Physics I

011

27/07/2023 08:30 AM – 11:30 AM

ORDINARY LEVEL NATIONAL EXAMINATIONS, 2022-2023

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

1) Write your names and index number on the answer booklet as they appear on your registration form, and **DO NOT** write your names and index number on additional answer sheets of paper if provided.

2) Do not open this paper until you are told to do so.

3) This paper consists of **THREE** sections **A**, **B** and **C**

    SECTION A: This section is **compulsory**.   **(55 marks)**

    SECTION B: Attempt any **three** questions.   **(30 marks)**

    SECTION C: This section is **compulsory**   **(15 marks)**

4) Calculators and mathematical instruments may be used.

5) Use only a **blue** or **black** pen for writing and a **pencil** for drawing.

SECTION A: Attempt all questions from this section. **(55 marks)**

1) Choose the best alternative that completes each of the statements below:
   a) The upthrust/buoyant force exerted on a body immersed in a liquid is equal to the: **(1 mark)**
      i)   Weight of the liquid
      ii)   Mass of the liquid displaced
      iii)   Weight of the liquid displaced
      iv)   Density of the liquid
   b) The pressure exerted by a liquid ……………………. **(1 mark)**
      i)   Increases with depth
      ii)   Decreases with depth
      iii)   Doesn't change with depth
      iv)   Is different in different directions at the same depth.
   c) Archimedes' principle holds for……………………………. **(1 mark)**
      i)   Liquid only
      ii)   Both liquid and gas
      iii)   Gas only
      iv)   Both liquid and solid.

2) State whether each of the following statements is true or false.
   a) Paint spraying is an application of electrostatics. **(1 mark)**
   b) In thunderstorm accompanied by lightning, it is safe to run near a tree or an open ground rather than sitting inside a car. **(1 mark)**
   c) The charge distribution is dependent on the shape of the conductor. **(1 mark)**
   d) Electric potential is the amount of work needed to move a unit charge from a reference point to a specific point against an electric filed. **(1 mark)**

3) a) List any to elements of telecommunication system. **(2 marks)**
   b) What are the two main types of signals which are used in electronics? **(2 marks)**

4) Fill in the blanks using appropriate terms from the box.
   Write only the missing term from each sub question. The symbols have their usual meanings.

Resistance	RI	Electric current
Potential difference	$\dfrac{U^2}{R}$	Time

   a) The formula to calculate the electric power is P = …………….. **(1 mark)**
   b) Two factors on which the electric energy consumed by an electric appliance depend are the ……………. Of the appliance and the ………… for which the appliance is used. **(2 marks)**
   c) Ohm's law states that the …………………. across a conductor is directly proportional to the electric current flowing through it, provided all physical conditions and temperature remain constant. **(1 mark)**

5) What two types of energy and their corresponding sources do you use in your home? You may use the following table. **(4 marks)**

Types of energy	Corresponding source of energy

6) Study the table below and suitably match the items given in column **I** with those in column **II**. **(4 marks)**

Don't copy the table, answer like this y) corresponds to vi)

Column I	Column II
a) Stable equilibrium	i) When an object in this state of equilibrium has a disturbing force applied, the centre of gravity remains at the same height and the object does not move when the disturbing force is removed.
b) Isosceles triangle lamina	ii) Its centre of gravity lies at point of intersection of the medians.
c) Rectangular lamina	iii) In this state of equilibrium, the centre of gravity of a body is at the lowest point. When the body is slightly tilted, its centre of gravity rises but the body comes back to its original equilibrium position.
d) Neutral equilibrium	iv) Its centre of gravity lies at the point of intersection of its diagonals.

7) a) List any two types of simple machines. **(2 marks)**
   b) Name any one example of a simple machine. **(1 mark)**

8) a) Can a stationary magnet induce electromotive force in coil at rest? Explain. **(2 marks)**
   b) The Faraday's law of electromotive induction is expressed as follows.

   $$\varepsilon = -\frac{N\Delta\Phi}{\Delta t}$$

   What does N mean? **(1 mark)**
   c) How can induced electromotive force from an AX generator be increased? **(1 mark)**

9) a) Rewrite the Newton's second law of motion as a vector quantity. **(1 mark)**
   b) How does the acceleration due to gravity vary with the mass of an object being accelerated? **(1 mark)**
   c) Do you exert the same force on Earth as it exerts on you? Explain. **(2 marks)**

10) The magnification produced by a spherical mirror is – 3 (minus 3). What are the four characteristics of the mirror and the image? **(4 marks)**

11) a) Distinguish between work and power. **(2 marks)**
    b) What will cause greater change in kinetic energy of a body? **(1 mark)**

12) a) Calculate the pressure that water exerts at 8 m below the surface of the water in a lake. The density of water is $1000kg/m^3$ and the acceleration due to gravity is 9.81 N/kg. **(2 marks)**
    b) What force must be applied to a surface area of $0.2m^2$ to create a pressure of 150Pa? **(2 marks)**

13) The velocity of an object of mass 10 kg increases from 4m/s to 8m/s when a force acts on it. What is the impulse applied to the object? **(2 marks)**

14) Some of the elements of a house electrical installation are: electric meter, electric wires, incandescence light bulb, plug sockets, circuit breaker, fuse, wall switches.

   a) Which is more efficient, a circuit breaker or fuse? Explain. **(2 marks)**
   b) Electrical resistivity and melting points of some substances at 20°C are given below.

