

December 2015

BASIC PHYSICS

Time Allowed: 3 Hours

Full Marks: 70

Answer to Question No.1 is compulsory and to be answered first.

This answer is to be made in separate loose script(s) provided for the purpose.

Maximum time allowed is 45 minutes, after which the loose answer scripts will be collected and fresh answer scripts for answering the remaining part of the question will be provided.

On early submission of answer scripts of Question No.1, a student will get the remaining script earlier.

Answer any five questions from Group-A & B, taking at least two from each group.

1. Answer the following questions (any twenty):

20x1

- i) $ML^{-1}T^{-1}$ is the dimensional formula of – (a) work, (b) energy, (c) torque, (d) co-efficient of viscosity.
- ii) If the error in the measurement of the volume of the sphere is 6%, then the error in the measurement of its surface area will be – (a) 2%, (b) 3%, (c) 4%, (d) 7.5%.
- iii) Which of the pairs have same dimension – (a) Torque and work, (b) Stress and energy, (c) Force and stress, (d) Force and work.
- iv) Compressibility of a substance is the reciprocal of its – (a) Bulk modulus, (b) Rigidity modulus, (c) Young's modulus, (d) None of these.
- v) In a horizontal pipe, water is flowing at a speed of 10 cm s^{-1} . What will be the speed if the radius of the pipe is doubled? – (a) 10 cm s^{-1} (b) 5 cm s^{-1} (c) 2.5 cm s^{-1} (d) 1 cm s^{-1} .
- vi) Keeping the length of the wire unchanged its diameter is doubled. Young's modulus for the material of the wire will – (a) Increases, (b) Decrease, (c) Remain the same, (d) None of these.
- vii) Jurin's law is given by – (a) $rh = \text{constant}$, (b) $r^2h = \text{constant}$, (c) $r/h = \text{constant}$, (d) $rh^2 = \text{constant}$.
- viii) The principle of the multiplication of thrust is based on the – (a) Archimedes' principle, (b) Boyle's law, (c) Pascal's law, (d) None of these.
- ix) Buoyant force on a body immersed in fluid depends upon – (a) The density of the fluid, (b) Density of the body, (c) The volume of the body, (d) None of these.
- x) The ratio of the lengths, cross sectional areas and the differences in the temperature of the two ends of the two conducting rods are 2:3 each. If the rate of the heat conduction through them be equal then the ratio of the Co-efficient of the thermal conductivity of the materials is – (a) 2:3, (b) 3:2, (c) 4:9, (d) 9:4.
- xi) Concept of temperature comes from – (a) First law of thermodynamics, (b) Zeroth law of thermodynamics, (c) Second law of thermodynamics, (d) Third law of thermodynamics.
- xii) In adiabatic compression – (a) The gas becomes hot, (b) The gas becomes cold, (c) At first temperature of the gas increases and decreases, (d) The temperature of the gas remain unchanged.
- xiii) The SI unit of luminous flux is – (a) lumen, (b) candela, (c) lux, (d) none of these.

