BOTSWANA EXAMINATIONS COUNCIL
Botswana General Certificate of Secondary Education

PHYSICS

Paper 3 Theory

0571/03

October/November 2023

1 hour 15 minutes

You must answer on the Question Paper.

No additional materials are needed.

CANDIDATE NAME

CENTRE NAME

2100561

INSTRUCTIONS

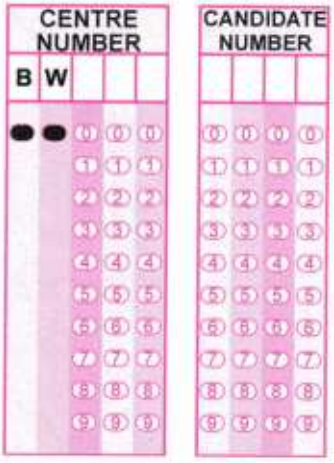
Shade using an HB pencil, do not use ink.

Erase unwanted marks completely.

Do not use correction fluid.

Do not make any stray marks on this form.

Mark answers by shading the oval heavily, like this: - ●



INSTRUCTIONS

- Answer **all** questions.
- Use black or dark blue pen.
- Write your candidate name, centre name and candidate number in the spaces provided at the top of this page.
- Write your answer to each question in the space provided.
- Do not use an erasable pen or correction fluid.
- DO **NOT** WRITE IN ANY BARCODES.
- You may use an HB pencil for any diagrams, graphs or rough working.
- Electronic calculators may be used.

INFORMATION

- The total mark for this paper is 70.
- The number of marks for each question or part question is shown in brackets [ ].
- You may lose your marks if you do not show your working.
- Take the weight of 1 kg to be 10 N (i.e. acceleration of free fall = 10 m/s^2)

This document consists of **15** printed pages and **1** blank page.

[Turn over

1 **(a)** State the difference between *speed* and *velocity*.

.....

..... [1]

(b) Fig. 1.1 shows a speed-time graph for a cyclist riding along a straight level road. The cyclist covers a distance of 800 m. The diagram is not drawn to scale.

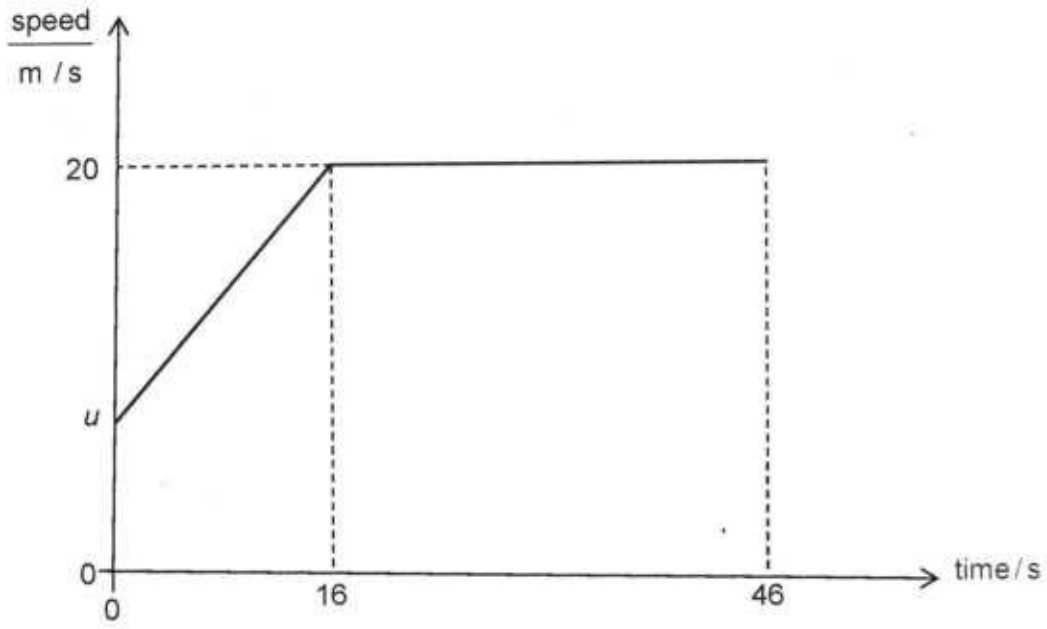


Fig. 1.1

Describe the motion of the cyclist in terms of acceleration between:

(i) 0 s and 16 s .....

