

December 2019

**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) The relation between force  $F$  and time  $t$  is  $F=at+bt^2$ . The dimensional formula of  $a$  and  $b$  are respectively – (a)  $MLT^{-1}$  and  $MLT^0$  (b)  $MLT^{-3}$  and  $ML^2T^{-4}$  (c)  $MLT^{-4}$  and  $MLT$  (d)  $MLT^{-3}$  and  $MLT^4$ .
  - ii) The SI unit of surface tension is – (a)  $N/m^3$ , (b)  $N/m^2$ , (c)  $N/m$ , (d) none of these.
  - 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) Poisson's ratio is the ratio of – (a) lateral strain to longitudinal strain (b) longitudinal strain to lateral strain (c) shearing stress to shearing strain (d) shearing strain to shearing stress.
  - v) In a horizontal pipe, water is flowing at a speed of  $10\text{ cm s}^{-1}$ . What will be the speed if the radius of the pipe is doubled? – (a)  $10\text{ cm s}^{-1}$  (b)  $5\text{ cm s}^{-1}$  (c)  $2.5\text{ cm s}^{-1}$  (d)  $1\text{ cm s}^{-1}$ .
  - 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) The internal energy of an ideal gas depends on – (a) Pressure (b) Volume (c) Temperature (d) Size of the molecule.
  - viii) Isothermal bulk modulus of gas at a pressure  $p$  is – (a)  $p/\gamma$ , (b)  $p$ , (c)  $p\gamma$ , (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) A steel rod of thermal conductivity  $K$  is cut into two equal parts then thermal conductivity of each part will be – (a)  $K/2$  (b)  $2K$  (c)  $K$  (d) none.
  - 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) Bar is the unit of – (a) thrust, (b) force, (c) pressure, (d) none of these.
- xvi) Virtual magnified image is formed by a convex lens when the object is placed – (a) within the focus (b) within  $f$  and  $2f$  (c) beyond  $2f$  (d) at infinity.
- xvii) Power of the convex lens of focal length 20 cm is – (a) 5W, (b) 5D, (c) 5J, (d) 0.2m.
- xviii) The SI unit of thermal conductivity is – (a) WmK (b)  $\text{Wm}^{-1}\text{K}$  (c)  $\text{Wm}^{-1}\text{K}^{-1}$  (d)  $\text{W m K}^{-1}$ .
- 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) The difference of temperature of two bodies in Celsius scale is  $15^\circ$ . In Kelvin scale this difference will be – (a) 20, (b) 27, (c) 30, (d) 15.
- xxi) Specific gravity of aluminum is 2.70. The density of aluminum in S.I will be – (a)  $2070 \text{ kgm}^{-3}$ , (c)  $2.70 \times 10^3 \text{ kgm}^{-3}$ , (d)  $2.70 \times 10^{-3} \text{ kgm}^{-3}$  (b) None of the above.
- xxii) In case of a falling body of radius  $r$  through a viscous medium with a terminal velocity  $v$  – (a)  $v \propto r$  (b)  $v \propto r^{-2}$  (c)  $v \propto r^{-1}$  (d)  $v \propto r^2$ .
- xxiii) Two waves interfere constructively if the phase difference between them is – (a)  $2\pi$ , (b)  $\pi$ , (c)  $\frac{\pi}{2}$ , (d)  $\frac{3\pi}{2}$ .
- xxiv) For which colour of light the absolute refractive index of a medium is minimum? – (a) Green (b) Yellow (c) Violet (d) Red.

#### Group-A

2.
  - a) Explain which one is more fundamental – Stress or Strain?
  - b) What is meant by young's modulus of steel is  $1.2 \times 10^{12} \text{ N/m}^2$ ?
  - c) What will be the equivalent spring constant when two springs of different force constant are joined in series.
  - d) At normal pressure the volume of a substance is  $3500 \text{ cm}^3$  then calculate the change of volume at 25 atm. If bulk modulus of the substance is  $10^{12} \text{ dyn/cm}^2$ . 2+2+3+3
3.
  - a) Define surface tension. What are the effects of temperature and impurity on surface tension?
  - b) Calculate the energy evolved when 8 droplets of water of radius 0.5 mm each combine to form a single drop. If surface tension of each droplet is  $7.2 \times 10^{-2} \text{ Nm}^{-1}$ .
  - c) What is the dimension of surface tension? Define cohesive and adhesive force. (1+2)+4+3
4.
  - a) What is meant by the term 'thermal equilibrium'? What is meant by internal energy of a system?
  - b) State first law of thermodynamics. Write down its mathematical form for isothermal process and for adiabatic process.
  - c) Define molar specific heat at constant pressure of a gas. Explain qualitatively why the value of molar specific heat at constant pressure ( $C_p$ ) of a gas is more than the value of molar specific heat at constant volume ( $C_v$ ). (1+1)+(2+1+1)+(2+2)
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) A piece of pure gold of density  $19.3 \text{ gm/cc}$  is suspected to be hollow inside. It weighs 38.6 gm in air and 36.1 gm in water. Calculate the volume of the hollow portion in the gold. 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( $\mu$ ) 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

### Group-B

7. a) Define candela. What is its relation with lumen?  
 b) State and explain the principle of photometry.  
 c) A lamp is hanging at a height of 120 cm from a table. If the lamp is lowered 30 cm calculate the percentage increase of illuminance of the table. (2+2)+3+3
8. a) Define optical centre of a lens. Can the optical centre of a lens lie outside the lens?  
 b) What is meant the power of a lens? What is its unit?  
 c) Using lens maker's formula calculate the radius of curvature of the spherical surface of a plano-concave lens of focal length 20 cm using glass of refractive index 1.5  
 d) A lens made of glass ( $\mu = 1.5$ ) of focal length 12 cm is immersed in water ( $\mu = 1.33$ ) what will be the focal length of the lens in water? 2+2+3+3
9. a) What is wave front ? What is interference of light?  
 b) Write down the condition of destructive and constructive interference.  
 c) The distance between the two slits in young's double slit experiment is 0.1mm. Interference fringes for light of wave length  $4000\text{\AA}$  are formed on the screen at a distance of 60 cm from the slits determine the distance of the 4th bright fringe. (2+2)+3+3
10. a) Explain briefly – (i) work function, (ii) stopping potential.  
 b) Work function of potassium is 2.2 eV. What is the threshold frequency of photoelectron?  
 c) Photoelectric threshold wavelength for a metal is  $3800\text{\AA}$ . Find the maximum kinetic energy of emitted photoelectron, when ultraviolet radiation of wavelength  $2000\text{\AA}$  is incident on the metal surface. ( $h=6.62 \times 10^{-34} \text{ J.S}$ ) 2+2+3+3