FORM TP 2024107

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MAY/JUNE 2024

CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

PHYSICS

Paper 02 – General Proficiency

2 hours 30 minutes

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READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in TWO sections. Answer ALL questions.
2. Write your answers in the spaces provided in this booklet.
3. Do NOT write in the margins.
4. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
5. You may use a silent, non-programmable calculator to answer questions, but you should note that the use of an inappropriate number of figures in answers will be penalized.
6. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer.**
7. **If you use the extra page(s), you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

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DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

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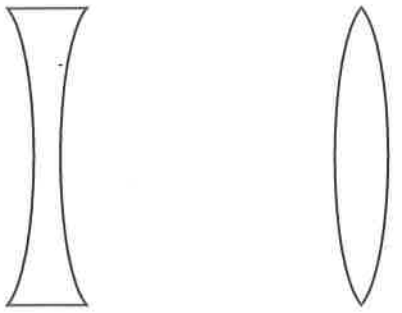
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SECTION A

Answer ALL questions.

1. (a) Identify the types of lenses shown in Figure 1.



Lens A **Lens B**

Figure 1. Types of lenses

Lens A .....

Lens B .....

(2 marks)

(b) A student used the apparatus shown in Figure 2 to determine the focal length of a lens. She adjusted the position of the lens and screen to obtain a sharp image on the screen. She measured the image distance, v, deduced the magnification, m, of the object and recorded her results in Table 1 below.

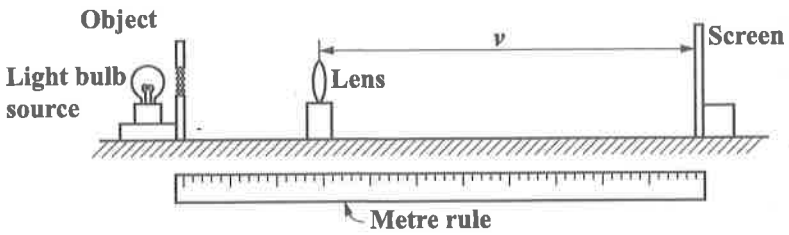


Figure 2. Apparatus set up to determine the focal length of a lens

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TABLE 1: IMAGE DISTANCE, *v*, AND MAGNIFICATION OF THE OBJECT, *m*

v/cm	20	30	40	50	60	70	80
m	0.15	0.65	1.20	1.85	2.35	2.95	3.52

(i) Using a scale of 2 cm to represent 0.50 on the y-axis, plot a graph of magnification, m, against image distance, v, on the grid provided **on page 7**.

(8 marks)

(ii) Calculate the gradient, G.

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(6 marks)