(ii) 16 s and 46 s .....

[2]

(c) Determine the initial speed u of the cyclist.

u = ... [3]

(d) Calculate the average speed of the cyclist.

average speed = ... [2]

2 **(a)** Define *pressure*.

.....

..... [1]

(b) Fig. 2.1 shows a U-tube manometer.

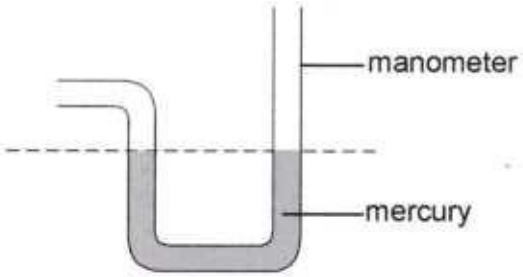


Fig. 2.1

Explain why the mercury level in both arms of the manometer is the same.

.....

..... [1]

(c) Fig. 2.2 shows the mercury levels when the manometer is connected to a gas cylinder.

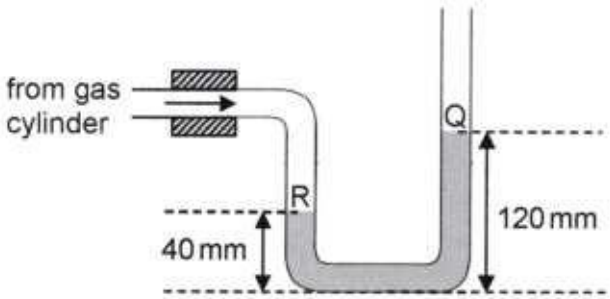


Fig. 2.2

The atmospheric pressure is 760 mmHg.

(i) State the value of the pressure at surface Q.

pressure = ... [1]

(ii) Determine the value of the pressure exerted by the gas.

pressure = ... [2]

(d) The set-up in Fig. 2.2 is taken to the top of a mountain.

State the effect, if any, that this will have on the pressure exerted by the gas.

.....

..... [1]

3 **(a)** Define the term *melting point*.

.....

..... [1]

(b) Fig. 3.1 shows a cooling curve for a liquid substance of mass 0.25 kg.

The initial temperature of the substance is 78 °C.

