



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – PHYSICS

FIFTH SEMESTER – NOVEMBER 2018

16UPH5ES01- PROBLEMS SOLVING SKILLS IN PHYSICS

Date: 30-10-2018
Time: 09:00-12:00

Dept. No.

Max. : 100 Marks

PART-A(20 x 2 = 40 MARKS)

ANSWER ALL QUESTIONS.

- 1). A ball is thrown with initial speed of 5ms^{-1} . The maximum height reached by the ball
- (a) $\frac{5}{4}m$ (b) $\frac{4}{5}m$ (c) $\frac{7}{5}m$ (d) $\frac{5}{7}m$
- 2). A ball is thrown with horizontal velocity of 3ms^{-1} . If we neglect the air friction, the direction of acceleration experienced by the ball is along
- (a) $-\hat{j}$ (b) $-\hat{i}$ (c) $-\hat{k}$ (d) \hat{k}
- 3). If force of $5\hat{i} + 3\hat{j}$ moves the object $7\hat{i}$ then calculate the work done by the force on the object.
- (a) 30 J (b) 35J (c) 40J (d) 0
- 4). A 1m length of rod is moving at a speed of $c/2$. The length of rod with respect to ground is
- (a) $\frac{\sqrt{3}}{2}m$ (b) $\frac{\sqrt{3}}{4}m$ (c) $\frac{\sqrt{3}}{8}m$ (d) $\sqrt{3}m$
- 5). If the number density doubles, the pressure increased in the gas by the factor of
- (a) 4 (b) 2 (c) remains same (d) 8
- 6). If 5 J of heat is supplied to the gas and gas has pushed the piston in to 1m^3 with pressure of 2 Pascal, then the change in internal energy of the gas is
- (a) 5J (b) 4J (c) 3J (d) 6J
- 7). The state of gas is denoted by (P,V,T). If the pressure of the gas doubles and volume of the gas quadruples, then the new temperature is
- (a) 8 T (b) 10T (c) 5T (d) 2T
- 8). 1 kg of water is heated from 0°C to 100°C and the specific heat of water is $4186\text{Jkg}^{-1}\text{K}^{-1}$. The change in entropy of the water is approximately
- (a) 1287JK^{-1} (b) 4186JK^{-1} (c) 5000JK^{-1} (d) 2000JK^{-1}

9) If a charge of 200 micro coulombs is placed at the origin, then the electric field produced by this charge at a distance of 10 mm in the positive x axis.

(a) $\frac{1}{4\pi\epsilon_0} NC^{-1}$ (b) $\frac{1}{2\pi\epsilon_0} NC^{-1}$ (c) $\frac{1}{16\pi\epsilon_0} NC^{-1}$ (d) $\frac{1}{32\pi\epsilon_0} NC^{-1}$

10) Charge of 1C is placed at origin. The electrostatic potential created by the charge at a distance of 7m is

(a) $\frac{1}{28\pi\epsilon_0} JC^{-1}$ (b) $\frac{1}{2\pi\epsilon_0} JC^{-1}$ (c) $\frac{1}{16\pi\epsilon_0} JC^{-1}$ (d) $\frac{1}{32\pi\epsilon_0} JC^{-1}$

11) If a charge of $0.5\mu C$ is moved with velocity $\vec{v} = -2\hat{i}$ in a magnetic field $\vec{B} = -2B_0\hat{k}$ where $B_0 > 0$. The Lorentz force experienced by the charge is

(a) $2B_0\hat{j} \mu N$ (b) $2B_0\hat{i} \mu N$ (c) $-2B_0\hat{j} \mu N$ (d) $-4B_0\hat{i} \mu N$

12) An infinite length of conductor carrying current of 10 A. The magnetic field created by this current at a distance 5m is

(a) $\frac{\mu_0}{\pi}$ tesla (b) $\frac{\mu_0}{2\pi}$ tesla (c) $\frac{10\mu_0}{\pi}$ tesla (d) $\frac{\mu_0}{10\pi}$ tesla

13) The value of $[p_x^2, x]$ is

(a) $i\hbar$ (b) $-i\hbar p_x$ (c) $-2i\hbar p_x$ (d) zero

14) If the wave function satisfies the following relation $\int_{-\infty}^{\infty} \Psi^* \Psi dx = 36$, the value of normalization constant is

(a) $\frac{1}{6}$ (b) $\frac{1}{36}$ (c) $\frac{1}{18}$ (d) $\frac{1}{72}$

15) If an electron is in the fourth excited state of infinite square well potential, then the energy of the electron

