a) When there is a large current in the circuit, the circuit breaker trips.

Describe what happens to the soft-iron core, iron lever, spring and contacts.

soft-iron core: ……

iron lever: ……

spring: ……

contacts: …… [4]

(b) Suggest one modification to the circuit breaker so that it will operate at a lower current.

……

…… [1]

[Turn over

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Name:	Index number:	Class:

Section B

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

10 Fig. 10.1 shows a device used to measure the flow of air. The turbine is made to rotate by the air that flows through it. The rim of the turbine contains small magnets. An e.m.f is formed in the coil wound on a soft-iron core nearby.

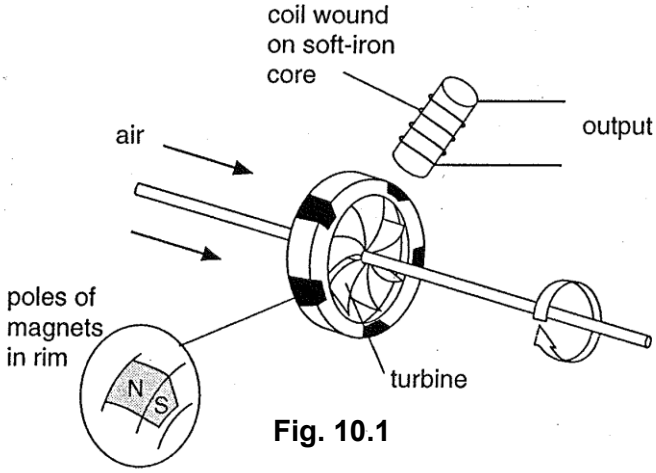

Fig. 10.1

(a) Explain how an e.m.f is formed in the coil.

……..

……..

……..

……. [3]

(b) The line on Fig. 10.2 shows how the induced e.m.f. varies with time when the turbine rotates at a steady speed.

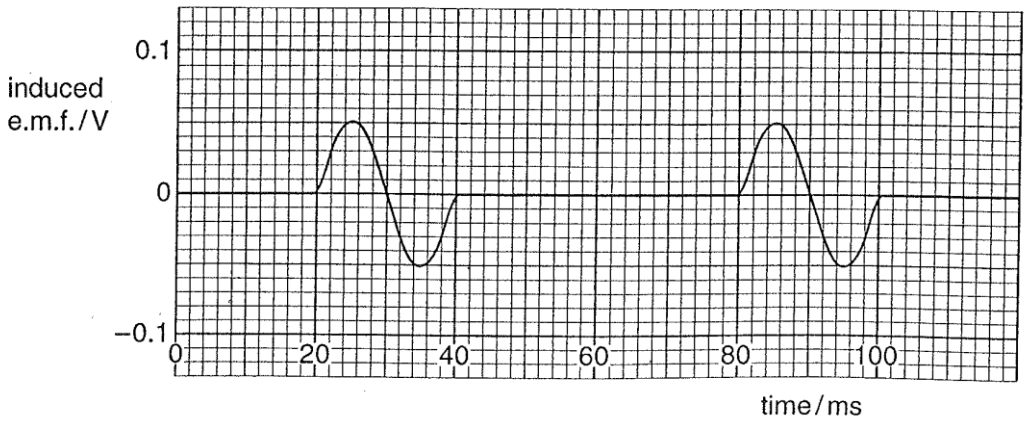

Fig. 10.2

On Fig. 10.2, draw a line to show how the induced e.m.f. varies if the turbine rotates twice as fast.

[3]

[Turn over

A power station generates electrical energy at 25 kV, 12 kA. Fig. 10.3 shows the generator in the power station connected to the primary coil of an ideal transformer. The transformer changes the voltage before the electrical energy is transmitted across the country.

The output from the secondary coil of the transformer is 400 kV.