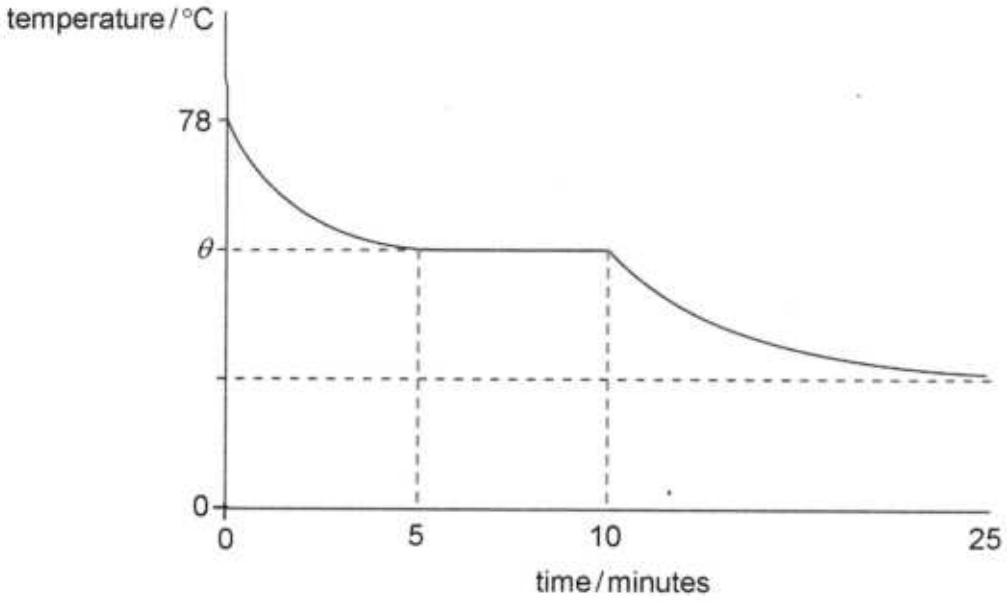


Fig. 3.1

(i) Identify the state of the substance between 10 minutes and 25 minutes.

..... [1]

(ii) The specific heat capacity of the liquid substance is 133 000 J / kg °C.

Explain the meaning of the statement.

.....

..... [1]

(iii) The substance loses 730 000 J of heat energy as it cools between 0 minutes and 5 minutes.

Determine the value of the temperature θ.

θ = ... [3]

4 (a) State the difference between a liquid and a solid in terms of:

(i) distances between molecules, ...

.....

(ii) movement of molecules. .....

.....

[2]

(b) Fig. 4.1 shows a bicycle pump with a sealed nozzle.

The pump contains air of volume 250 cm^3 which exerts a pressure of 80 kPa on the walls of the pump.

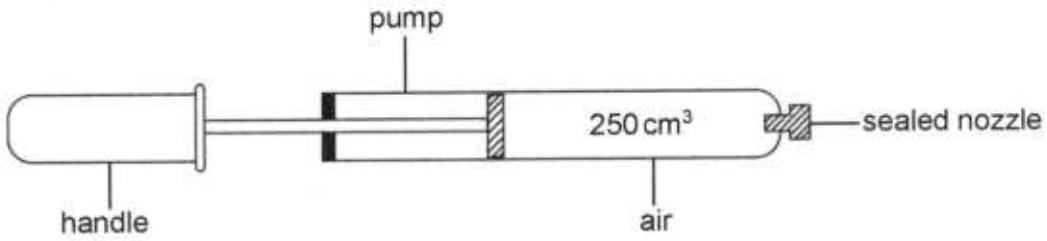


Fig. 4.1

The handle is pulled backwards to increase the volume of the air to 400 cm^3.

(i) State and explain the effect of increasing the volume on the pressure exerted by the air.

effect .....

explanation .....

.....

[2]

(ii) Calculate the pressure exerted by the air when its volume is 400 cm^3.

pressure = ... [2]

(iii) State the assumption made to answer **(b)(ii)**.

..... [1]

5 (a) (i) Define the term *critical angle*.

.....

..... [1]

(ii) The refractive index for glass is 1.5.

Calculate the critical angle for glass. Show your working.

critical angle = ... [2]

(b) Fig. 5.1 shows a ray of light incident on end A of an optical fibre.

Fig. 5.1

(i) Explain why the incident ray does not bend when it enters the optical fibre at end A.

.....

..... [1]

(ii) Explain why the ray of light is able to emerge at end B of the optical fibre.

.....

.....

.....

..... [2]

6 **(a)** State the difference between a transverse and a longitudinal wave.

.....

..... [1]

(b) Fig. 6.1 shows layers of air, initially the same distance apart, as a sound wave travels through air.

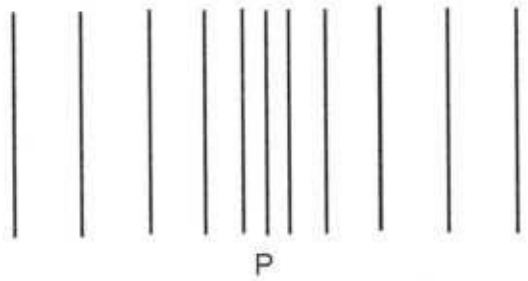


Fig. 6.1

The sound wave has a wavelength of 0.0132 m and travel at a speed of 330 m / s.

