LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **PHYSICS**

FIFTH SEMESTER – **NOVEMBER 2019**

16/17UPH5ES01 – PROBLEMS SOLVING SKILLS IN PHYSICS

Date: 06-11-2019 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

Part-A

ANSWER **ALL** THE QUESTIONS **20x2=40**

1. An object moving with uniform acceleration covers 10 m in 4^{th} second and 20 m in 8^{th} second. The acceleration of the object in ms^{-2} is

   a) 2.0 b) 1.25 c) 2.5 d) 5

2. A train is moving towards east and a car is going along north both with same speed. The observed direction of car to the passenger in the train is :

   a)east-north direction b) west-north direction c) south-east direction d) none of the three

3. A sphere of mass10 kg moving with a speed of 5 ms^{-1} is stopped on collision with another sphere of mass 20 kg moving with 2 ms^{-1} speed in the same direction on a friction less surface. The speed in ms^{-1} of the sphere after collision will be,

   a)5 b) 3.5 c) 4.5 d) 10

4. A circle of radius 1 m is at rest. The area of the circle with respect to frame moving with speed 0.8c is

   a)0.8 π m^2 b) 0.6 π m^2 c) 1 m^2 d) 1.8 m^2

5. The equation of state of given gas is P(v-b) = nRT where b is constant, n is the number of moles and R is the Universal gas constant, when 2 moles of this gas undergo reversible isothermal expansion from v to 3v, the work done by the gas is

   a) 2RT ln $(\frac{2v-b}{v-b})$ b) 3RT ln $(\frac{3v-b}{v-b})$ c) 3RT ln $(\frac{2v-b}{v-b})$ d) 2RT ln $(\frac{3v-b}{v-b})$

6. Morning breakfast gives 5000 cal to a 60 kg person. The efficiency of person is 30 %. The height up to which the person can climb up by using energy obtained from breakfast is

   a) 5 m b) 10.5 m c) 15 m d) 16.5 m

7. The value of root mean square speed of molecule of hydrogen at N.T.P is (The Boltzmann constant is 1.38 x 10^{-23} J/degree and Avogadro number is 6x 10^{26}(Kg. mole)$^{-1}$)

a)2038 ms^{-1} b) 1838 ms^{-1} c) 1683 ms^{-1} d) 1083 ms^{-1}

8. A mass of dry air at NTP is compressed to $(\frac{1}{3\gamma})^{th}$ of its original volume suddenly. If γ = 1.4 the final pressure would be

a) 32 atm b) 128 atm c) 1/32 atm d) 150 atm

9. Electromagnetic waves are _____ in nature

a) Transverse b) Longitude c) Both transverse and longitude d) Elliptical

10. A thin conducting wire is bent into circular loop of radius r and placed in a time dependent field $\hat{B} = B_0 e^{-\alpha t}\hat{k}$ where $B_0 > 0$ and $\alpha > 0$ such that plane of loop is perpendicular to $\hat{B}(t)$. then the induced emf in the loop is

a) $\pi r^2 \alpha B_0 e^{-\alpha t}$ b) $\pi r^2 B_0 e^{-\alpha t}$ c) $-\pi r^2 \alpha B_0 e^{-\alpha t}$ d) $-\pi r^2 B_0 e^{-\alpha t}$

11. The charge density can be found using the Maxwell's equation

a) $\nabla . \vec{E} = \frac{\rho}{\varepsilon_0}$ b) $\nabla . \vec{B} = \frac{\rho}{\varepsilon_0}$ c) $\nabla X \vec{E} = \frac{\rho}{\varepsilon_0}$ d) $\nabla X \vec{B} = \frac{\rho}{\varepsilon_0}$

12. Electrostatic field should satisfy the Maxwell's equation

a) $\nabla \times E = 0$ b) $\nabla \times B = 0$ c) $\nabla . \mathrm{E} = \frac{\rho}{\varepsilon_0}$ d) $\nabla \times \mathrm{E} = \frac{\rho}{\varepsilon_0}$

13. If A and B are Hermitian operators then (AB+BA) is _____

a) Non-Hermitian b) Hermitian c)Skew hermitian d) Unitary

14. The commutation relation $[x, p_x]$=_____

a)$i\hbar$ b) $\hbar$ c) i d) h

15. The general Heisenberg uncertainty relation is

a)$\Delta x \Delta p \geq \frac{\hbar}{2}$ b) $\Delta x \Delta p \geq \frac{1}{2}$ c) $\Delta x \Delta p \geq \frac{\pi}{2}$ d) $\Delta x \Delta p \geq \pi$