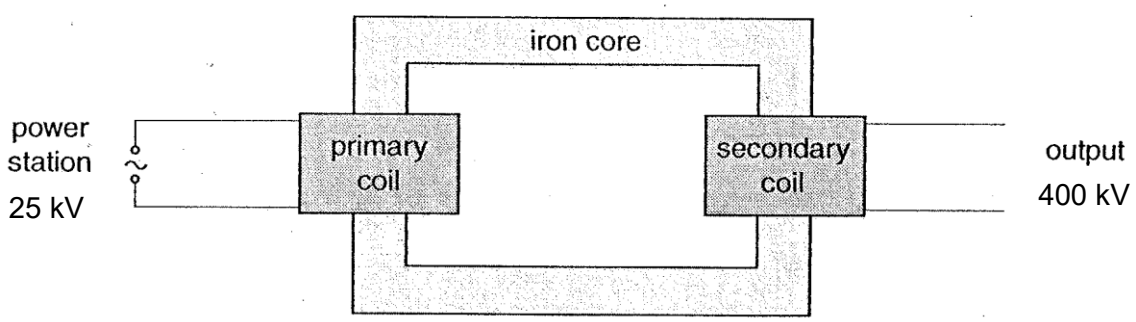

Fig. 10.3

(c) Calculate the turns ratio, the number of turns in the secondary coil to the number of turns in the primary coil.

turns ratio = ... [1]

(d) Assuming the transformer is ideal, calculate the output current from the transformer.

output current = ... [2]

(e) State one advantage of using a high voltage for the transmission of the electrical energy.

.....

..... [1]

11 **(a)** What is the difference between *input* transducers and *output* transducers?

……

…… [1]

(b) Fig. 11.1 shows how the resistance of the thermistor changes with temperature.

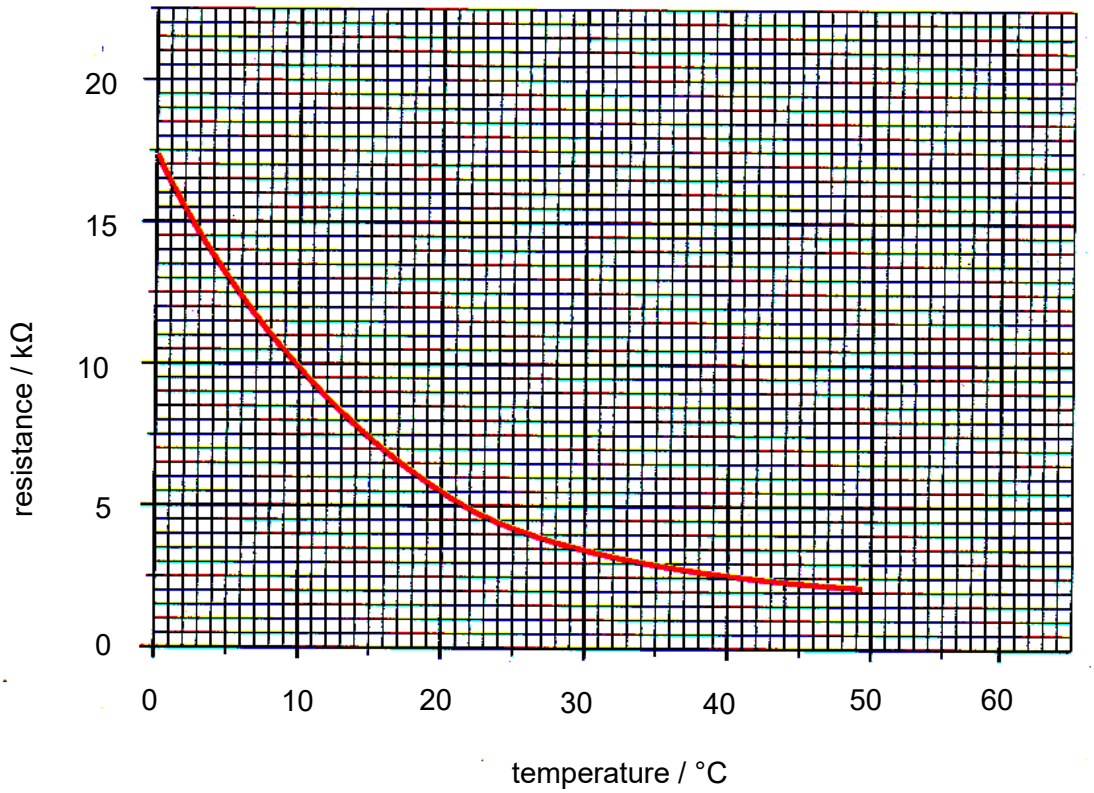

Fig. 11.1

(i) From the graph, determine the resistance of the thermistor at 40 °C.

resistance of thermistor = ….…… [1]

(ii) Explain why the graph shows that the temperature sensor is a non-ohmic device.

