GENERAL CERTIFICATE OF EDUCATION (GCE) BOARD

General Certificate of Education Examination

Physics 2
0580

JUNE 2021 **ORDINARY LEVEL**

Subject Title	**PHYSICS**
Paper No	**Paper 2**
Subject Code	**0580**

Two and a half hours

Answer ALL questions.

Section 1 is designed to be answered in 1 hour and Section 2 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,* $e = 1.6 \times 10^{-19}\ C$

Calculators are allowed.

[redacted]

Section 1 (1hour)
Answer ALL questions

1. (a) Define temperature and name an instrument used in a school laboratory for its measurement. **(2 marks)**

   (b) An un-calibrated liquid-in-glass thermometer is placed in steam from boiling water under atmospheric pressure. The length of the mercury thread is 23 cm. It is then placed in pure melting ice and the length of the thread changes to 3 cm. Calculate:
   (i) the fundamental interval. **(2 marks)**
   (ii) the temperature for which the length of the mercury thread will be 13 cm. **(2 marks)**

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2. (a) (i) State two factors that affect the pressure exerted by liquids. **(2 marks)**
   (ii) Determine the total pressure at a point 10 m below the surface of a lake. Assume that atmospheric pressure is $1.0 \times 10^5\ Pa$ and the density of the lake water is $1025\ kg\ m^{-3}$. **(3 marks)**
   (b) State Hooke's law and name a material that obeys the law. **(3 marks)**

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3. (a) Two isotopes of carbon are designated as: $^{12}_{6}C$ and $^{14}_{6}C$.
   (i) What are isotopes? **(1 mark)**
   (ii) Determine the neutron-proton (N/Z) ratio for each of the isotopes and hence deduce which of them is more stable. **(3 marks)**
   (b) (i) Explain why an atom is said to be neutral, even though it contains charged particles. **(2 marks)**
   (ii) Name the part of an atom where it's mass is mostly concentrated. **(1 mark)**

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4. Figure 1 shows a network of three resistors connected to a battery of e.m.f., 28 V.

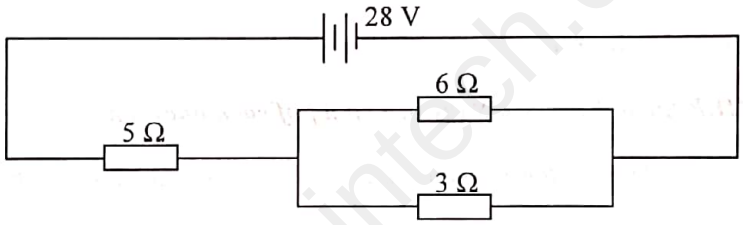

Figure 1

Calculate:
(a) the total resistance of the circuit. **(2 marks)**
(b) the total current in the circuit. **(2 marks)**

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5. (a) (i) Distinguish between intrinsic and extrinsic semiconductors. **(2 marks)**
   (ii) State one example of each type. **(2 marks)**
   (b) (i) Define doping. **(1 mark)**
   (ii) State the majority charge carriers in an n-type semiconductor and those in a p-type semiconductor. **(2 marks)**

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6. (a) Define the 'moment of a force'. **(1 mark)**
   (b) Explain why a longer spanner is preferred to a shorter one, in undoing a nut. **(2 marks)**
   (c) State two differences between mass and weight. **(2 marks)**
   (d) Draw a free body diagram showing all the forces acting on a body falling freely through air. **(3 marks)**

Section 2 (1 ½ hours)

Answer ALL questions, choosing one question from each pair of alternatives

Answer either 7 (a), (b) and (c) OR 7 (d), (e) and (f)

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

7. (a) (i) Sketch a displacement-distance graph for two cycles of a wave profile. On it, indicate the amplitude and the wavelength of the wave. **(3 marks)**

(ii) Describe an experiment to determine the speed of sound in air. Your description should include:

- a labelled diagram
- the procedure followed in collecting data
- the processing of the data to determine the speed of sound
- any precaution taken to minimise error. **(7 marks)**

(b) A ship's sonar sends down a sound of frequency 6000 Hz into water in a sea, at a point which is 3000 m deep. The echo is heard 4 seconds later.