Substance	Resistivity/Ωm	Melting point/°C
Silver	1.60×10^{-8}	961.78
Copper	1.62×10^{-8}	1084.62
Tungsten	5.20×10^{-8}	3422.00
Nichrome	10.00×10^{-6}	1175.00

   What material is used in incandescent light bulb? Justify your answer. (*An incandescent bulb works on the principle of incandescence, a general term meaning light produced by heat.*) **(2 marks)**

15) a) State any two requirements that plants need to make their own food. **(1 mark)**
    b) What will happen to plants when left in a dark area for a long time? **(1 mark)**
    c) What will happen to plants if they are unwatered (not supplied with water either naturally or artificially)? **(2 marks)**

SECTION B: ATTEMPT ONLY THREE QUESTIONS (30 MARKS)

16) You are provided with a certain amount of water, salt and sand. Design a laboratory experiment whose purpose/aim is to separate the mixture of 40g of salt and 40 g of sand. In order to obtain the sand from the mixture, salt must first be dissolved in 150 ml of water. In your account, you should pay particular attention to:
   a) Materials used.   **(2 marks)**
   b) The procedure to be followed:
      You should draw diagrams, showing the arrangement of your labelled laboratory materials and measurements to be taken.   **(7 marks)**
   c) The safety precautions to be taken.   **(1 mark)**

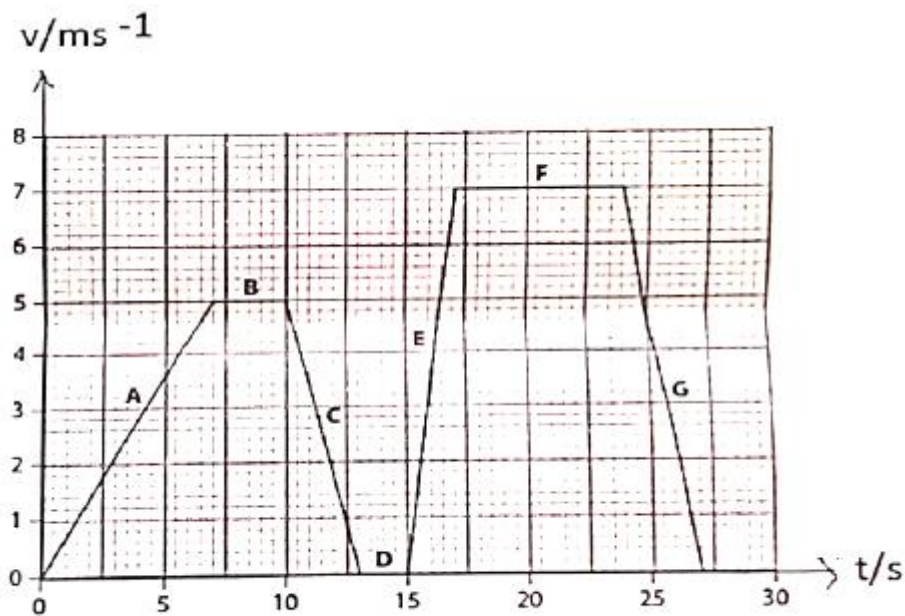17) A learner cycles to school. The graph (figure 1) shows the stages A to G of the journey.

Figure 1

Analyse the graph and answer the following sub questions.
   a) Use the table below to describe the motion of the learner during the stages B and D.   **(2 marks)**

Stage	Description
B	
D	

   b) Find the acceleration to two decimal places for stage A.   **(2 marks)**
   c) Calculate the distance that the learner travels in the first 10 s.
                                                                (5 marks)
   d) The total distance travelled in 106.5 m. Show that the average speed of the journey is about 4m/s.   **(1 mark)**

18) a) A student ties two balloons to a support with some string. The student rubs both balloons with a dry cloth which gives the balloons a negative charge. The diagram (figure 2) shows the balloons after they were rubbed.
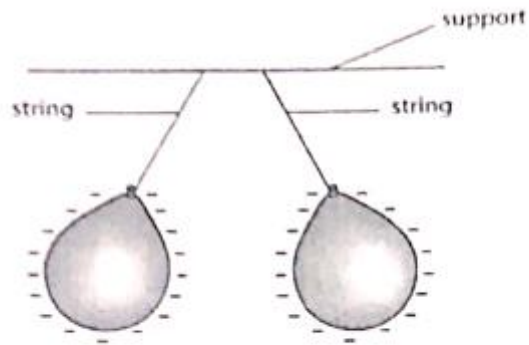

Figure 2

Use 6 terms from the box to complete the sentences.

attract	electric	electrons	repel
negative	friction	positive	protons

The balloons .... each other because they have the same .... The cloth is left with a .... electric charge. The charged particles that are transferred from the cloth to the balloons are called .... The balloons are charged by.................. If somebody touches one of the balls, it becomes discharged and the balls will .... each other. **(3 marks)**

b) Two charger balloons of $+46\,nC$ and $-2.5 \times 10^{-8}\,C$ are separated by a distance of 0.8 m as shown in figure 3 (not to scale).