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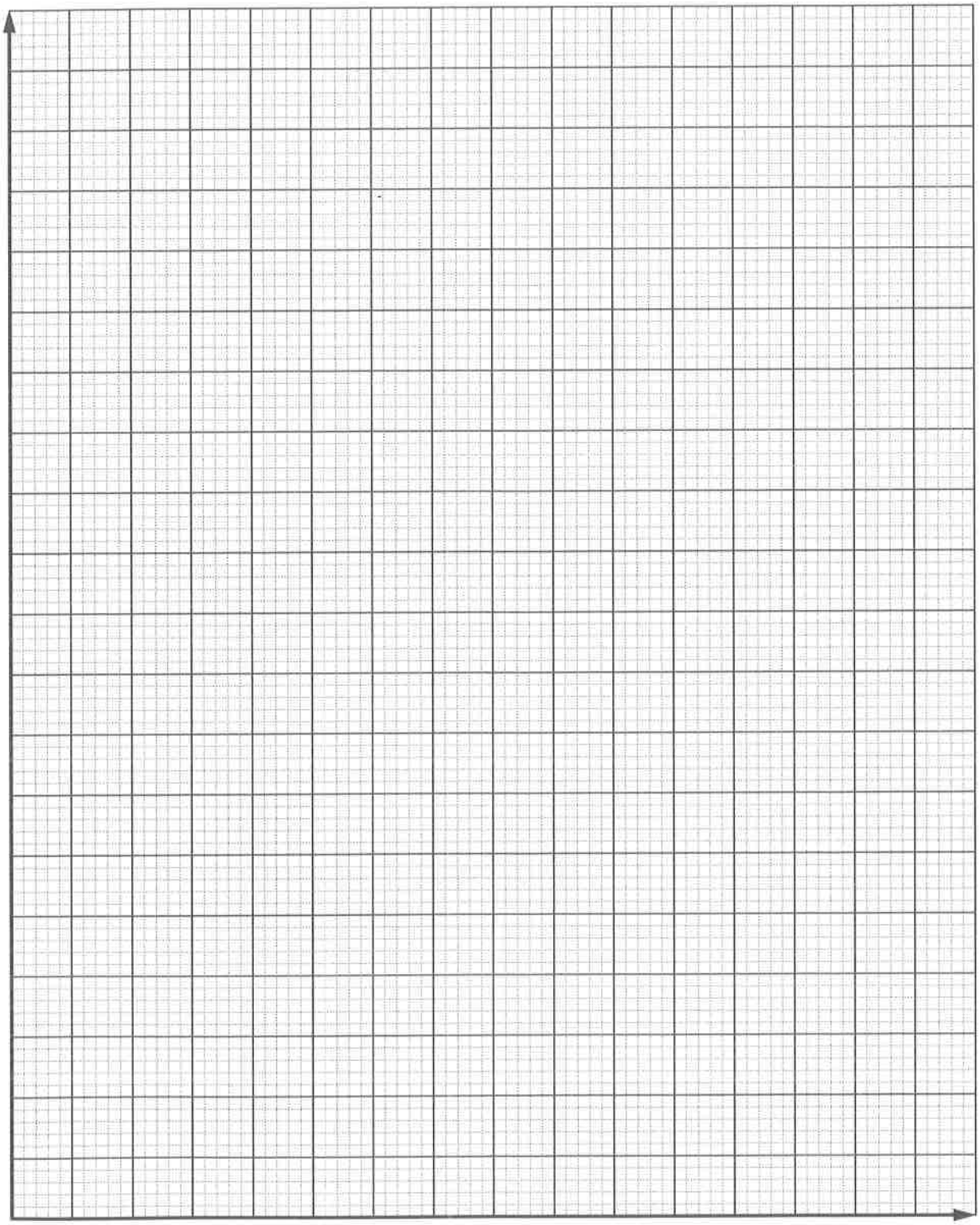


Figure 3. Graph of magnification, *m* against image distance, *v*

(iii) Given that $G = 1/f$, calculate the focal length of the lens, f.

(3 marks)

(c) Figure 4 shows a full-scale diagram of an object, O, which has a height of 3 cm. The object is placed 8 cm in front of a **diverging** lens, L.

