GENERAL CERTIFICATE OF EDUCATION BOARD

General Certificate of Education Examinations

PHYSICS 2
0580

JUNE 2023 **ORDINARY LEVEL**

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

Two and a half hours

Answer ALL questions.

Section 1is designed to be answered in 1 hour and Section 2 in 1½ hours.

You are advised to divide your time accordingly.

In section 2 answer EITHER the a, b and c OR the d, e, and f of each question

For your guidance the approximate mark(s) 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,* $g = 10\ m\ s^{-5}$
- *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 calculators are allowed.

Section I

Answer all questions in one hour

1. (a) Distinguish between a conductor and a semiconductor. **(2 marks)**
   (b) Compare n-type and p-type semiconductors in terms of:
   - doping material used at production, and
   - majority charge carriers. **(4 marks)**
   (c) State how the conductivity of an intrinsic semiconductor can be increased. **(1 mark)**

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2. (a) Figure 1 shows a set of plane waves approaching two different obstacles in a ripple tank.

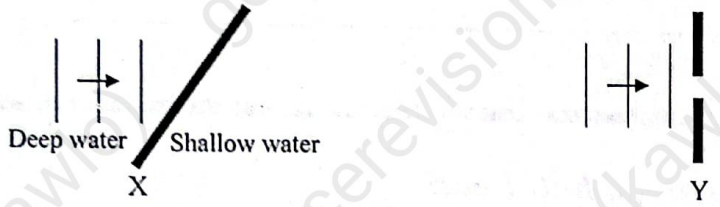

Figure 1

   i) Copy each diagram and draw the wave fronts after the obstacle. **(4 marks)**
   ii) Name the wave phenomenon illustrated at X of figure 1. **(1 marks)**

   (b) i) Define interference. **(1 mark)**
   ii) Two similar waves, each of amplitude 4 cm undergo constructive interference. Determine the amplitude of the resultant wave. **(2 marks)**

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3. Figure 2 shows a transformer that a student intends to use to operate a small radio set.

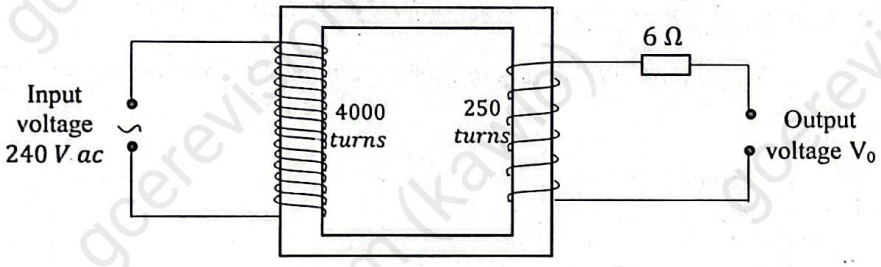

Figure 2

Using the information on the diagram, calculate:
i) the output voltage, V_0. **(2 marks)**
ii) the current through the 6 Ω resistor. **(2 marks)**
iii) explain whether or not the transformer will function normally if the alternating current in the primary circuit is replaced with a direct current. **(2 marks)**

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4. Figure 3 shows a network of two resistors connected to a 12 V battery.

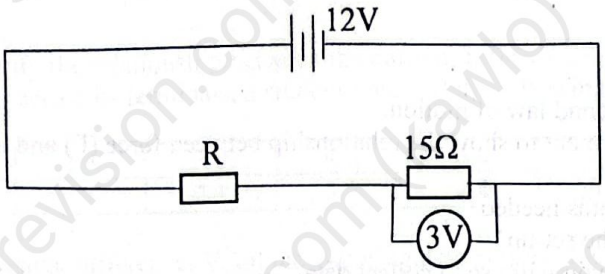

Figure 3

Determine:

(a) the potential difference across the resistor, R. **(2 marks)**

(b) the current through the 15 Ω resistor. **(2 marks)**

(c) the resistance of the resistor, R. **(2 marks)**

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5. (a) State the law of conservation of linear momentum. **(2 marks)**

(b) A car of mass 2500 kg moving with velocity of 30 m s^{-1} collides with a stationary car of mass 1500 kg. After collision, the two cars lock together and move with a common velocity.