- xiv) If the distance between a point source and a screen be increased by 10 %, the luminance on the screen – (a) Increases by 10%, (b) decreases by 10%, (c) Increases by 20%, (d) Decreases by 20%.
- xv) The refractive index of a medium depends on – (a) The angle of incidence, (b) The angle of refraction, (c) The wavelength of the light used, (d) The intensity of the light used.
- xvi) The speed of the light in a medium of refractive index $\frac{4}{3}$ is (given speed of light in vacuum = 3×10^8 m/s) – (a) $\frac{9}{4} \times 10^8$ ms⁻¹, (b) $\frac{4}{9} \times 10^8$ ms⁻¹, (c) 4×10^8 ms⁻¹, (d) 3×10^8 ms⁻¹.
- xvii) Power of the convex lens of focal length 20 cm is – (a) 5W, (b) 5D, (c) 5J, (d) 0.2m.
- xviii) A real image of same size as that of an object is formed by a convex lens of focal length f when the object is placed – (a) at focus, (b) between optical centre and focus, (c) between f and $2f$, (d) at $2f$.
- xix) Wave front of a wave is defined as the surface containing all points at which? – (a) Phase of oscillations is same, (b) Frequency of the oscillations is same, (c) Amplitude of oscillations is same, (d) None of these.
- xx) Threshold frequency of photoelectric emission depends on – (a) Number of incident photons, (b) Duration of photon incidence, (c) The material emitting photon electrons, (d) Wave length of light.
- xxi) Specific gravity of aluminum is 2.70. The density of aluminum in S.I will be – (a) 2070 kgm^{-3} , (b) $2.70 + 62.5 \text{ kgm}^{-3}$, (c) $2.70 \times 10^{-3} \text{ kgm}^{-3}$, (d) $2.70 \times 10^{-3} \text{ kgm}^{-3}$.
- xxii) The ratio of specific heats in case of a diatomic gas is – (a) 1.66, (b) 1.41, (c) 14.1, (d) 1.33.
- xxiii) Two waves interfere constructively if the phase difference between them is – (a) 2π , (b) π , (c) $\frac{\pi}{2}$, (d) $\frac{3\pi}{2}$.
- xxiv) A body of mass 15 kg is dropped into the water. If the apparent weight of the body is 107N, then the applied thrust (Take $g = 9.8 \text{ m/s}^2$) will be – (a) 40N, (b) 80N, (c) 60N, (d) 100N.
- xxv) Universal gas constant is – (a) C_p/C_v (b) $C_p - C_v$ (c) $C_p + C_v$ (d) C_v/C_p .
2. a) Explain which was one is more fundamental – Stress or Strain?
 b) State the factors on which modulus of elasticity depend?
 c) Draw the stress – strain graph of a metal wire is subjected to longitudinal tensile force.
 d) A steel wire of uniform diameter has length 250 cm, mass 16gm and density 7.9 g.cm^{-3} what is the Young's modulus of steel if a load of 12 kg is needed to elongate the wire by 1.8 mm? (2+2)+3+3
3. a) State Hooke's law. On what factors does the modulus of elasticity of a substance depend?
 b) Is Poisson's ratio an elastic modulus? Explain. Write down the relation between young's modulus, modulus of rigidity and Poisson's ratio.
 c) When a load of mass 20 kg is hanged at the lower end of a wire whose upper end is fixed to a rigid support, the increases in length of the wire is 1.0 mm. If the length and diameter of the wire are 1.5 m and 2.0mm respectively, calculate the young's modulus of the material of the wire. If the Poisson's ratio of the wire be 0.3, calculate the decreases in its diameter. (1+2)+(1+1)+5
4. a) State the zeroth law and the first law of thermodynamics.
 b) Distinguish between isothermal process and adiabatic process.
 c) Define molar specific heat at constant pressure and molar specific heat at constant volume of a gas. Write down their relation. (2+2)+3+3
5. a) What is meant by streamline and turbulent flow of a fluid? Define poise.
 b) An ice block with a cork piece embedded inside floats in water. What will happen to the level of water when ice melts? Explain your answer.

- c) What is buoyancy? A cube of wood floating in water supports a 200 gm mass at the centre of its top face. When the mass is removed the cube rises by 2 cm. determine the volume of cube. 3+3+(1+3)
6. a) Distinguish between the fundamental and the derived units.
 b) Convert 10 Joule into erg with the help of dimensional analysis.
 c) If force, velocity and time are taken as fundamental quantities, find the dimension of work.
 d) In an experiment, refractive index(μ) of glass was observed to be 1.56, 1.45, 1.54, 1.44, 1.53 and 1.54. Calculate i) mean value of refractive index ii) mean value of absolute error iii) relative error & iv) percentage error. 2+2+2+4
7. a) What do you mean by absolute error, proportional error and % of error in the measurement?
 b) A current of (2.00 ± 0.01) A passes through a conductor of resistance $(100 \pm 0.2) \Omega$. Find the % of error in power using the formula $P = I^2 R$.
 c) Velocity of sound in a Gas is given by $V = (\gamma P/D)^{1/2}$ where V is the velocity and $\gamma = C_p/C_v$, P=Pressure and D=Density. Show that the formula obeys the principle of dimensional homogeneity.
 d) The error in the measurement of the radius of a sphere is 1%, find the error in the measurement of its volume. 3+2+3+2
8. a) What do you mean by the term Interference of light? Define coherent source.
 b) Derive an expression for width of interference fringes in Young's double slit experiment.
 c) Give the conditions for sustained interference. What is principle of superposition of waves? 2+4+4
9. a) Define stopping potential. Draw the graph of frequency of light versus photo electric current.
 b) Write Einstein's photo electric equation with proper meaning of symbols used in the equation; hence define threshold frequency.
 c) The photo-electric threshold wave length for a certain metal is 4000 angstrom. Find the maximum energy of the emitted electrons from the surface by UV light of wavelength 2000 angstrom. Given $h = 6.62 \times 10^{-34}$ J-S and 1 angstrom = 10^{-10} meter. 3+4+3