(i) Which wave phenomenon is responsible for echoes? **(1 mark)**

(ii) Calculate the speed of the sound in water. **(2 marks)**

(iii) Calculate the wavelength of the sound. **(2 marks)**

(iv) State a factor which affects the speed of the sound in water. **(1 mark)**

(c) A boy stands 100 cm in front of a large plane mirror and observes the image of a girl who is standing 50 cm behind him.

(i) How far is the image of the girl seen in the mirror from the boy? **(3 marks)**

(ii) State one property of the image. **(1 mark)**

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

7. (d) (i) Draw a ray diagram of a convex lens to show how rays parallel to the principal axis and passing through it are refracted. On the diagram, indicate the principal focus and the focal length. **(3 marks)**

(ii) Describe an experiment to determine the focal length of a convex lens using the plane mirror method. Your description should include:

- a labelled diagram
- the procedure followed in collecting data
- the processing of the data to determine the focal length
- any precaution taken to minimise error. **(7 marks)**

(e) Figure 2 shows two rays diverging from a stone, O, at the bottom of a 1 *m* deep pond. The refractive index of water is 1.3.

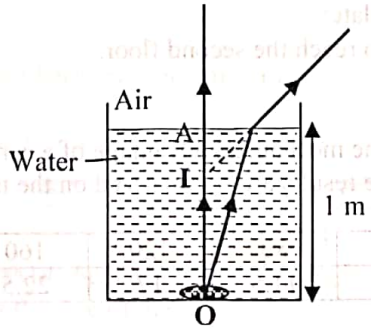

Figure 2

(i) Define refractive index. **(1 mark)**

(ii) Calculate the apparent depth of the stone to an observer. **(2 marks)**

(iii) What wave phenomenon is responsible for the change in direction of the light as it moves into air? **(1 mark)**

(iv) Given that the speed of light in air is $3.0 \times 10^8\ m\ s^{-1}$, determine the speed of light in water. **(2 marks)**

(f) On a stormy day, a student sees lightning in the cloud and hears the sound 20 seconds later.

(i) Explain why he sees the lightning before hearing the sound. **(1 mark)**

(ii) Given that the speed of sound in air is $340\ m\ s^{-1}$, determine how far from the student was the cloud producing the lightning. **(2 marks)**

(iii) State one factor which affects the speed of sound in air. **(1 mark)**

Answer either 8 (a) and (b) and (c) OR 8 (d), (e) and (f)

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

8. (a) (i) Define linear momentum. **(1 mark)**

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

(iii) Describe a real life situation in which this principle is applied. **(2 marks)**

(b) A hunter fires a bullet of mass 0.05 kg with a velocity of $400\ m\ s^{-1}$ into a wooden block of mass 5 kg lying on a smooth surface. Calculate:

(i) the momentum of the bullet just as it hits the block. **(2 marks)**

(ii) the combined velocity of the bullet and the block given that they stick together on impact. **(2 marks)**

(c) In an experiment to determine the acceleration of a moving car, the magnitude of its velocity and the corresponding times were recorded over a period of 300 seconds. The results are shown on the table below:

Velocity /ms^{-1}	0	4.0	7.0	8.0	10.6	12.6	17.0	21.0
Time /s	0	60	100	120	150	180	240	300

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

(ii) Plot a graph of velocity (y-axis) against time (x-axis). **(5 marks)**

(iii) Determine the slope of your graph and state its significance. **(3 marks)**

(iv) Use the graph to calculate the total displacement of the car. **(2 marks)**

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

8. (d) (i) Define work. **(1 mark)**

(ii) State the principle of conservation of energy. **(2 marks)**

(iii) Describe the energy changes that take place when a stretched catapult projects a stone. **(2 marks)**

(e) A girl of mass 40 kg runs up a flight of stairs to the second floor of a building which is located 12 m above the ground floor, in 7.5 s. Calculate:

(i) the work done by the girl to reach the second floor. **(2 marks)**

(ii) the power of the girl. **(2 marks)**

(f) In an experiment to determine the mechanical advantage of a certain machine, loads were applied to it and the corresponding efforts noted. The results are summarized on the table below:

