PHYSICS

Time: ONE Hour   **Max. Marks: 60**

- *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 in arriving at an answer has to be shown wherever required. However if the answer can be arrived at without detailed working, write only the answer*
- *Use of calculators or graph papers is not permitted.*
- *All questions carry equal marks*

Some useful data:

Planck's constant h	$= 6.6 \times 10^{-34}$ Js
Velocity of light c	$= 3 \times 10^{8}$ ms^{-1}
Charge of electron e	$= 1.6 \times 10^{-19}$ C
Acceleration due to gravity g	$= 10$ ms^{-2}
Density of water	$= 1$ g·cm^{-3}
Specific heat of water	$= 4.2$ J g^{-1}K^{-1}

1   Two men leave a place with an interval of t between them. They arrive at one end of a bridge of length L with time interval of T and reach the other end of the bridge at the same time. Find the ratio of their speeds. How far is the nearer end of the bridge from their starting point?

2   A cubical box made of a sheet of thickness 1 cm has external dimensions of 5 cm. When it floats in water it has three fourth of its external volume submerged in water. Find the density of the material of the cube. Due to a small hole in the bottom water flows in to the hollow space and the cube starts sinking. To what level would water rise when the cube is about to submerge.
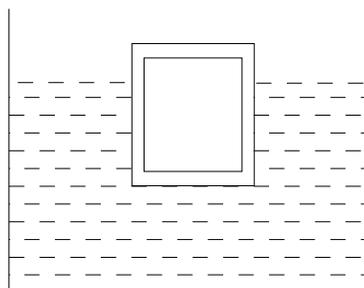
3   A solid ball of radius 10 cm floats with half its volume submerged in water. It is coated with a very thin layer of some very dense material of mass 200 g and now it just sinks. Find the density of the material of the ball. What would happen if water is replaced with a liquid of relative density 0.8.

4 Position time graph of a moving particle is as shown. Coordinates of A are 1 s and 5 m. and the coordinates of B are 8 s and 2 m. What is the displacement of the particle in this time? What is the magnitude of its average velocity, what can you say about its speed.
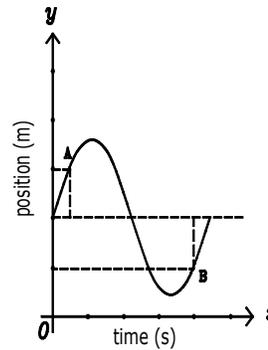
5 A ball falls from a height of 2 m and undergoes repeated collisions with the ground. Each time it hits the ground it raises to half of the height from which it fell. What is the time interval between third and fourth hits with the ground? What is the total distance traveled till the moment it makes fourth hit with the ground? Neglect the time of contact with the ground.

6 In the circuit shown find the readings of ammeter, voltmeters on the left and the right. Assume all meters are ideal.
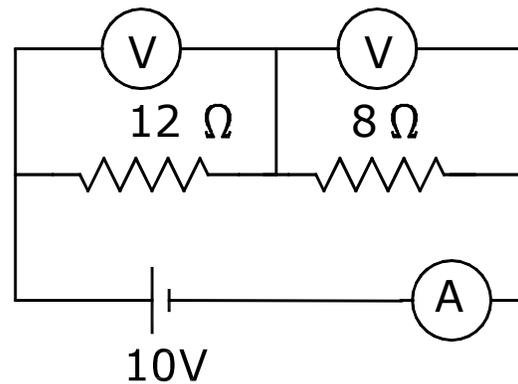
7 A man of height H stands in front of a mirror hung on a vertical wall in front of him. He is just able see his toes in the mirror. He can also just see his shoulders, which are a height h above the ground. What is the size of the mirror and how far above the ground is the top edge of the mirror? Ignore the size of forehead. Draw a neat ray diagram.

8 If an electron looses kinetic energy K as it slows down while approaching an atom in the target of an x-ray tube, the wavelength of the radiation emitted is $\lambda = hc/K$. An electron starting from rest and accelerated through V = 20 000 V in an x - ray tube loses half the energy it acquired as it approaches an atom of the target material. The remaining KE is lost in subsequent interactions with other atoms. Find the wavelength of the radiation emitted in the first interaction.

9 In a new hypothetical system of measurement of temperature a thermometer has its lower fixed point marked 0° u set at melting point of Francium, which corresponds to 300 K and upper fixed point marked 64° u set at boiling point of Bromine which corresponds to 332 K. If this thermometer reads 40 u what is the corresponding Kelvin reading? If 100 g water is heated from 20° u to 40° u as measured by this scale, find the heat absorbed by the water for this rise.

10 A wire of circular cross section has inner portion of radius R made of material of resisitivity ρ and is surrounded by an outer portion of thickness R made of a material of twice greater resisitivity. Find the resistance of length L of such a wire.
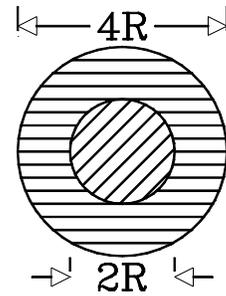
11 Calcite has the interesting property of splitting a ray of light incident on it in to what are known as ordinary and extraordinary rays. That is, it has two different refractive indices. If the velocity for ordinary ray is c_1 and that for extraordinary ray is c_2, find the angle between them after first and second refractions as the light is incident on a slab made of such material at an angle θ. Write the expressions, which lead you to the solutions. You need not solve the equations.
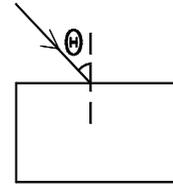
12 A ray of light is incident at A, a height R/2 above the center C of a sphere. The ray after refraction at A emerges from the sphere at B. Find the angle of emergence and the angle of deviation of the ray. Also find the refractive index of the material of the sphere. While doing calculations of refractive index you could write the necessary equations without having to solve them.