Calculate:

(i) the total momentum of the system just before collision. **(2 marks)**

(ii) the common velocity with which the locked cars move. **(2 marks)**

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6. A polythene rod charged by rubbing with dry cloth is brought close to but not touching a metallic sphere placed on an insulating stand.

(i) Name one other method used in charging a material. **(1 mark)**

(ii) What type of charge is stored on the polythene rod? **(1 mark)**

(iii) Explain why the rod would not have been charged if the cloth was wet. **(2 marks)**

(iv) Explain with the aid of diagrams how the metallic sphere can be made to acquire a positive charge. **(3 marks)**

Section 2

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)* (i) State Newton's second law of motion. **(2 marks)**

(ii) Describe an experiment to show the relationship between force (F) and acceleration (a). Your description should include:

- a list of apparatus needed
- a diagram of the set-up
- the procedure you will use to collect data
- how the data will be used to show the relationship between force and acceleration
- any precaution taken to minimize error.

(7 marks)

(b) An object weighing 500 N on earth is taken from the earth's surface to another planet whose acceleration due to gravity is 6.5 m s^{-2}.

(i) Give one difference between mass and weight. **(1 mark)**

(ii) Calculate the weight of the object on this planet. **(3 marks)**

(c) A uniform metre bar of length 100 *cm* and mass 20 *kg* is pivoted at its 30 *cm* mark. A load, X, is placed at the end of the bar closer to the pivot to balance the weight of the bar.

(i) Define the moment of a force, **(1 mark)**

(ii) State two conditions necessary for an object to be in equilibrium. **(2 marks)**

(iii) Draw a diagram showing all the forces acting on the bar and their respective distances from the pivot. **(2 marks)**

(iv) Calculate the weight of the load, X. **(2 marks)**

OR 7 d, e, and f

7. (d) (i) Define specific heat capacity. **(2 marks)**

(ii) Describe an experiment to determine the specific heat capacity of an aluminium block. Your description should include:

- a list of apparatus needed
- a diagram of the set-up
- the procedure you will use to collect data
- how the data will be used to obtain the specific heat capacity
- any precaution taken to minimize error. **(7 marks)**

(e) A mass of 5 *kg* of water is heated with a 500 W heater for 20 minutes.

(i) Calculate the heat supplied by the heater supplied during this time. **(2 marks)**

(ii) Given that the specific heat capacity of water is 4200 J $kg^{-1}K^{-1}$, determine the change in temperature of the water during this time. **(2 marks)**

(iii) Explain why water is often used as a cooling liquid in car radiators. **(2 marks)**

(f) A student used an un-calibrated thermometer in the laboratory to measure the temperature of a given liquid. He first put it in pure melting ice and the mercury thread was 10 cm long. He then removed it and put in steam from boiling water, the mercury thread was 50 cm long. Then he puts it in the liquid and the mercury thread was 35 *cm* long.

(i) Define temperature. **(1 mark)**

(ii) State two properties that make mercury suitable for use in thermometers. **(2 marks)**

(iii) Calculate the temperature of the liquid. **(2 marks)**

Answer EITHER 8 a, b and c

8. (a) (i) State Ohm's law. **(2 marks)**

In an experiment to verify the relationship between the current, I, flowing through a conductor, and the potential difference, V, across its terminals, a student obtained the following data:

V/V	0.0	1.5	3.0	4.5	6.0	8.0	9.0	10.0
I/A	0.0	1.1	2.1	3.2	4.4	5.7	6.4	7.1

(ii) Plot a graph of potential difference, V, on the y-axis against current, I, on the x-axis. **(5 marks)**
(iii) Determine the gradient of the graph and state its significance. **(3 marks)**
(iv) What is the current in the circuit when the potential difference is 7.5 V? Show clearly how you arrived at your answer. **(2 marks)**

