December 2016

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 <u>any five</u> questions from Group-A & B, taking <u>at least two</u> from each group.

1. Choose the correct answer from the given alternatives (any twenty): 20x1

i) The SI unit of surface tension is – (a) N/m^3, (b) N/m^2, (c) N/m, (d) none of these.

ii) Which of the following is unit of a basic physical quantity? – (a) Pascal, (b) Newton, (c) Radian, (d) Joule.

iii) Dimension of angular velocity is – (a) zero, (b) $[L^1]$, (b) $[L^1T^{-1}]$, (d) $[T^{-1}]$.

iv) The dimensional formula of stress is the same as that of – (a) energy, (b) pressure, (c) force, (d) none of these.

v) The measured value of a capacitor is 205.3 μF, whereas the value is 201.4 μF. The percentage error is – (a) 1.94, (b) 2.94, (c) 0.94, (d) 0.094.

vi) The length of wire is increased by 0.02% and its radius is decreased by 0.005%. The percentage change in volume is – (a) 0.03%, (b) 0.01%, (c) 0.02%, (d) zero.

vii) Young modulus of perfectly rigid body is – (a) non-zero, (b) one, (c) zero, (d) infinity.

viii) Isothermal bulk modulus of gas at a pressure p is – (a) p/γ, (b) p, (c) $p\gamma$, (d) none of these.

ix) Surface tension is measured by – (a) force/mass, (b) force/area, (c) force/volume, (d) force/length.

x) If a liquid wet a solid then the angle of contact is – (a) $>90°$, (b) $<90°$, (c) $=90°$, (d) none of these.

xi) Bar is the unit of – (a) thrust, (b) force, (c) pressure, (d) none of these.

xii) A body is immersed in water and then again in kerosene. Buoyancy will be – (a) same, (b) greater in water, (c) greater in kerosene, (d) none of these.

xiii) The difference of temperature of two bodies in Celsius scale is 15°. In Kelvin scale this difference will be – (a) 20, (b) 27, (c) 30, (d) 15.

xiv) At what temperature, do the Celsius and Fahrenheit scale gives the same reading? – (a) 0°C, (b) 40°C, (c) 72°C, (d) –40°C.

xv) Heat from sun reaches the earth by – (a) conduction, (b) convection, (c) radiation, (d) none of these.

xvi) Which of the following processes of heat transfer depends on gravity? – (a) conduction, (b) convection, (c) radiation, (d) none of these.

xvii) In isothermal process the constant quantity is – (a) pressure, (b) volume, (c) temperature, (d) none of these.

xviii) For a mono atomic gas the value of γ is – (a) 1.33, (b) 1.40, (c) 1.67, (d) 1.00.

xix) Luminous intensity of a source depends upon its – (a) area, (b) distance, (c) volume, (d) none of these.

xx) Mirages are due to – (a) reflection, (b) refraction, (c) total internal reflection, (d) polarization.

xxi) The power of two lenses are +5D and –2.5D, the focal length of these two lenses in contact will be – (a) +40cm, (b) –40cm, (c) +40, (d) none of these.

xxii) Optical path difference corresponding to the geometrical path difference of 3m is (μ=1.5) – (a) 4.5m, (b) 3m, (c) 2m, (d) 1.2m.

xxiii) 1 eV is equivalent to – (a) 1.6×10^{-12} J, (b) 1.6×10^{-19} J, (c) 1.6 J, (d) none of these.

xxiv) The energy of a photon associated with a radiation of frequency γ is – (a) h/γ, (b) $h\gamma$, (c) γ, (d) none of these.

Group-A

2. a) What do you mean by fundamental and derived quantities? What do you mean by proportional error and absolute error?
   b) The time period (T) of a pendulum may depend on mass of the bob (m), effective length of the pendulum (l) and acceleration due to gravity (g). By the principle of dimensional homogeneity, prove that $T = K\sqrt{\frac{l}{g}}$ where K is a dimensionless constant. (2+3)+5

3. a) What do you mean by systematic error? The error in the measurement of radius of a sphere is 1%. Find the error in the measurement of its volume.
   b) State and explain Hooks law of elasticity. Write down the relationship between K, σ, Y and η. (1+3)+(3+2)

4. a) Define surface tension. What are the effects of temperature and impurity on surface tension?
   b) If a capillary tube of radius 0.1mm is dipped in water of surface tension 7.2×10^{-2} N/m then find the rise of water through the capillary tube. Assume the angle of contact is 0°.
   c) What is the dimension of surface tension? Define cohesive and adhesive force. (1+2)+4+3

5. a) State Pascals law for transmission of fluid pressure. What is critical velocity? How does the coefficient of viscosity of fluid depends on temperature?
   b) What do you mean by thermal expansion of a solid? Establish the relationship between, α, β and γ. (2+1+2)+(1+4)

6. a) Distinguish between conduction, convection and radiation. Give examples of two good and bad conductors of heat.
   b) State Zeroth law of thermodynamics. Establish, P-T, V-T relationship for adiabatic process. (3+2)+(1+4)

Group-B

7. a) Write down the principle of photometry. State laws of refraction of light. What do you mean by critical angle? Explain with diagram.
   b) What will be the speed of light in glass (μ=1.5) if the speed of light in air is 3×10^{8} m/sec? (1+2+2)+5

8. a) What do you mean by power of a lens? What are the units of power of a lens? The power of lens is +4D. What is the focal length of the lens and what is the type?

b) The focal length of plano-convex lens is 20cm (μ=1.5). Calculate the radius of curvature of the curved surface using lens makers formula. (1+2+2)+5

9. a) What do you mean by coherent source? State Huygens principle of propagation of wave. What are the conditions for constructive and destructive interference?

b) Describe briefly Young's double slit experiment and find out an expression for fringe width. (1+1+3)+5

10. a) What are photons? Write down their characteristics.

b) Work function of potassium is 2.2 eV. What is the threshold frequency of photoelectron?

c) What is the ratio of intensities of bright and dark fringes if the slit width changes in the ratio 4:1 in Young's double slit experiment? (1+2)+3+4