GENERAL CERTIFICATE OF EDUCATION BOARD
General Certificate of Education Examination

PHYSICS 2
0580

JUNE 2022 **ORDINARY LEVEL**

Subject Title	**Physics**
Paper No.	**2**
Subject Code No.	**0580**

Two and a half hours

Answer ALL questions.

Section I is designed to be answered in 1 hour and Section II in 1½ hours.

You are advised to divide your time accordingly.

In Section II answer EITHER the (a), (b) and (c) OR the (d), (e), and (f) of each question.

For your guidance, the approximate mark for each part of a question is indicated in brackets.

You are reminded of the necessity for good English and orderly presentation in your answers.

In calculations, you are advised to show all the steps in your working, giving your answer at each stage.

Where necessary, assume:
- *the acceleration of free fall, $g = 10\ m\ s^{-2}$*
- *the speed of light in air, $c = 3 \times 10^8\ m\ s^{-1}$*
- *the charge on an electron, $e = 1.6 \times 10^{-19}\ C$*

Non-programmable and cordless calculators are allowed.

SECTION I

Answer all questions

1. Two liquids A and B are poured into a measuring cylinder as shown in Figure 1.

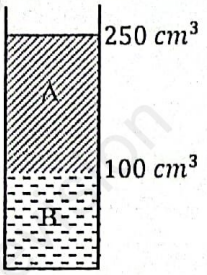

Figure 1

(a) Which of the liquids (A or B) occupies a greater volume? **(1 mark)**
(b) Which of the liquids (A or B) has a lower density? **(1 mark)**
(c) Calculate the density of liquid B in $g\ cm^{-3}$, if its mass is 330 g. **(2 marks)**

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2. (a) An uncalibrated mercury-in-glass thermometer is placed in steam from boiling water at standard atmospheric pressure, and the length of the mercury thread is30 cm. It is then placed in melting ice and the length of the thread drops to 5 cm. When it is placed in warm water, the length of the thread is 9.3 cm.
(i) Calculate the temperature of the warm water. **(3 marks)**
(ii) State a reason why water is not used as a thermometric liquid. **(1 mark)**

(b) On method of heat transfer through a material is called conduction.
(i) Define heat conduction. **(1 mark)**
(ii) State one advantage of heat conduction. **(1 mark)**
(iii) State one disadvantage of heat conduction. **(1 mark)**

(c) The specific heat capacity of copper is $400J\ kg^{-1}K^{-1}$. A piece of copper of mass 10 kg is at a temperature of 80 °C. Calculate the amount of heat it must lose for its temperature to decrease to50 °C. **(2 marks)**

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3. (a) State the principle of moments. **(2 marks)**

(b) A uniform beam is pivoted at its centre of gravity and different forces applied to it at different positions as shown in Figure 2.

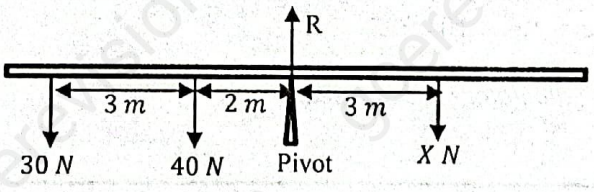

Figure 2

Given that the beam is balanced, determine:
(i) the value of X. **(2 marks)**
(ii) the reaction force R acting at the pivot. **(2 marks)**

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4. (a) State two factors that affect the resistance of a conductor. **(2 marks)**
(b) State two safety precautions taken in house wiring. **(2 marks)**
(c) State one reason why high tension lines are suspended high above the ground. **(1 mark)**
(d) State one advantage of transporting electricity as AC and not as DC. **(1 mark)**

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5. A pulley system made up of 4 wheels is used to raise a load of 750 N unto a storey building under construction.
(a) What is the value of the velocity ratio of the pulley system? Explain. **(2 marks)**
(b) Given that the mechanical advantage of the machine is 3, calculate the effort applied. **(2 marks)**

(c) Calculate the efficiency of the pulley system. **(2 marks)**

(d) State one reason why the efficiency is less than 100%. **(1 mark)**

6. (a) Waves are generated in a ripple tank using a straight-edged vibrator which hits the water surface 40 times in 5 seconds. The waves move across the ripple tank with a distance of $2.5 \times 10^{-2}\ m$ between successive wavefronts and a maximum vertical displacement of $1.5 \times 10^{-2}\ m$ from the rest position.