(b) A wire of a given length and thickness is connected to a circuit containing an ammeter and a battery.
(i) Define electromotive force. **(2 marks)**
(ii) Explain what will happen to the current flowing through the ammeter if the wire is replaced with a thinner wire of the same material and length. **(2 marks)**

(c) (i) State the function of a fuse and also state where it is connected in an electrical circuit. **(2 marks)**
(ii) Explain how the fuse performs the function stated in c (i) above. **(2 marks)**

OR 8 d, e and f

8. (d) (i) State Snell's law of refraction. **(2 marks)**

In an experiment to verify Snell's law of refraction, a student put some water in a long glass jar and dropped a coin at the bottom. Then he measured the real depth and the apparent depth for different levels of water and obtained the following data.

Real depth /cm	0	5.0	8.0	10.0	12.0	15.0	18.0	20.0
Apparent depth / cm	0.0	3.8	6.0	7.4	9.2	11.5	13.6	15.4

(ii) Plot a graph of real depth on the y-axis against apparent depth on the x-axis. **(5 marks)**
(iii) Determine the gradient of your graph and state its significance. **(3 marks)**
(iv) What will be the apparent position of the coin when the level of the water is 14.0 *cm*? Show clearly how you arrived at your answer. **(2 marks)**

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

(f) (i) Name one member of the electromagnetic spectrum and give its wavelength range. **(2 marks)**
(ii) Explain the use of the named member in f (i) and relate it to its property. **(2 marks)**

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9. ***Answer either 9 (a), (b) and (c) OR 9 (d), (e) and (f)***

EITHER 9 (a), (b) and (c)

9. (a) Table 1 shows the three kinds of radiations emitted during a radioactive decay.

Radiation	Range in air	Deflection in an electric field	Minimum stopping material
Alpha		Towards the negative plate	
Beta	Few metres		
Gamma			Thick sheet of lead

Table 1

(i) Define radioactive decay. **(1 mark)**
(ii) Copy and complete table 1 to identify the different radiations. **(6 marks)**

(b) The count rate of a sample of carbon-14, ${}^{14}_{6}C$, drops from 1000 counts min^{-1} to 250 counts min^{-1} in 11600 *years*.
(i) Define half-life **(1 mark)**
Determine:
(ii) the half-life of the sample. **(2 marks)**
(iii) the number of protons and neutrons in the carbon nucleus. **(2 marks)**
(iv) the neutron to proton ratio of ${}^{14}_{6}C$ and state if it is stable or not. **(2 marks)**

(c) During an earth quake disaster in a certain city, a radioactive isotope with a long half-life escaped from a nuclear power station into the environment.
(i) State two possible health hazards that this could have on the population. **(2 marks)**
(ii) State and explain if after a few weeks, these escaped isotopes could still be hazardous to the population. **(3 marks)**
(iii) State an instrument that can be used to detect the presence of radioactive radiations in the environment **(1 mark)**

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

9. (d) Table 2 shows some transducers and their main energy conversions.

Transducer or process	Type of initial energy	Final energy obtained
Microphone		
	Electrical energy	Heat energy
Stretched rubber band released to throw a stone		

Table 2

(i) State the law of conservation of energy. **(2 marks)**
(ii) Copy and complete table 2. **(5 marks)**

(e) An electric motor connected to a pulley system is used to lift a load of 600 N through a height of 5 m in 6 s. A current of 3 A flows through the motor when it is connected to a 220 V supply.
(i) Define power. **(1 mark)**
(ii) Determine the energy supplied to the motor. **(2 marks)**
(iii) Determine the work done in lifting the load, **(2 marks)**
(iv) Explain whether or not the motor is 100 % efficient. **(2 marks)**

(f) A hydro-electric power plant derives its power from a dam built 75 m above the turbines. 500 kg of water falls on the turbines every second.
(i) State two hazards that may result from a careless use of electricity. **(2 marks)**
(ii) Calculate the potential energy of the 500 kg of water from the dam as it starts falling **(2 marks)**
(iii) Explain why the amount of electricity supply during the dry season is less than during the rainy season. **(2 marks)**

Go back and check your work