(i) State the name of the area labelled P.

..... [1]

(ii) Calculate the frequency of the sound wave.

frequency = ... [2]

(iii) State and explain whether the sound wave in Fig. 6.1 can be heard by a normal human being.

statement .....

explanation .....

.....

[2]

7 **(a)** Fig. 7.1 shows a cross-section of a solenoid carrying current.

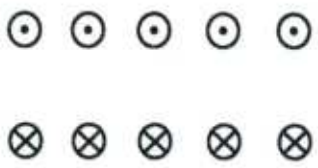


Fig. 7.1

On Fig. 7.1, draw the magnetic field pattern due to the current in the solenoid. [2]

(b) Fig. 7.2 shows a set-up used to demonstrate electromagnetic induction.

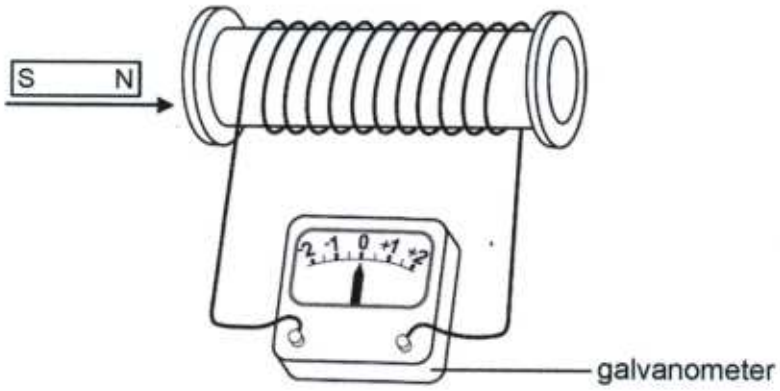


Fig. 7.2

The north pole of the magnet is pushed into the coil and the galvanometer needle deflects in one direction and back.

(i) Explain why the galvanometer needle deflects when the north pole is pushed into the coil.

.....

..... [2]

(ii) State **two** changes that could be made to the set-up to increase the deflection of the galvanometer needle.

1 .....

2 .....

[2]

(iii) Suggest **one** practical application of electromagnetic induction.

..... [1]

8 Fig. 8.1 shows a set-up used to demonstrate thermionic emission.

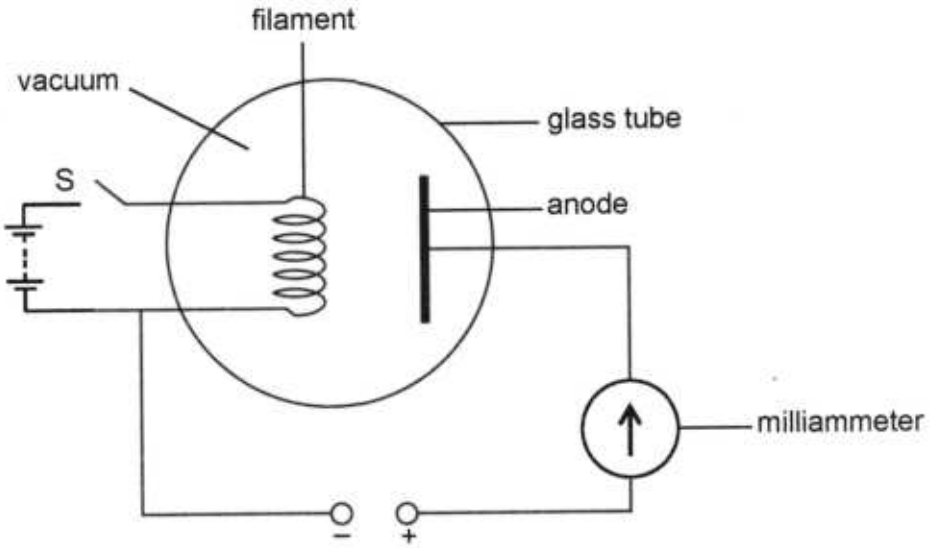


Fig. 8.1

The milliammeter reads 0 mA.
The switch S is closed and the needle of the milliameter moves to the right.