……

…… [1]

[Turn over

(c) The thermistor is connected to a circuit in Fig. 11.2. The variable resistor R is set at 7.5 kΩ and the battery has an e.m.f of 20.0 V.

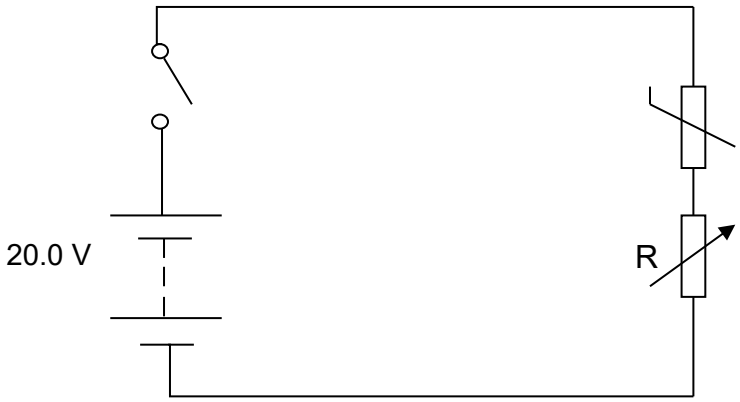

Fig 11.2

When the switch is closed, determine the current (in mA) flowing in the circuit at 40 °C.

current = ……..…… [2]

(d) The variable resistor R is connected to an electronic circuit as shown in Fig. 11.3. The electronic circuit is switched on when the potential difference across R is between 6.0 V to 10.0 V. The resistance of the variable resistor is still set at 7.5 kΩ.

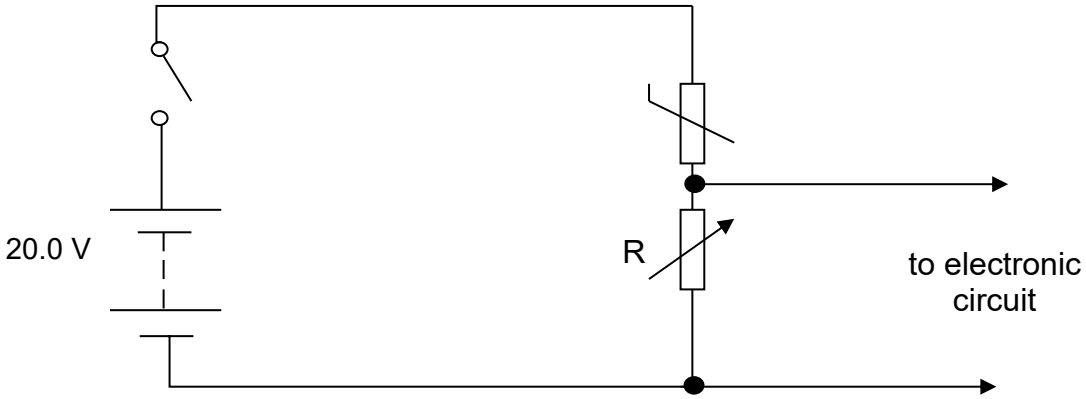

Fig. 11.3

(i) Calculate the output voltage across R when the temperature is 40 °C.

output voltage = …… [1]

(ii) Calculate the maximum and minimum temperature for the electric circuit to be switched on.

maximum temperature = …….

minimum temperature = …….
[3]

(iii) Suggest a use for this circuit.

……..……..……...

……..……..……..…… [1]

[Turn over

12 EITHER

Fig. 12.1 shows an electrical circuit with six identical resistors of 10 Ω, a lamp, a voltmeter and a dry cell. The electromotive force of the dry cell is 24 V and the voltmeter connected across the lamp reads 6.0 V.