(a) $\frac{50\pi^2\hbar^2}{2ma^2}$ (b) $\frac{25\pi^2\hbar^2}{2ma^2}$ (c) $\frac{5\pi^2\hbar^2}{2ma^2}$ (d) $\frac{10\pi^2\hbar^2}{2ma^2}$

16) For a two dimensional harmonic oscillator, the value of the ground state energy is

(a) $\hbar\omega$ (b) $\frac{\hbar\omega}{2}$ (c) $\frac{3\hbar\omega}{2}$ (d) $2\hbar\omega$

17) If two physical quantities A and B are measured with error ΔA and ΔB , then the error in the physical quantity $Z=A+B$ is

(a) $\Delta A - \Delta B$ (b) $\Delta A + \Delta B$ (c) $\frac{\Delta A}{\Delta B}$ (d) $\Delta A \times \Delta B$

18) The maximum value of the function $f(x) = 5 \sin x$ is

- (a) 5 (b) -5 (c) 0 (d) 1

19) The length of rectangle $l = (5 \pm 0.2) \text{ cm}$ and breadth $b = (3 \pm 0.1) \text{ cm}$. The fractional error in area of rectangle is

- (a) 0.2 (b) 0.02 (c) 0.07 (d) 0.1

20) If the potential energy is $U = -\frac{1}{2}kx^2$, then the force experienced by the particle is

- (a) kx (b) $-kx$ (c) $2kx$ (d) $-2kx$

PART-B (10x 6 = 60 MARKS).
ANSWER ANY TEN QUESTIONS.

21). A ball is thrown with speed v at an angle Θ with respect to the ground. At highest point in the motion, the strength of gravity is somehow magically doubled. What is the horizontal distance travelled by the ball?

22). What minimum horizontal speed should be given to the bob of simple pendulum of length l , so that it executes a complete circle.

23). Calculate the charge density for a given electric field $\vec{E} = k[5xz\hat{i} - 3y^2x\hat{j} + 6xz\hat{k}]$

24). An electric part of EM wave is given by $\vec{E} = E_0 \sin(kz - \omega t)\hat{j}$. a) What is the direction of propagation (b) Calculate the magnetic part of EM wave?

25). The state of the quantum particle moving in the infinite square well potential is given by $\Psi = 5\phi_1 + 2\phi_2 - 3i\phi_3$. If energy is measured in this state, then calculate (a) the probability of getting E_1, E_2 and E_3 (b) expectation of value of energy.

26). For a given matrix $A = \begin{pmatrix} 1 & -i \\ i & 0 \end{pmatrix}$ (a) verify that A is hermitian (b) Calculate the eigen values of the matrix A.

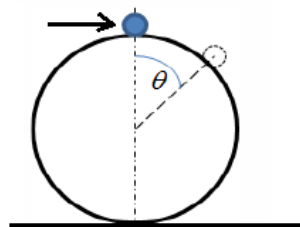
27). The equation of state of a gas is given as $P(V-b) = nRT$ where b is constant, n is the number of moles and R is the universal gas constant. When 2 moles of this gas undergo reversible isothermal expansion from volume V to volume $2V$, What is the work done by the gas?

28) Two Carnot engines A and B are operated in series. The first one A receives heat at 900K and rejects to a reservoir at temperature T K. The second engine, B receives the heat rejected by the first engine and in then rejects to a heat reservoir at 400K. Calculate the temperature T for the situation (a) if efficiency of both engines is same (b)if workdone by both engine is same

29) Plot the following functions (a) $\sin 2x$ (b) e^{-x^2} (c) $|x|$

30) A physical quantity x is given by $x = \frac{a^2 b^3}{c \sqrt{d}}$. 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.

31) A small particle of mass m placed on the top of sphere of radius R. If small kick is given on the horizontal direction as shown in the figure. At what angle the particle leaves the sphere?



32) Three charges each equal to Q are placed at the three corners (A,B and C) of a square of side L. Calculate the magnitude of electric field at the fourth corner D.

33) An electron is moving inside the infinite square well potential of length a. Calculate the probability of finding the electron from $x=0$ to $x = a/2$. Assume the electron is in the first excited state.

34) Calculate the total torque acting on the bob of a simple pendulum about its pivot point O.

35) A satellite of mass m_s revolving in a circular orbit of radius r_s around the earth of mass M has total energy E. Calculate the angular momentum of satellite