(a) Explain why there is a deflection in the milliameter when the switch is closed.

.....

.....

.....

..... [3]

(b) Fig. 8.2 shows an electric circuit.

A cathode ray oscilloscope (CRO) is connected across a resistor.

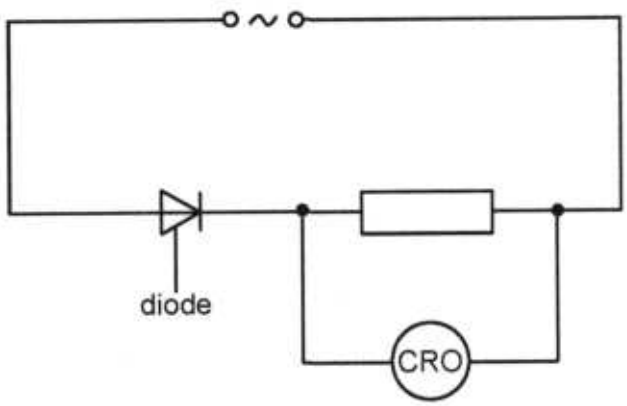
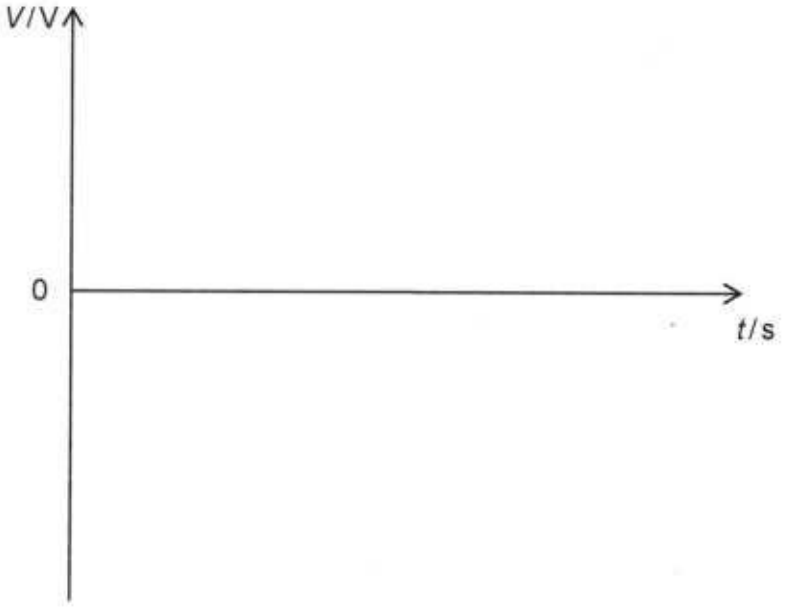


Fig. 8.2

(i) State the function of the diode in the circuit.

..... [1]

(ii) On the axes below, sketch the waveform of voltage against time displayed by the CRO. [2]



9 **(a)** Table 9.1 shows part of the colour-code of resistors.

Table 9.1

colour	value
black	0
brown	1
red	2
gold	±5 %

Fig. 9.1 shows a colour-coded resistor.

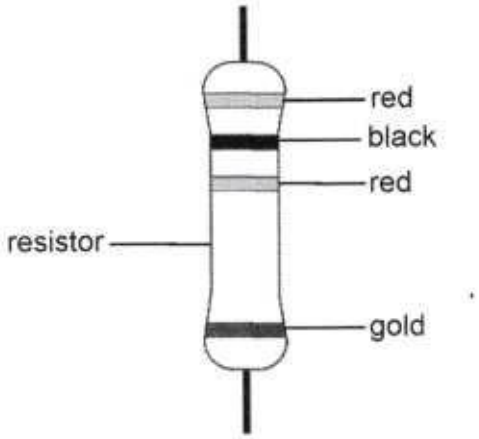


Fig. 9.1

Determine the maximum resistance of the resistor.

resistance = ... [2]

(b) Two 1000 Ω resistors are connected in parallel.