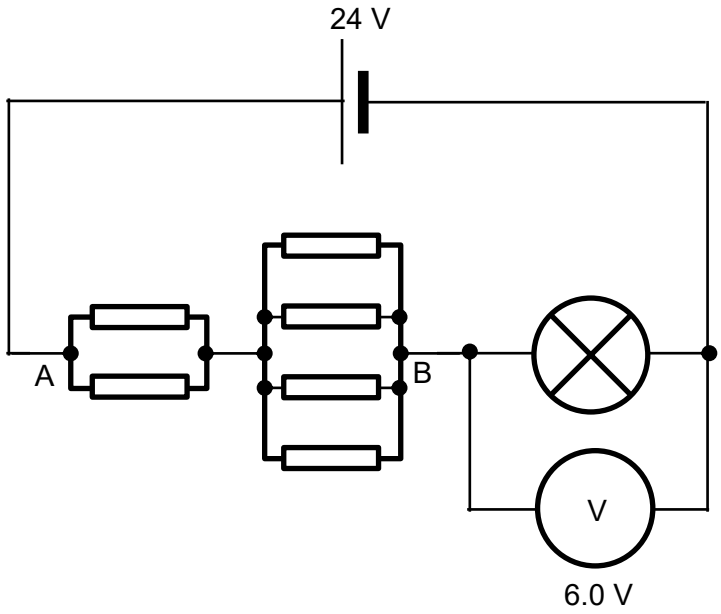

Fig. 12.1

(a) Calculate the effective resistance between the points AB.

effective resistance = …….. [2]

(b) (i) Define *electromotive force* and *potential difference* in terms of work done.

……...……

…….……..

…...……..

…...…… [2]

(ii) State the potential difference between AB.

potential difference = ……..…… [1]

(c) **(i)** Calculate the current supplied by the dry cell.

current = …….. [2]

(ii) Calculate the resistance of the lamp.

resistance = …….. [1]

(d) Explain why there is a need to earth the metal casings of all electrical appliances.

……..

……..

……..

……. [2]

12 OR

(a) (i) Fig. 12.2 shows an object O placed in front of a converging lens. Complete the scaled ray diagram by adding two rays to show how a converging lens forms the virtual image of the object with a linear magnification of 2.0.
(linear magnification = image height/object height)

Mark the focal point and label it as 'F'. [2]

