

Physics Question Paper

2003

General Instructions

1. *Section I is compulsory. Attempt any four questions from Section II.*
2. *The intended marks for questions or parts of questions are given in brackets [].*

SECTION I (40 Marks)

Attempt all questions from this Section

Question 1

- (a) (i) What is the relationship between the mechanical advantage and the velocity ratio for:
- (1) An ideal machine; (2) A practical machine?
 - (ii) Which physical quantities do the following units represent?
(1) Diopetre; (2) Kelvin. [4]
- (b) (i) The weights of two bodies are 2.0 N and 2.0 kgf respectively. What is the mass of each body? ($g = 10 \text{ ms}^{-2}$)
- (ii) If the power of a motor is 40 kW, at what speed can it raise a load of 20,000 N? [4]
- (c) (i) State the law of floatation.
- (ii) A cube of ice whose side is 4.0 cm is allowed to melt. The volume of the water formed is found to be 58.24 cm³. Find the density of ice. [4]
- (d) (i) Does land cool at a slower or faster rate than water? Give one reason for your answer.
- (ii) Explain, why steam pipes warm a building more effectively than hot water pipes in cold countries. [4]
- (e) (i) A ray of light, after refraction through a concave lens, emerges parallel to the principal axis. Draw a ray diagram to show the incident ray and its corresponding emergent ray.
- (ii) *The velocity of light in diamond is 121,000 kms⁻¹. What is its refractive index? (Velocity of light in air is $3 \times 10^8 \text{ m/s}$) [4]*
- (f) (i) What is the voltage of the electricity that is generally supplied to a house?
- (ii) (1) The neck and bottom of a bottle have diameters 2 cm and 8 cm respectively. The bottle is completely filled with kerosene. If the cork in the neck is pressed with a force of 10 N, what force is exerted on the bottom of the bottle?
- (2) Name the law or principle you have used to find this force. [4]
- (g) (i) The ratio of the amplitudes of two waves is 4 : 9. What is the ratio of their intensities?
- (ii) A pendulum has a frequency of 5 vibrations per second. An observer starts the pendulum and fires a gun simultaneously. He hears the echo from a cliff after 8 vibrations of the pendulum. If the velocity of sound in air is 340 ms⁻¹, what is the distance between the cliff and the observer? [4]
- (h) (i) Which of the two wires of similar dimensions, copper or nichrome, would you use for the electric heater element? Give reasons to justify your answer.
- (ii) Two fuse wires of the same length are rated 5 A and 20 A. Which of the two fuse wires is thicker and why? [4]
- (h) (i) A flag is made up of three strips of cloth of yellow, white and cyan colours. Name the colour of a particular light in which this flag will appear to be of a single colour.
- (ii) Explain, why radium paint, consisting of zinc sulphide and a trace of radium salt, glows in the dark. [4]
- (j) (i) An electric kettle is rated 2.5 kW, 250 V. Find the cost of running the kettle for two

hours at 60 paise per unit.

(ii) A mass of lead is embedded in a block of aluminium (2 mm thick). Radiations from a radioactive source incident on the side of the block produce a shadow on a fluorescent screen placed beyond the block. The shadow of the block of aluminium is fainter than the shadow of lead. Give the reason for this difference. [4]

Section - II (40 marks)

Answer any four questions from this section.

Question 2

(a) A jeweller claims that he makes ornaments of pure gold that has a relative density of 19.3. He sells a bangle weighing 25.25 g to a person. The clever customer weighs the bangle when immersed in water and finds that it weighs 23.07 g in water. With the help of suitable calculations, find out if the ornament is made of pure gold or not. [4]

(b) Draw a labelled sketch of an acid battery hydrometer and explain how it indicates whether a car battery needs recharging. [4]

(c) Give two reasons why the efficiency of a single movable pulley system is not 100%. [2]

Question 3

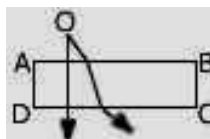
(a) A monochromatic point source of light 'O' is seen through a rectangular glass block ABCD. Paths of two rays, in and outside the block, are shown in the figure below.

i. Does the source 'O' appear to be nearer or farther with respect to the surface AB?

ii. How does the shift depend on the thickness (AD or BC) of the block?

iii. Justify your answer in (ii) with the help of an appropriate ray diagram.

iv. For the same rectangular glass block, which colour from the visible spectra will produce the maximum shift? [6]



(b) A postage stamp appears raised by 7.0 mm when placed under a rectangular glass block of refractive index 1.5. Find the thickness of the glass block. [4]

Question 4

(a) State three characteristics of the image of an extended source, formed by a concave lens. [3]

(b) (i) If a monochromatic beam of light, undergo minimum deviation through an equiangular prism, how does the beam pass through the prism, with respect to its base?

(ii) If white light is used in the same way as in (i) above, what change is expected in the emergent beam? [2]

(c) (i) Sound made in front of a tall building 18 m away, is repeated. Name the phenomenon and briefly explain it.

(ii) A tuning fork, held over an air column of a given length, produces a distinct audible sound. What do you call this phenomenon? How does it occur? [5]

Question 5

(a) In a laboratory experiment for finding specific latent heat of ice, 100 g of water at 30°C was taken in a calorimeter made of copper and of mass 10 g. When 10 g of ice at 0°C was added to the mixture and kept within the liquid till the ice melted completely, the final temperature of the mixture was found to be 20°C.

i. What is the total quantity of water in the calorimeter at 20°C?

ii. Specific heat capacities of water and copper being 4.2 J/g°C and 0.4 J/g°C respectively, what quantity of heat would each release in cooling down to 20°C?

from the initial stage?

iii. Write an expression for the heat gained by ice on melting.

iv. Calculate the value of the latent heat of fusion of ice from the data discussed above. [6]

(b) Electrical power P is given by the expression: $P = (Q \times V) / \text{time}$

i. What do the symbols Q and V represent?

ii. Express 'Power' in terms of current and resistance explaining the symbols used therein. [4]

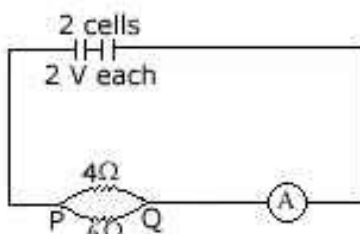
Question 6 [5]

(a) With reference to the diagram given below, calculate: The equivalent resistance between P and Q .

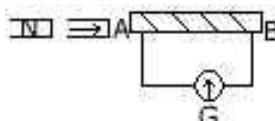
i. The equivalent resistance between P and Q .

ii. The reading of the ammeter.

iii. The electrical power between P and Q .



(b) The diagram shows a coil connected to a centre zero galvanometer G . The galvanometer shows, a deflection to the right when the N-pole of a powerful magnet is moved to the right as shown: [5]



i. Explain, why the deflection occurs in the galvanometer?

ii. Does the direction of the current in the coil appear clockwise or anticlockwise when viewed from the end A ?

iii. State the observation in G when the coil is moved away from N .

iv. State the observation in G when, both the coil and the magnet, are moved to the right at the same speed.

Question 7

(a) State two factors on which the rate of emission of thermions depends. [2]

(b) The isotope of ${}_{92}\text{U}_{238}$ decays by alpha emission to an isotope of Thorium (Th). The thorium isotope decays by beta emission to an isotope of Protactinium (Pa). Write down the equations to represent these two nuclear changes. [4]

(c) Draw a cathode ray tube consisting of a heater, a cathode, cylindrical anode and a deflecting system. Show how you will connect a low tension battery of 6V and a high tension one of 1000V to the electrodes of the tube. [4]