Determine the total resistance of the resistors.

resistance = ... [2]

(c) A copper wire of length 20.0 m has a cross-sectional area of $0.000050\,m^2$.

The resistivity ρ of copper is $1.7 \times 10^{-8}\,\Omega m$.

Determine the resistance of the wire.

resistance = ... [2]

10 *Fig. 10.1 shows a circuit used to monitor the temperature of air in a room.*

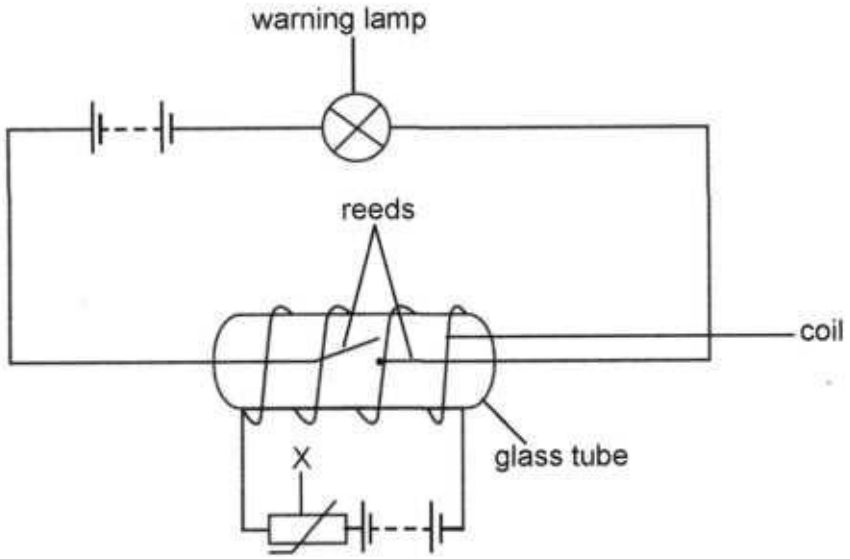


Fig. 10.1

When the temperature of the air rises, the warning lamp lights.

(a) State the name of component X.

.....[1]

(b) Explain why the warning lamp lights when the temperature of the air rises.

.....

.....

.....

.....

.....[4]

11 **(a)** Radioactive emissions occur randomly over space and time.

Explain the meaning of this statement.

.....

..... [1]

(b) Describe the nature of an alpha particle.

..... [1]

(c) Fig. 11.1 shows a Geiger-Muller (GM) tube placed near a radioactive source which only emits alpha and beta radiation. Different materials are placed at position X.

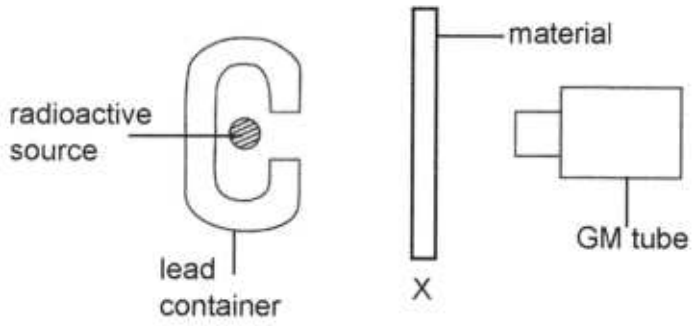


Fig. 11.1

Table 11.1 shows the count rate when different materials are placed at position X.

Table 11.1

material at X	count rate / counts/s
nothing	100
one sheet of paper	70
5 mm of aluminum	20

State the value of the count rate which is due to:

(i) background radiation .....

(ii) alpha radiation .....

(iii) beta radiation .....

[3]

(d) State **two** dangers of exposure to radioactive emissions.

1 .....

2 .....

[2]