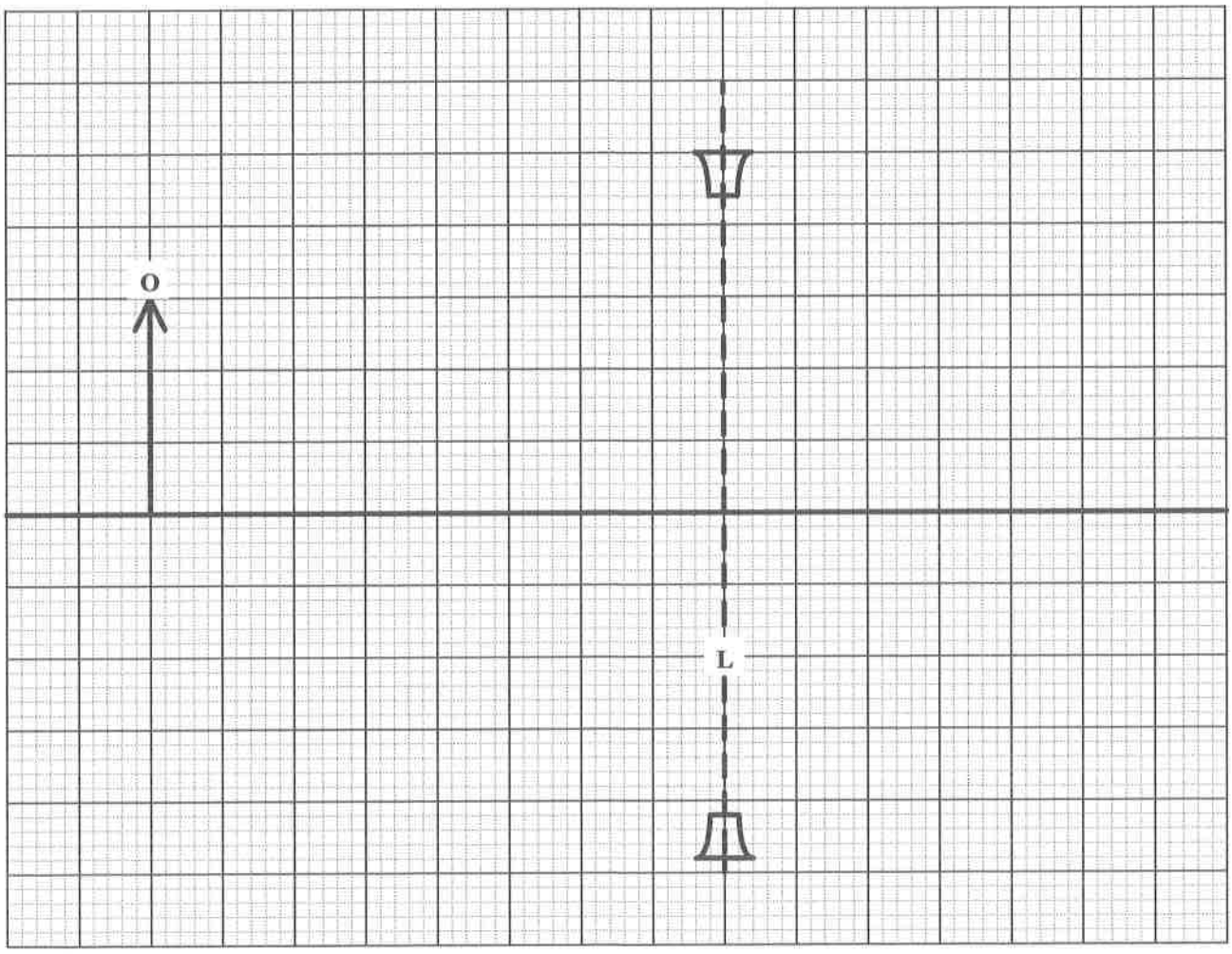


Figure 4. Full-scale diagram of optical arrangement

(i) Given that the focal length of the lens is 5 cm, draw the ray diagram in Figure 4 to find the image of the object. **(4 marks)**

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(ii) Record the image distance.

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(1 mark)

(iii) State whether the image is real or virtual.

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(1 mark)

Total 25 marks

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2. Figure 5 shows a bottle filled with water resting on the ground in three different positions, A, B and C.

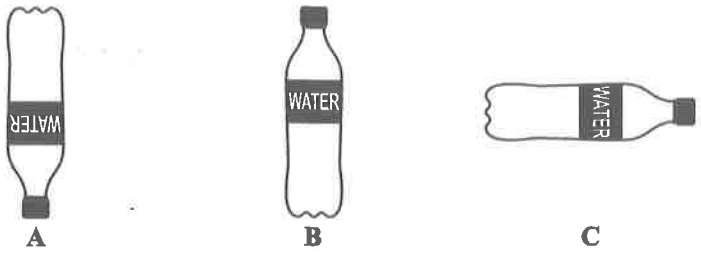


Figure 5. Three different positions of a full bottle of water

(a) State the type of equilibrium for EACH of the following.

(i) Position A .....

(ii) Position B .....

(iii) Position C .....

(3 marks)

(b) Define the term 'moment of a force'. State its SI unit.

