LECTURE BASED PROBLEM SHEET

PHYSICS CRACK SHOT QUESTIONS **Faculty: Moni Kakati**

Q.1. A sample of radioactive material decays simultaneously by two processes A and B with half lives $\frac{1}{2}$ and $\frac{1}{4}$ hr respectively. For first half hr it decays with the process A, next one hr with the process B and for further half an hour with both A and B. If originally there were N_0 nuclei, find the number of nuclei after 2 hr of such decay.

(a) $\frac{N_0}{(2)^8}$ (b) $\frac{N_0}{(2)^4}$

(c) $\frac{N_0}{(2)^6}$ (d) $\frac{N_0}{(2)^5}$

Q.2. In which of the following process the number of protons in the nucleus increases

(a) α- decay (b) β^- decay

(c) β^+- decay (d) k- capture

Q.3. In a photoelectric experiment, with light of wavelength λ, the fastest electron has speed v. If the exciting wavelength is changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted electron will become

(a) $v\sqrt{\frac{3}{4}}$ (b) $v\sqrt{\frac{4}{3}}$

(c) less than $v\sqrt{\frac{3}{4}}$ (d) greater than $v\sqrt{\frac{4}{3}}$

Q.4. A radioactive element X converts into another stable element Y. Half life of X is 2 hrs. Initially only X is present. After time t, the ratio of atoms of X and Y is found to be 1: 4, then t in hours is:

(a) 2 (b) 4

(c) between 4 and 6 (d) 6

Q.5. If the ratio of the intensity of two coherent sources is 4 then the visibility [$(I_{max} - I_{min}) / (I_{max} + I_{min})$] of the fringes is

(a) 4 (b) 4/5 (c) 3/5 (d)9

Q.6. A convex lens has focal length 40 cm. The distance between the positions of the object for which the image size is double of the object size is:

(a) 20cm (b) 40cm

(c) 60 cm (d) 15 cm

Q.7. An inductor L and a resistor R are connected in series with a direct current source of emf E. The maximum rate at which energy is stored in the magnetic field is:

(a) $\frac{E^2}{4R}$ (b) $\frac{E^2}{R}$ (c) $\frac{4E^2}{R}$ (d) $\frac{2E^2}{R}$

Q.8. A uniform magnetic field exists in region given by $\vec{B}=3\hat{\imath}+4\hat{\jmath}+5\hat{k}$. A rod of length 5 m is placed along y- axis is moved along x- axis with constant speed 1m/sec. Then induced e.m.f. in the rod will be

(a) zero (b) 25 volt

(c) 20 volt (d)15 volt

Q.9. A rod of length ℓ having uniformly distributed change Q is rotated about one end with constant frequency 'f'. Its magnetic moment

(a) $\pi f Q l^2$ (b) $\frac{\pi f Q l^2}{3}$

(c) $\frac{2\pi f Q l^2}{3}$ (d) $2\pi f Q l^2$

Q.10. In an ideal transformer, the voltage and the current in the primary are 200 volt and 2 amp respectively. If the voltage in the secondary is 2000 volt. Then value of current in the secondary will be:

(a) 0.2 amp (b) 2amp

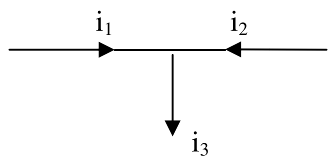
(c) 10 amp (d) 20 amp

Q.11. An insulating rod of length l carries a charge q distributed uniformly on it. The rod is pivoted at its mid point and is rotated at a frequency f about a fixed axis perpendicular to rod and passing through the pivot. The magnetic moment of the rod system is –

(a) zero (b) $\pi q f \ell^2$

(c) $\frac{1}{6}\pi q f \ell^2$ (d) $\frac{1}{3}\pi q f \ell^2$

Q.12. If $i_1 = 3\sin\omega t$ and $i_2 = 4\cos\omega t$, then i_3 is



(a) 5 sin $(\omega t+53^0)$ (b) 5 sin $(\omega t+37^0)$

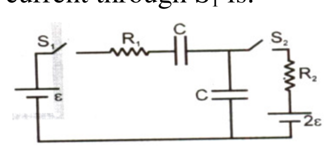
(c) 5 sin $(\omega t+45^0)$ (d) 5 cos $(\omega t+53^0)$

Q.13. A bulb is rated at 100 V, 100W, it can be treated as a resistor. Find out the inductance of an inductor (called choke coil) that should be connected in series with the bulb to operate the bulb at its rated power with the help of an ac source of 200 V and 50 Hz.