16. The eigen values of matrix A=$\begin{pmatrix} 1 & -i \\ i & -1 \end{pmatrix}$ is

a) $\pm\sqrt{2}$ b) $\pm\sqrt{3}$ c) $\pm\sqrt{5}$ d) $\pm\sqrt{6}$

17. The SI unit of co-efficient of viscosity is

a)m^2Ns^{-1} b) $Ns\ m^{-2}$ c) Nm d) Nm^{-1}

18. Two resistances R_1=(100±3) Ω and R_2=(150±2) Ω are connected in series. What is their equivalent resistance?

a)$250 \pm 5\ \Omega$ b) $250 \pm 3\ \Omega$ c) $250 \pm 6\ \Omega$ d) $250 \pm 4\ \Omega$

19. The buoyant force experienced by a submerged body in a fluid is equal to

a)ρgV b) ρgh c) ρg d) ghV

20. The maximum possible error in the sum of two quantities is equal to the ----------of the absolute errors in the individual quantities

a) sum b) difference c) zero d) product

Part-B

ANSWER ANY **TEN** QUESTIONS **10x6=60**

1. The motion of a particle is given by a = $t^3 - 3t^2 + 8$ where 'a' is the acceleration in ms^{-2} and 't' is the time in seconds. The velocity of the particle at t = 1 second is 6.25m/s and the displacement is 8.8 meters. Calculate the displacement and velocity at t = 2 seconds.
2. Calculate the angular momentum of conical pendulum about its pivot point and the bob. The pendulum is in steady circular motion with constant angular velocity 'ω'.
3. A statellite of mass m_s revolving in a circular orbit of radius r_s around the earth of mass M has a total energy E. Find its angular momentum.
4. At what temperature is the root mean square velocity equal to the escape velocity from the surface of the earth for hydrogen and for oxygen?
5. Two Carnot engines A and B are operated in series. The first one A receives heat at 900 K and rejects to a reservoir at temp T K. The second engine B receives the heat rejected by the first engine and then reject to a heat reservoir at 400 K. Calculate the temperature T for this situation

a) if the efficiency of both engines are same.

b) if the work output are same for both engines

6. A certain system is found to have Gibbs free energy given by G= RT ln $(\frac{aP}{(RT)^{\frac{5}{2}}})$ where a and R are constants. Find the specific heat at constant pressure C_p.
7. Three charges each equal to Q are placed at the three corners (A,B and C) of a square of side L. Then find the magnitude of electric field at the fourth corner.
8. A long solenoid of radius 'a' is driven by alternating current so that field inside is sinusoidal $\vec{B}(t)=B_0 \cos \omega t\, \hat{k}$. A circular loop of wire of radius $\frac{a}{2}$ and resistance R is placed inside the solenoid and co-axial with it. Find the current induced in the loop as a function of time.
9. An electromagnetic wave is represented by the following form $\vec{E} = E_0 \sin(5 \times 10^{-8} z - 10t)\hat{y}$ travels in the unknown medium. Determine the unknown medium?

10. An electron is considered in an infinite potential well of length 'a'

a) Calculate the probability of finding the electron between x=0 to x=a/2 in first excited state.

b) Calculate the expectation vale of $\hat{P}_x$ in the first excited state.

11. The state of quantum particle moving in the infinite square well potential is given by $\Psi = 5\varphi_1 + 2\varphi_2 - 3i\varphi_3$. If the energy of this quantum particle is measured, calculate

a) The probability of getting E_1, E_2 and E_3

b) The expectation value of Energy

12. A particle in the infinite square well has its initial wave function an even mixture of the first two stationary states $\Psi(x,0) = A[\Psi_1(x) + \Psi_2(x)]$

a) normalize $\Psi(x,0)$ b)Find $\Psi(x,t)$ and $|\Psi(x,0)|^2$

13. Plot of a graph for the function $y=4x^2+2x$ taking x values between 0 to 10.

14. a) The voltage across a wire is (100 ± 5) V and the current passing through it is (10 ± 0.2) A find the resistance of the wire.

b) The temperature of two bodies measured by a thermometer are $t_1=(20\pm0.5)^{\circ}C$ and $t_2=(50\pm0.5)^{\circ}C$. Calculate the temperature difference and the error.

15. A physical quantity x is given by $x = \frac{a^2b^3}{c\sqrt{d}}$. If the percentage errors of measurement in a, b, c and d are 4%, 2%, 3% and 1% respectively. Then calculate the percentage error in x.

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