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(4 marks)

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(c) Figure 6 shows a uniform metre rule balanced horizontally on a fulcrum with a mass of 0.24 kg hanging from one end. [$g = 10\ N\ kg^{-1}$]

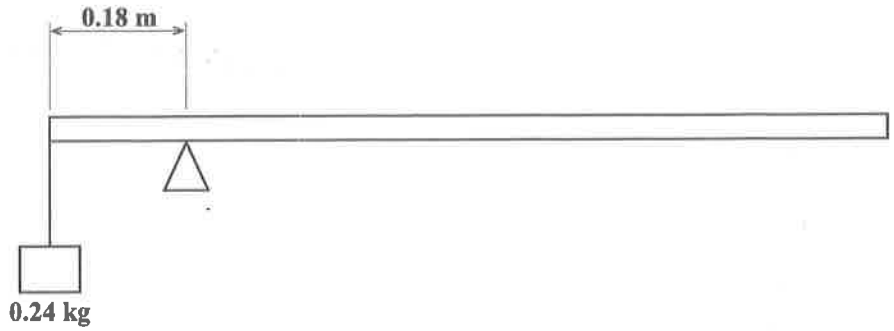


Figure 6. A uniform metre rule

(i) Calculate the weight of the 0.24 kg mass.

(2 marks)

(ii) By taking moments, calculate the weight of the metre rule.

(4 marks)

(iii) Calculate the magnitude of the force of the fulcrum acting on the metre rule.

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(2 marks)

Total 15 marks

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3. (a) Using arrows, match each mode of heat transfer to ONE correct description.

Mode of Heat Transfer	Description
Conduction	Transfer by medium movement
Convection	Transfer without a medium
Radiation	Transfer by electromagnetic wave
	Transfer without medium movement
	Transfer by physical contact
	Transfer through liquids and gases

(3 marks)

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(b) Figure 7 shows a section of a solar water heater which utilizes the greenhouse (glasshouse) effect in its operation.

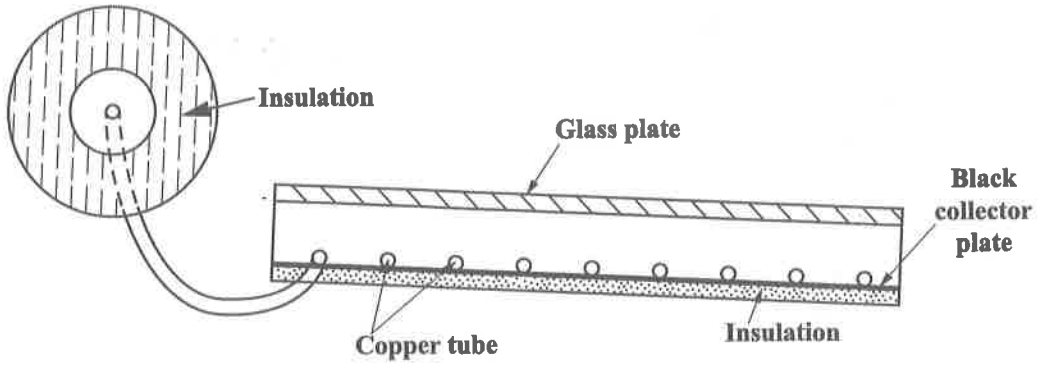


Figure 7. Section of a solar water heater

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(i) Briefly describe the greenhouse (glasshouse) effect.

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(4 marks)

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(ii) The energy absorbed from the sun by a solar water heater is 360 kJ. Thirty-five per cent of the energy is transferred to 1.5 kg of water in the pipes. Calculate the final temperature of the water if its initial temperature is 30 °C.

[Specific heat capacity of water is 4200 J kg^{-1} $°C^{-1}$.]

(6 marks)

(iii) Explain why the pipes (tubes) are made from copper.

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(2 marks)

Total 15 marks

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(2 marks)

Total 15 marks

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SECTION B

Answer ALL questions.

4. (a) Figure 8 shows a circuit diagram with a low voltage power supply circuit which can be used to test whether a given material is a conductor or insulator.