(a) $\frac{\pi}{\sqrt{3}}$ H (b) 100 H

(c) $\frac{\sqrt{2}}{\pi}$ H (d) $\frac{\sqrt{3}}{\pi}$ H

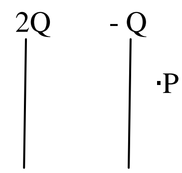
Q.14. In the circuit shown, switch S_2 is closed first and is kept closed for a long time. Now S_1 is closed. Just after that instant the current through S_1 is:



(a) $\frac{\varepsilon}{R_1}$ towards right (b) $\frac{\varepsilon}{R_1}$ towards left

(c) zero (d) $\frac{2\varepsilon}{R_1}$

Q.15. In the figure shown the plates of a parallel plate capacitor have unequal charges. Its capacitance is 'C'. P is a point outside the capacitor and close to the plate of charge-Q. The distance between the plates is'd'.



(a) A point charge at point 'P' will experience electric electric force due to capacitor

(b) The potential difference between the plates will be $\frac{3Q}{2C}$

(c) The energy stored in the electric field in the region between the plates is $\frac{9Q^2}{8C}$

(d) The force on one plate due to the other plate is $\frac{Q^2}{2\pi\epsilon_0 d^2}$

Q.16. Two long coaxial and conducting cylinders of radius a and b are separated by a material of conductivity σ and a constant potential difference V is maintained between them, by a battery. Then the current, per unit length of the cylinder flowing from one cylinder the other is:

(a) $\frac{4\pi\sigma}{\ell n(b/a)}$V (b) $\frac{4\pi\sigma}{(b+a)}$V

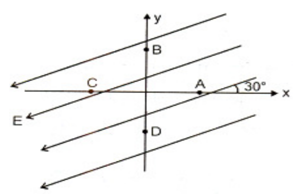
(c) $\frac{2\pi\sigma}{\ell n(b/a)}$ V (d) $\frac{2\pi\sigma}{(b+a)}$V

Q.17. To get maximum current through a resistance of 2.5Ω, one can use 'm' rows of cells, each row having 'n' cells. The internal resistance of each cell is 0.5Ω, What are the values of n & m, if the total number of cells is 45.

(a) 3, 15 (b) 5, 9

(c) 9, 5 (d) 15, 3

Q.18. There exists a uniform electric field in the space as shown. Four points A, B, C and D are marked which are equidistant from the origin. If V_A, V_B, V_c and V_d are their potentials respectively, then



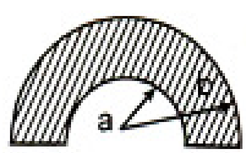
(a) $V_B > V_A > V_C > V_D$

(b) $V_A > V_B > V_D > V_C$

(c) $V_A = V_B > V_C = V_D$

(d) $V_B > V_C > V_A > V_D$

Q.19. A non – conducting semicircular disc (as shown in figure) has a surface charge density σ. The ratio of electric field to electric potential at the centre of the disc will be:



(a) $\frac{1\ell nb/a}{\pi(b-a)}$

(b) $\frac{2}{\pi}$

(c) $\frac{1\ell n(b/a)^2}{\pi(b-a)}$ (d) $\frac{\pi(b-a)}{2\ell n(b/a)}$

Q.20. A rod of length ℓ and cross section area A has a variable thermal conductivity given by k $=\alpha$ T, where α is a positive constant and T is temperature in Kelvin. Two ends of the rod are maintained at temperatures T_1 and T_2 ($T_1 > T_2$). Heat current flowing through the rod will be

(a) $\frac{A\,\alpha\,(T_1^2-T_2^2)}{\ell}$ (b) $\frac{A\,\alpha\,(T_1^2+T_2^2)}{\ell}$

(c) $\frac{A\,\alpha\,(T_1^2+T_2^2)}{3\ell}$ (d) $\frac{A\,\alpha\,(T_1^2-T_2^2)}{2\ell}$

Q.21. In a process the pressure of a gas is inversely proportional to the square of the volume. If temperature of the gas increases, then work done by the gas:

(a) is positive (b) is negative

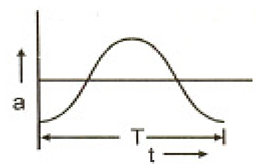
(c) is zero (d) may be positive

Q.22. A string of length 1.5 m with its two ends clamped is vibrating in fundamental mode. Amplitude at the centre of the string is 4mm. distances between the two points having amplitude 2mm is:

