

# PHYSICS

Time: ONE Hour

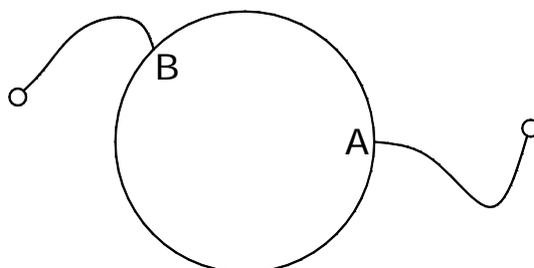
Max. Marks: 50

- *Answers must be written either in English or the medium of instruction of the candidate in high school.*
- *Answer all the questions in the booklets provided for the purpose.*
- *There will be no negative marking.*
- *The relevant working or the argument in arriving at an answer has to be included in your answer.*
- *Use of calculators is not permitted.*
- *Questions in Part A carry 5 marks each, questions in part B carry 3 marks each, questions in part C carry 5 marks.*

## Part A

1. A solid sphere and a hollow sphere of same external radius and made of same material are floating in water. Solid sphere has three fourths of its volume submerged and the hollow sphere is half submerged. What fraction of the volume of hollow sphere is hollow?
2. Two men are running on a circular track. They start from the same position. If they take 3 minutes and 5 minutes to run once around the track, find the time interval between successive crossings and the number of times they cross each other in an hour if they travel the path in (i) opposite sense (ii) same sense
3. A lens of focal length 20 cm forms the image of a bright object kept 30 cm from it on a screen. If the lens is replaced by another lens, the object has to be moved by 5 cm to obtain a sharp image on the screen. Find the possible values of the focal length of the second lens.

4. A wire of resistance  $R$  is bent to form a ring. Contacts can be made at points A and B on the ring. A is a fixed contact and B can not be closer to A than a quarter of the perimeter of the ring. Find the maximum and minimum possible resistances between various choices of the contact point B.



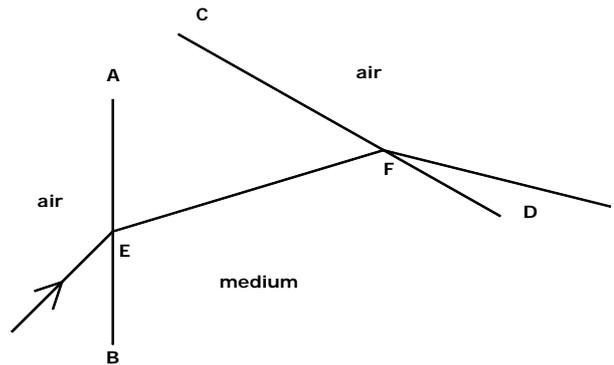
5. A row-boat travels downstream on a river at a speed of 8 m/s with respect to the shore. A motor-boat comes from the opposite direction at a speed of 10 m/s with respect to the water. 10 seconds after meeting each other they are at 160 metres from each other. At what speed does the river flow
6. A piece of ice at  $-10\text{ }^{\circ}\text{C}$  is heated to  $-1\text{ }^{\circ}\text{C}$  using a certain quantity of energy. Then another 20 times as much energy is necessary to finally obtain water. Using that the specific heat of ice is half of the specific heat of  $4.2\text{ kJ}/(\text{kg }^{\circ}\text{C})$  of water, determine the heat of fusion of ice from the above measurement data.

## Part B

7. The electrical power of a vacuum cleaner is 1 kW. It expels 50 litre of air per second with a speed of 80 m/s. What percent of the total power is in the form of kinetic energy of air? (Density of the flowing air is  $1.2 \times 10^{-3}\text{ gcm}^{-3}$ )

8. A stone is projected vertically upward from some height at  $2v$ . Some  $\Delta t$  later another stone is projected vertically upward at  $v$  from the same position. If they reach the initial position at the same time, find  $v$ .
9. A nuclear reactor uses 1 kg of uranium enriched to 1% in one hour. Assuming 60% efficiency find the electrical power generated. Assume each fission of uranium nucleus produces 200 MeV of energy and 238 g of Uranium contains  $6.0 \times 10^{23}$  atoms. What fraction of mass has disappeared in the process?
10. An alpha particle moving vertically downward at right angles to a uniform magnetic field experiences a northward force. What is the direction of the force on a beta particle moving northward?

11. A ray of light is incident at E at  $45^\circ$  as it passes from air in to a medium across boundary AB. It then is incident at F on boundary CD and emerges in to air. Sum of the angles at E and F in the medium is  $60^\circ$ . Find the deviation of the ray at F. Refractive index of the medium with respect to air is  $\sqrt{2}$ .



### Part C

12. Nucleons in a nucleus are held together by attractive short range forces. These forces are stronger than coulombic forces and act between neighbouring nucleons. These forces are charge independent.  
Explain in one or two sentences why  
(i) A large nucleus can not consist only of protons  
(ii) All matter is not nuclear. (2 Marks)
13. X rays are produced when a beam of electrons strikes a target. If  $n$  electrons strike the target in one second, find (i) the beam current in an x ray tube. If electrons are accelerated by  $V$  before striking the target, find the rate at which heat is produced in the target if 90% of their kinetic energy is converted to heat. (3 Marks)