REV-01
MSP/32/37

2022/07

M.Sc. PHYSICS
FOURTH SEMESTER
CONCEPTS OF PHYSICS
MSP – 405 MDC

(Use Separate Answer Scripts for Objective & Descriptive)

Duration: 3 hrs. **Full Marks: 70**

[PART-A: Objective]

Time: 20 min. **Marks: 20**

Choose the correct answer from the following: ***1X20=20***

1. The escape speed of an object of mass m from the surface of earth is given by
   a. $\sqrt{g\,R}$ b. $\sqrt{2\,g\,R}$
   c. $\sqrt{g\,R/2}$ d. $2\sqrt{g\,R}$

2. The relation between wave propagation constant and wave length is
   a. $k = \frac{2\pi}{\lambda}$ b. $k = 2\,\pi\lambda$
   c. $\lambda = 2\,\pi\,k$ d. $\lambda = \frac{1}{k}$

3. Mathematically Kepler's Law of Area state that
   a. $\frac{\Delta\vec{P}}{\Delta t}$=const b. $\frac{\Delta\vec{A}}{\Delta t}$=const
   c. $\frac{\Delta\vec{J}}{\Delta t}$=const d. $\frac{\Delta K}{\Delta t}$=const

4. The potential energy of an orbiting satellite at height 'h' is
   a. $-\frac{GmM}{(h+R)}$ b. $-\frac{G\,M}{2(h+R)}$
   c. $-\frac{G\,M}{(h+R)}$ d. $-\frac{G\,m\,M}{2(h+R)}$

5. The human heart beat is 60 cycle per minute. What is its frequency?
   a. 1 Hz b. 10 Hz
   c. 100 Hz d. 60 Hz

6. The CGS unit of radius of curvature of a spherical mirror is
   a. m/sec b. cm
   c. m d. no unit

7. Speed of light in glass is
   a. $1.5 \times 10^8 m/s$ b. $3 \times 10^8 m/s$
   c. $4 \times 10^8 m/s$ d. $2 \times 10^8 m/s$

8. The relation between the focal length and power of a lens is
   a. $p = \frac{1}{f}$ b. $p = f$
   c. $p = \frac{2}{f}$ d. $p = f/2$

9. In adiabatic process which one of the following relation is correct?
   a. PV = const b. $P^{\gamma}V$ = const
   c. $V^{\gamma}P$ = const d. PV = n $K_B T$

10. The radius of curvature of a concave mirror is 30 cm. What is its focal length?
    a. 30 cm b. 10 cm
    c. 15 cm d. 20 cm

11. The angle of incidence in a plane mirror is 30°. What is the angle of reflection?
    a. 20° b. 30°
    c. 15° d. 10°

12. The current (I) drawn from a cell of emf (ϵ), internal resistance (r), and load resistance (R) is
    a. $I = \frac{\epsilon}{r+R}$ b. $I = \frac{\epsilon}{r}$
    c. $I = \frac{\epsilon}{R}$ d. $I = \epsilon R$

13. The amount of heat produced in a current carrying conductor of resistance R in time t is
    a. $I R t$ b. $R^2 I t$
    c. $I^2 R t$ d. I^2/R

14. The absolute temperature of a gas molecule at $27^{\circ}C$ is
    a. 290K b. 300K
    c. 273K d. 100K

15. The displacement of a particle executing simple harmonic motion is $x(t) = 10\ (\text{cm})\ \sin\left(\frac{2\pi t}{0.05}\right)$. Its time period (millisecond) is
    a. 10 ms b. 15 ms
    c. 20 ms d. 50 ms

16. The velocity of a wave is 450 m/s and its wave-length 9 m. Its frequency is
    a. 45 Hz b. 50 Hz
    c. 40 Hz d. 35 Hz

17. A conductor of resistance 10 Ω carrying a current 0.1 A. The potential difference across the conductor is
    a. 10 volt b. 1 volt
    c. 2 volt d. 5 volt

18. An object is placed 30 cm in front of a concave mirror having radius of curvature 30 cm. The image will formed at distance
    a. 10 cm b. -20 cm
    c. 30 cm d. -30 cm

19. The image height is equal the object height in
    a. a concave mirror b. a convex mirror
    c. a plane mirror d. a prism

20. According to the law of equipartition of energy, each degree of freedom has same amount of energy equal to
    a. $\frac{1}{2}k_B T$ b. $\frac{3}{2}k_B T$
    c. $k_B T$ d. $\frac{2}{3}k_B T$

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PART-B : Descriptive

Time : 2 hrs. 40 min. Marks : 50

[Answer question no.1 & any four (4) from the rest]

1. a. State Kirchoff's law of electricity. **4+6=10**

   b. Derive the balanced condition on Wheatstone bridge using the Kirchoff's law.

2. a. State Kepler's law of planetary motion. **4+3+3 =10**

   b. Derive the law of period of planetary motion.

   c. If the time period of earth reduced to 18 hrs, find the new radius of the earth.

3. a. Derive an expression of speed of a transverse wave in stretched string. **4+3+3 =10**

   b. A plane progressive wave is given by y(x, t) = 10 (cm) $\sin 2\pi \left(10^{-2}t + \frac{x}{200}\right)$, where x & t are in meters and sec. Find its time-period, amplitude, wave-length.

   c. Find the displacement of the above progressive wave in time t=12.5 s at position 25 m.

4. a. Derive Newton's formula for speed of sound wave. **4+4+2 =10**

   b. Explain Laplace correction of Newton's formula for speed of sound wave.

   c. What are the postulates considered in the Laplace correction?

5. a. What do you mean by regular and diffused reflection? Write answers with suitable diagram. **3+3+4 =10**

   b. State the laws of reflection.

   c. Draw a spherical mirror (concave or convex) showing its pole, focus, focal-length, centre of curvature, principal axis.

6. a. Draw ray diagram of a simple microscope. 4+3+3 =10

b. Define power of a lens. Write its SI unit.

c. Two thin lens of focal length 20 m and -30 m, respectively are in contact. Find the equivalent power of the lenses.

7. a. State zeroth and first law of thermodynamics. 4+2+4 =10

b. Define specific heat ratio.

c. Find the specific heat ratio for a diatomic gas molecule.

8. a. What do you mean by transverse and longitudinal wave? 4+3+3 =10

b. Explain the effects of temperature, pressure and density on speed of sound wave.

c. At what temperature rms speed of a gas molecule becomes double to its value at $27^{\circ}C$?

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