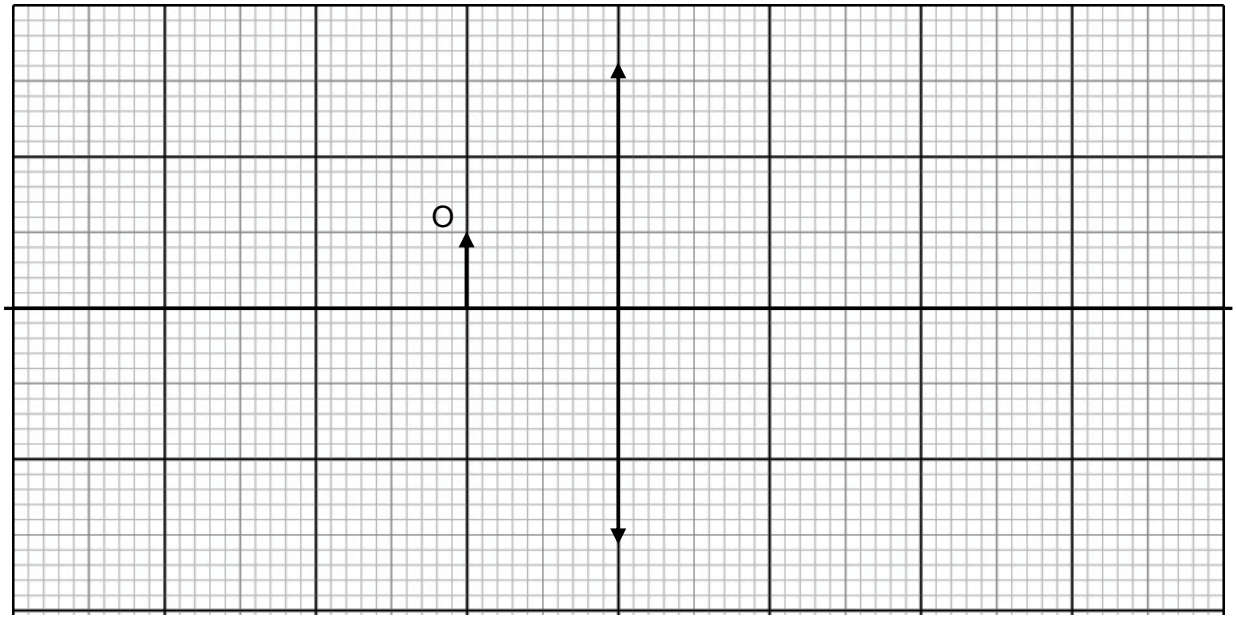

Fig. 12.2

(ii) Fig. 12.3 shows an object O placed in front of a converging lens. Complete the scaled diagram by adding two rays to show how a converging lens forms the real image of the object with a linear magnification of 2.0.

Mark the focal point and label it as 'F'. [2]

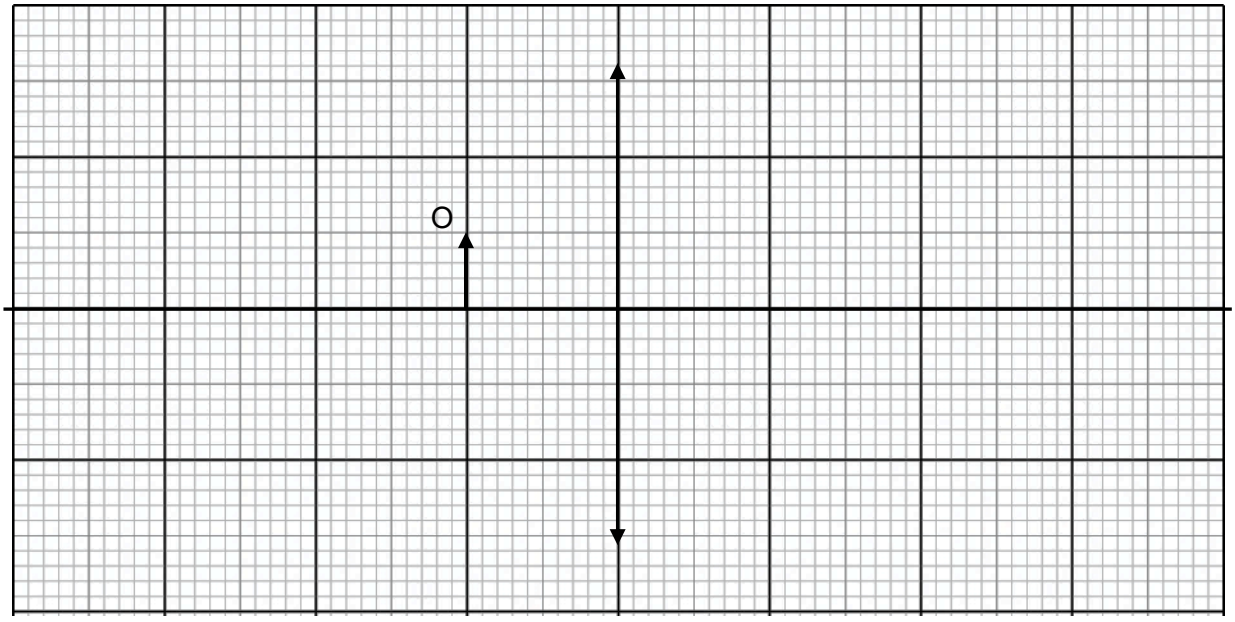

Fig. 12.3

(b) The image formed in Fig. 12.2 is virtual and enlarged.

State one other characteristic of the image in Fig. 12.2.

……..…….

……..… [1]

(c) Name a particular use of the lens arranged in Fig. 12.3, and explain why the characteristics of the image described is suitable for the use stated.

……..…….

……..…….

……..… [2]

(d) The converging lens can also be used in a photocopying machine to make identical copies of documents.

With reference to the lens, where should the object be placed so that the lens can be used in a photocopying machine.

……..…….

……..… [1]

(e) The converging lens works based on the use of curved surfaces and the laws of refraction.

State the two laws of refraction.

1. …..……..…….

……..…….

2. …..……..…….

……..… [2]

- End of Paper -

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