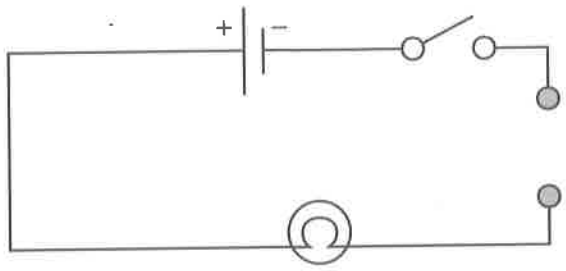


Figure 8. Circuit diagram

(i) Describe the procedure which would be used to test whether the material is a conductor.

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(3 marks)

(ii) Name ONE material which is an electrical conductor and ONE which is an insulator.

Conductor .....

Insulator .....

(2 marks)

(iii) On the diagram in Figure 8, mark the direction of electron flow. **(1 mark)**

(b) Figure 9 shows a circuit diagram which has a combination of four resistors and an ammeter, A.

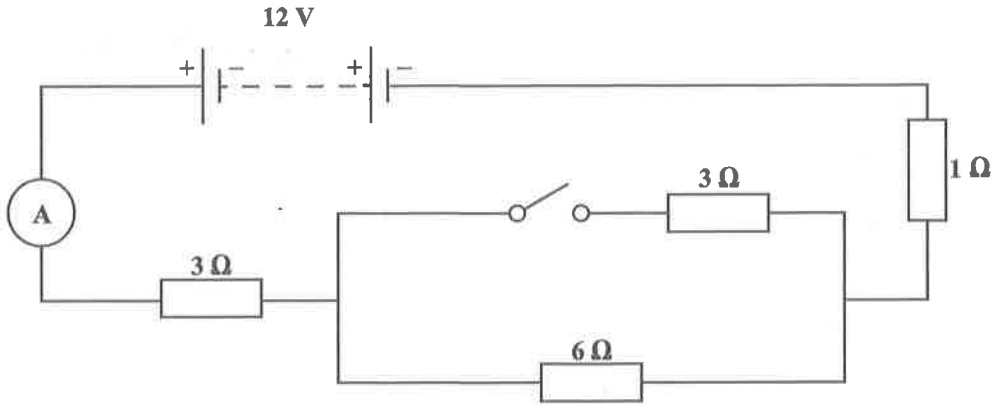


Figure 9. Circuit diagram

Calculate the reading of the ammeter when the switch is

(i) open

(3 marks)

(ii) closed.

(4 marks)

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(c) Calculate the power dissipated in the 1 Ω resistor when the switch is closed.

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(2 marks)

Total 15 marks

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5. (a) (i) Define the term 'electric field'.

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(3 marks)

(ii) Figure 10 represents the electric field between and around two charged objects.

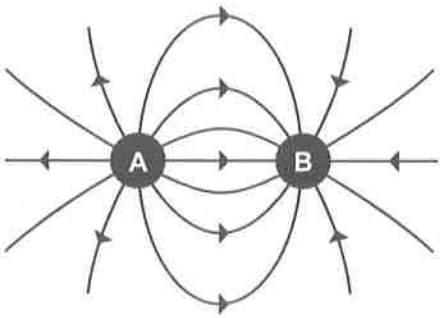


Figure 10. An electric field

State the type of charge at object A.

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(1 mark)

(b) Explain how a polythene rod when rubbed with fur becomes negatively charged.

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(2 marks)

(c) A magnetic relay is used to switch on a circuit carrying a large current.

Figure 11 shows an electromagnet used in a magnetic relay to operate the starter motor of a car.