(i) Calculate the frequency of the wave **(1 mark)**

(ii) Calculate the speed of the wave. **(2 marks)**

(iii) What is the name of the vertical displacement of $1.5 \times 10^{-2}\ m$? **(1 mark)**

(b) In the middle of the tank mentioned in (a) above is a barrier, having a gap of width $1.5 \times 10^{-2}\ cm$.

(i) Draw a diagram to show the wavefronts before and after the barrier. **(2 marks)**

(ii) Name the effect produced by the gap. **(1 mark)**

(iii) Name a situation or device in which the effect mentioned in (ii) above is advantageous. **(1 mark)**

SECTION II

Answer all questions choosing, EITHER the (a), (b), and (c) OR the (d), (e), and (f) of each question.

Answer EITHER 7 a), b), and c)

7 (a) The value of the acceleration of free fall is $10\ m\ s^{-2}$ near the earth's surface.

(i) What is the meaning of the underlined phrase? **(2 marks)**

(ii) Describe an experiment to measure the acceleration of free fall. Your description should include:

- a labelled diagram of the experimental setup.
- the procedure you will follow.
- the data you will collect.
- how you will calculate the acceleration of free fall from the data collected.
- any precaution you will take to ensure better results. **(7 marks)**

(iii) State one reason why the acceleration of free fall varies from place to place on the earth's surface. **(1 mark)**

(b) A ball falls from a certain height until it hits the ground.

(i) Sketch a distance-time graph of the motion, and state the significance of its slope. **(3 marks)**

(ii) Sketch a velocity-time graph of the motion, and state the significance of its slope. **(3 marks)**

(c) (i) State the principle of conservation of linear momentum. **(2 marks)**

(ii) State two real life situations where the principle of conservation of linear momentum is applied. **(2 marks)**

OR 7 (d), (e) and (f).

7. (d) For a given convex lens, the value of focal length is 10 cm.

(i) What is the meaning of the underlined phrase? **(2 marks)**

(ii) Describe a direct method that you can use to accurately measure the focal length of a convex lens. Your description should include:

- a labelled diagram of the experimental setup.
- the procedure you will follow.
- the data you will collect.
- how you will obtain the value of the focal length.
- any precaution you will take to ensure better results. **(7 marks)**

(iii) State the object distance for which the lens of focal length 10 cm will produce an image of the same size as the object. **(1 mark)**

(e) Draw a ray diagram to show how a virtual image is formed by:

(i) a convex lens **(3 marks)**

(ii) a concave lens **(3 marks)**

(f) (i) Define critical angle. **(2 marks)**

(ii) State the two conditions for total internal reflection to occur. **(2 marks)**

Answer EITHER 8 (a), (b) and (c)

8. (a) Define the following and state the unit in which each of them is measured:
   (i) Density. **(2 marks)**
   (ii) Pressure. **(2 marks)**

   Low density and high density materials find applications in different areas of life.
   (iii) Name a useful practical application of a named low density material **(2 marks)**

(b) The graph in Figure 3 shows how the extension of a copper wire varies with the stretching force.