Load /N	0	40	80	120	160	200	240	280
Effort /N	0	5.0	11.5	17	22.5	28.5	34	39.5

(i) Define mechanical advantage? **(1 mark)**

(ii) Plot a graph of load (y-axis) against the effort (x-axis). **(5 marks)**

(iii) Determine the slope of your graph and state its significance. **(3 marks)**

(iv) If the efficiency of the machine is 80 %, calculate its velocity ratio. **(2 marks)**

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

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

9. (a) (i) A polythene rod can be charged by rubbing. Identify the type of charge acquired by the rod and explain its origin. **(2 marks)**

Two charged metallic balls A and B on insulating stands are placed a short distance from each other as shown in figure 3. Ball A is positively charged while ball B is negatively charged.

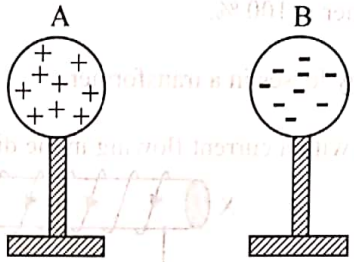

Figure 3

(ii) Name the type of force that exist between A and B. **(1 mark)**
(iii) State two factors that affect the size of the force. **(2 marks)**
(iv) State and explain what will happen if A and B are connected using a conducting wire. **(2 marks)**

(b) A battery causes charges to move round a circuit for 30 s and it is observed that the current in the circuit is 5 A. Calculate:
(i) the quantity of charge that passes through the battery. **(2 marks)**
(ii) the number of electrons that flow round the circuit per unit time given that the charge on one electron is 1.6×10^{-19} C. **(2 marks)**
(iii) the amount of energy converted into heat and light by a lamp, given that this battery provides a p.d. of 12 V across the lamp. **(2 marks)**
(iv) Differentiate between the potential difference (p.d.) the battery can supply across an external load such as a lamp and the electromotive force (e.m.f.) of the battery. **(2 marks)**

(c) (i) Draw a ring circuit used in house wiring. Your diagram should clearly show how a socket carrying a fuse is connected to the ring circuit. **(3 marks)**
(ii) State two advantages of the ring circuit over a linear circuit. **(2 marks)**

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

9. (d) (i) Differentiate between soft and hard magnetic materials. **(2 marks)**

Two bar magnets are placed side by side as shown in figure 4.

Figure 4

(ii) Name the type of force that exists between the two magnets. **(1 mark)**
(iii) Name two factors that affect the size of the force. **(2 marks)**
(iv) Copy the diagram and draw the magnetic field pattern between the two magnets. **(2 marks)**

(e) Figure 4 shows a transformer used to operate a radio set.

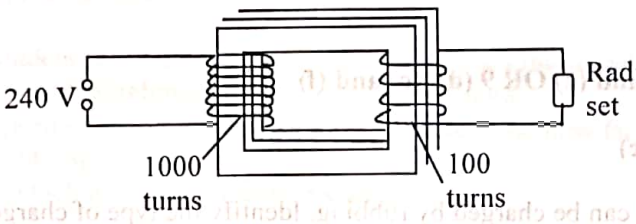

Figure 4

Calculate:

(i) the output voltage using the figures on the diagram. **(2 marks)**

(ii) the current in the primary coil given that the current in the secondary coil is 2 A, assuming that the efficiency of the transformer is 100 %. **(2 marks)**

(iii) the power of the radio set. **(2 marks)**

(iv) State two sources of energy losses in a transformer. **(2 marks)**

(f) Figure 5 shows a solenoid XY with a current flowing in the direction indicated.

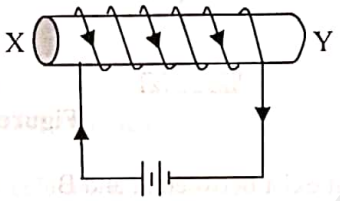

Figure 5

(i) Copy the diagram and indicate the magnetic flux pattern around the solenoid. **(3 marks)**

(ii) State two factors that will affect the strength of the magnetic field. **(2 marks)**