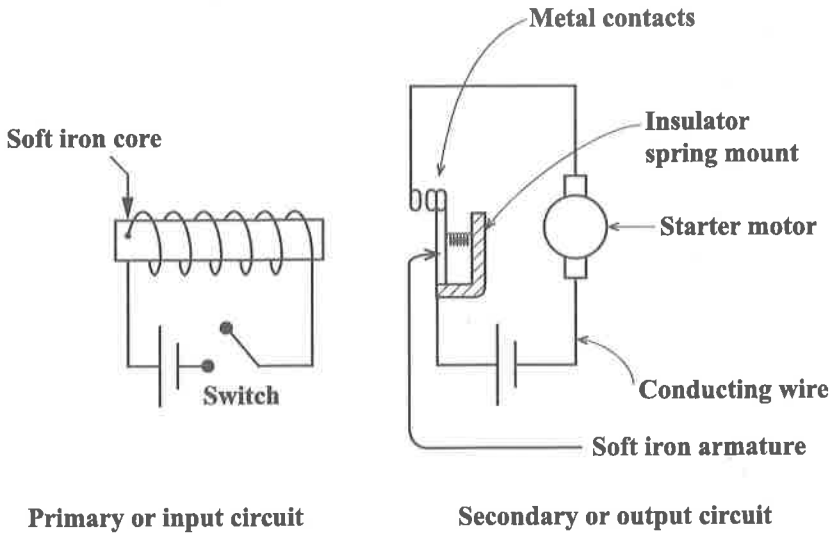


Figure 11. A magnetic relay

Explain how the magnetic relay can be used to operate the starter motor in Figure 11.

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(5 marks)

(d) Figure 12 shows a wire connected to a centre zero galvanometer. The wire is placed between the poles of a permanent magnet.

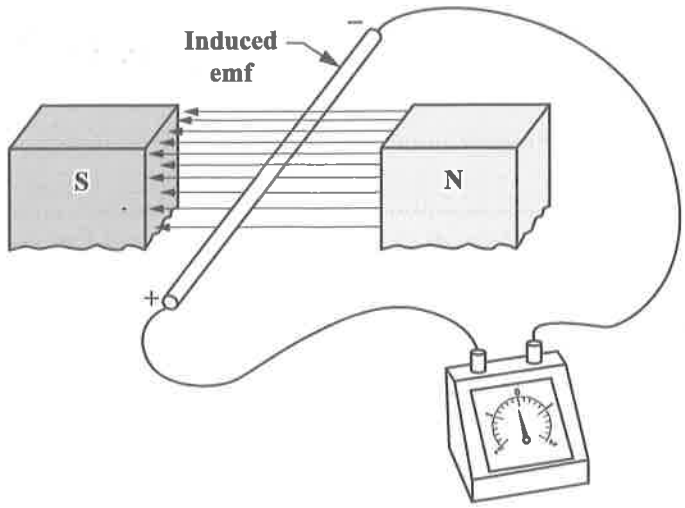


Figure 12. A wire placed between the poles of a permanent magnet

State what is observed on the galvanometer when the wire is moved in the direction shown by the arrows.

(i) parallel to the magnetic field ←→

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(1 mark)

(ii) upwards through the magnetic field ↑

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(1 mark)

(iii) downwards through the magnetic field ↓

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(2 marks)

Total 15 marks

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6. (a) A single nuclear fission reactor could produce most of the electricity requirements for many Caribbean countries.

(i) State TWO arguments against building such a nuclear reactor in one of the larger islands of the Caribbean.

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(2 marks)

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(ii) Give ONE argument to support the building of such a reactor to produce the electricity required for an island.

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(1 mark)

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(b) (i) Define the term 'radioisotope'.

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(1 mark)

(ii) Radioisotopes have useful applications in the fields of medicine, agriculture and industry.

Choose TWO of the fields above and describe ONE useful application of radioisotopes in EACH.

Field	Application
	....
	....

(2 marks)

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(c) The letters P, Q, R, X and Y represent five different nuclides.

$^{40}_{19}P$ $^{235}_{92}Q$ $^{40}_{18}R$ $^{238}_{92}X$ $^{39}_{19}Y$

Determine

(i) which nuclides have identical mass numbers

.....

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(1 mark)

(ii) how many neutrons are in the heaviest nuclide

.....

.....

(2 marks)

(iii) which pair of nuclides are isotopes.

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(2 marks)

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(d) In an experiment to determine the half-life of a radioactive isotope, the initial count rate of 16 000 counts per minute was recorded. After 100 seconds the new count rate was 1000 counts per minute.

Use the information given to calculate the half-life of the isotope.

(4 marks)

Total 15 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

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