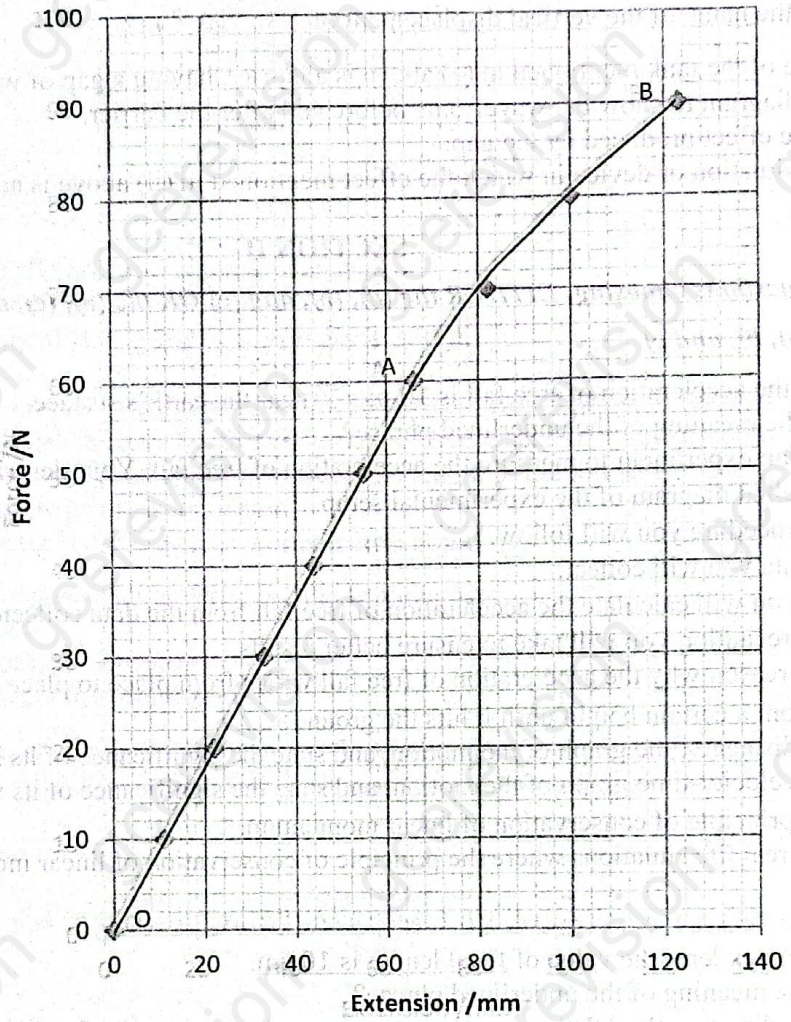

Figure 3

(i) From the shape of the graph, state the behaviour demonstrated by the wire in section OA. **(1 mark)**
(ii) The unstretched length of the wire is 1.5 m. Read from the graph the extension due to a force of 40 N and then calculate the length of the wire corresponding to this force. **(2 marks)**
(iii) Define elastic limit. **(2 marks)**
(iv) Use the graph to determine the value of the elastic limit of this wire. **(2 marks)**
(v) Name one practical application of the knowledge of elastic limit. **(1 mark)**

(c) A cylindrical container of base area 0.85 m^2 and height 1.75 m is filled with a liquid of density 13,600 kg m^{-3}. Determine:
(i) the mass of the liquid in the container. **(2 marks)**
(ii) the weight of the liquid in the container. **(2 marks)**
(iii) the pressure exerted at the bottom of the container. **(2 marks)**

OR 8 (d), (e) and (f).

8. (d) Define the following and state the unit in which each is measured:
   (i) count rate. **(2 marks)**
   (ii) half-life. **(2 marks)**
   State a practical application of:
   (iii) transmutation. **(1 mark)**
   (iv) a named short half-life radioisotope. **(2 marks)**

   (e) The graph in Figure 4 displays the results of an experiment carried out to study the variation of the number of radioactive nuclei in a given sample with time.