Q1 ⊖ — – – – — – – – – ·– ⊖ Q2

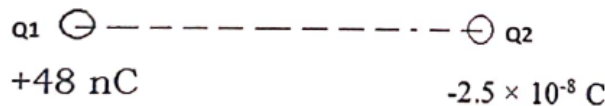+48 nC   -2.5 × 10⁻⁸ C

Figure 3

(i)   Copy the figure and indicate the direction of the electrostatic force. Experienced by Q1 due to Q2 and the electrostatic force experienced by Q2 due to Q1. **(2 marks)**

(ii)   Use scientific notation to express $46\,nC$ in C. **(1 mark)**

(iii) Use Coulomb's law to determine the electrostatic force between the two charged balloons. Coulomb's constant $k = 9 \times 10^9\,Nm^2C^{-2}$. **(2 marks)**

(iv)   Calculate the electric potential due to an electric charge of $-2.5 \times 10^{-8}\,C$ at a point located at $9 \times 10^{-2}\,m$ away from it. **(2 marks)**

19) Study the picture below (figure 4) which shows the main parts of a refrigerator.
    a) (i) Identify any three main parts of a refrigerator shown in the diagram. **(3 marks)**

Where does the heat required to vaporize refrigerant come from?

(1 mark)

b) (ii) Figure 5 shows the cooling curve for 0.500 kg water put into a cold freezer of a refrigerator.
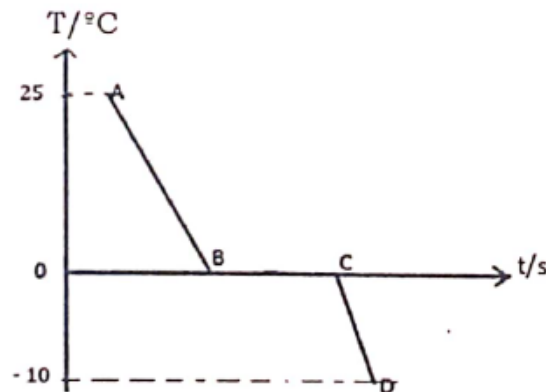

Figure 5

(i)   Which portion of the cooling curve for water above would both liquid and solid water be present?   **(1 mark)**

(ii)   How much heat energy is required by a refrigerator to cool 0.500 kg of liquid water at 25C to liquid water at 0°C?
        The specific heat capacity of water is 4200J/kg°C.   **(3 marks)**

c) Ice at 0°C changes into liquid water at 0°C. Calculate the amount of heat required to melt 0.500 g of ice at 0°C. The specific latent heat of fusion of ice is 334 400 J/kg.   **(2 marks)**

20) A circuit consists of 60 Ω and 30 Ω in parallel arrangement, a dry cell of electromotive force 3V and a negligible internal resistance is connected across the whole circuit as shown in figure 6.
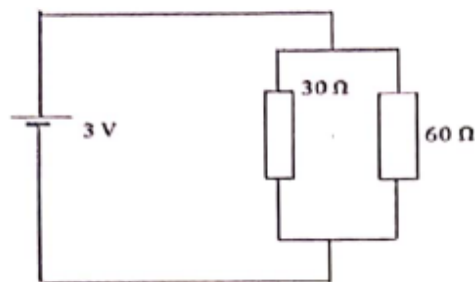

Figure 6

a) Analyse the given circuit and then find:
   i)   The equivalent resistance of this parallel network.   **(2 marks)**
   ii)   The total electric current I in the circuit.   **(2 marks)**
   iii)   The electric current I_1 through the 60 Ω resistor.   **(2 marks)**
   iv)   The electric current I_2 through the 60 Ω resistor.   **(2 marks)**

b) Compare the total electric circuit and individual electric currents in the two parallel branches. Conclude.   **(2 marks)**

SECTION C: THIS QUESTION IS COMPULSORY.   **(15 MARKS)**

21) Investigation of the variation of atmospheric pressure with altitude has been made. The table below shows the pressure **P** at selected altitudes **h** above sea level.

Table of results

h/km	P/10^{-2} atm
0	100
5	50
10	25
15	12
20	6
25	2

a) Plot a graph of P(y-axis) against h(x-axis). Draw a curve of the best fit. You are advised to use a graph paper.   **(6 marks)**

b) From your graph, estimate the altitude when P = 75 x 10^{-2} atm **(1 mark)**

c) Use the table of results or your graph to answer the following:
    Decide which of the statements below are true or false and support your answer.
    i)   The atmospheric pressure is measured using a manometer.
                                                              (2 marks)
    ii)   Atmospheric pressure decreases as altitude increases. **(2 marks)**
    iii)   Symbol of SI unit of altitude is km.   **(2 marks)**

d) Do you think that atmospheric pressure is important? Why do you think so?   **(2 marks)**

-END-