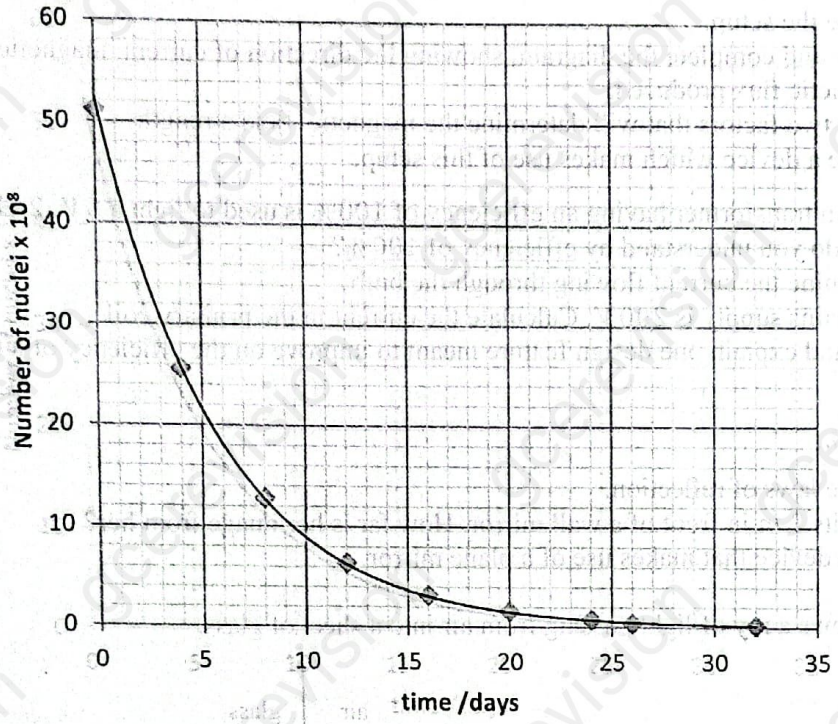

Figure 4

   (i) From the shape of the graph, state the type of change undergone by the radioactive material? **(1 mark)**
   (ii) Use the graph to determine the number of nuclei remaining on the 10^{th} day, and then calculate how many nuclei have decayed so far. **(2 marks)**
   (iii) Define background radiation. **(1 mark)**
   (iv) Use the graph to determine the half-life for this source. **(2 marks)**
   (v) State one precaution to be taken when using radioactive samples. **(1 mark)**

   (f) Two electrical devices of equal power rating are connected in parallel in an electric circuit. In 30 minutes, 9000 C of charge flow through the circuit and 300 J of electrical energy is converted every second. Calculate:
   (i) the current through the circuit. **(2 marks)**
   (ii) the resistance of the circuit. **(2 marks)**
   (iii) the resistance of each device **(2 marks)**
   (iv) Draw a labelled circuit diagram to show how the power sockets are connected in parallel using a three-cored cable. **(2 marks)**

Answer EITHER 9 a, b and c

9. (a) (i) State the First Law of Magnetism. **(1 mark)**
   (ii) What do you understand by a hard magnetic material? **(1 mark)**
   (iii) Give one example of a hard magnetic material. **(1 mark)**
   (iv) Name one device that makes use of a hard magnetic material. **(1 mark)**

(b) Figure 5 shows a current-carrying coil carrying a current, I, wound round a soft iron core.

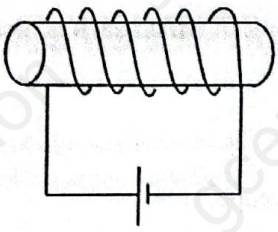

Figure 5

(i) Name the setup. **(1 mark)**
(ii) Copy and complete the diagram, showing the direction of current, magnetic poles of the iron core and the magnetic flux produced. **(4 marks)**
(iii) State two factors that will determine the magnetic field strength **(2 marks)**
(iv) Name a device which makes use of this setup. **(1 mark)**

(c) A step-down transformer having an efficiency of 100% is used to light a $6\ V$, $24\ W$ bulb.
(i) What do you understand by efficiency of 100%? **(1 mark)**
(ii) Determine the current flowing through the bulb. **(2 marks)**
(iii) The mains supply is $200\ V$. Calculate the current in the primary coil. **(2 marks)**
(iv) State and explain one design feature meant to improve on the efficiency of a transformer. **(2 marks)**

OR 9 (d), (e) and (f).

9. (d) (i) State the laws of reflection. **(2 marks)**
(ii) A girl sits $2\ m$ in front of a wall mirror. How far is her image from her? **(2 marks)**
(iii) Name a device that makes use of a plane mirror. **(1 mark)**

(e) Figure 6 shows a ray of light passing from air into a sheet of glass.

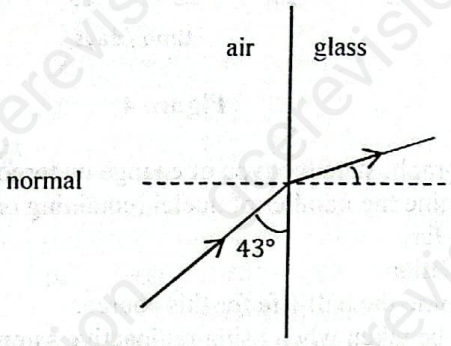

Figure 6

(i) Define refraction of light. **(1 mark)**
(ii) Describe one day-to-day experience of refraction. **(2 marks)**
(iii) Determine the angle of incidence. **(1 mark)**
(iv) Calculate the angle of refraction if the refractive index of glass is 1.5 **(2 marks)**
(v) State and explain whether or not total internal reflection is possible for light passing from air to glass. **(2 marks)**

(f) (i) Explain one observation that demonstrates that light travels faster in air than sound. **(1 mark)**
(ii) State two uses of sound waves in a medium. **(2 marks)**
(iii) State two factors that affect the speed of sound in air. **(2 marks)**
(iv) A radio station broadcasts at a frequency of $4.5 \times 10^7\ Hz$. Calculate the wavelength of the radio waves produced. **(2 marks)**