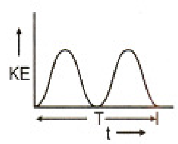
(a) 1m (b) 75 cm

(c) 60 cm (d) 50cm

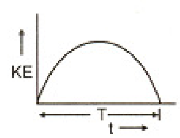
Q.23. Acceleration a versus time t graph of a body in SHM is given by a curve shown below. T is the time peirod. Then corresponding graph between kinetic energy KE and time t is correctly represented by



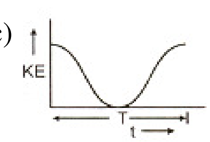
(a)



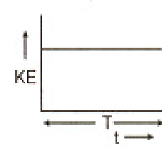
(b)



(c)



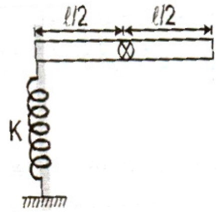
(d)



Q.24. A uniform rod of mass m and length ℓ is hinged at its mid point in such a way that it can rotate in the vertical plane about a horizontal axis passing through the hinge. One of its ends is attached to a spring of spring constant k which is unstretched when the rod is horizontal. If this end is now given a small displacement and released angular frequency of the resulting motion is

(a) $\sqrt{\frac{K}{m}}$ (b) $\sqrt{\frac{2K}{m}}$

(c) $\sqrt{\frac{3K}{m}}$ (d) $\sqrt{\frac{g}{\ell}}$



Q.25. A particle perform S.H.M. of amplitude A along a straight line. When it is at a distance $\frac{\sqrt{3}}{2}$ A from mean position, its kinetic energy gets increases by an amount $\frac{1}{2}$ mω^2A^2 due to an impulsive force. Then its new amplitude becomes:

(a) $\frac{\sqrt{5}}{2}$ A (b) $\frac{\sqrt{3}}{2}$ A (c) $\sqrt{2}$ A (d) $\sqrt{5}$ A

Q.26. A uniform ring of radius R is given a back spin of angular velocity V_0/2R and thrown on a horizontal rough surface with velocity of center to be V_0. The velocity of the centre of the ring when it starts pure rolling will be

(a) V_0/2 (b) V_0/4

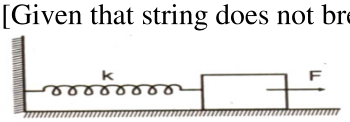
(c) 3V_0/4 (d) 0

Q.27. The potential energy of a particle of mass m free to move along x-axis is given by U= $\frac{1}{2}$ kx^2 for x < 0 and U =0 for x$\geq$ 0(x denotes the x-coordinate of the particle and k is a positive constant). If the total mechanical energy of the particle is E, then its speed at x = -$\sqrt{\frac{2E}{k}}$ is –

(a) zero (b) $\sqrt{\frac{2E}{m}}$

(c) $\sqrt{\frac{E}{m}}$ (d) $\sqrt{\frac{E}{2m}}$

Q.28. A block attached to a spring, pulled by a constant horizontal force, is kept on a smooth surface as shown in the figure. Initially, the spring is in the natural state. Then the maximum positive work that the applied force F can do is: [Given that string does not break]



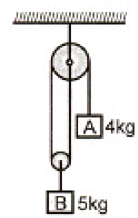
(a) $\frac{F^2}{K}$ (b) $\frac{2F^2}{K}$ (c)∞ (d) $\frac{F^2}{2K}$

Q.29. A bead of mass m is located on a parabolic wire with its axis vertical and vertex directed towards downward as in figure and whose equation is x^2 = ay. If the coefficient of friction isμ, the highest distance above the x-axis at which the particle will be in equilibrium is

(a) μa (b) $\mu^2 a$

(c)$\frac{1}{4}\mu^2 a$ (d) $\frac{1}{2}\mu a$

Q.30. The acceleration of the blocks (A) and (B) respectively in situation shown in the figure is: (pulleys & strings are massless)



(a) $\frac{2g}{7}$ downward, $\frac{g}{7}$ upward

(b) $\frac{2g}{3}$ downward,$\frac{g}{3}$ upward

(c) $\frac{10}{13}$ g downward, $\frac{5g}{13}$ upward

(d) none of these

ANSWERKEY

1.-(a) 2.-(b) 3.-(d) 4.-(c) 5.-(b)
6.-(b) 7.-(a) 8.-(b) 9.-(b) 10.-(a)
11.-(c) 12.-(a) 13.-(d) 14.-(b) 15.-(a), (b),(c) 16.-(c) 17.-(d) 18.-(b) 19.-(c)
20.-(d) 21.-(b) 22.-(a) 23.-(a) 24.-(c)
25.-(c) 26.-(b) 27.-(a) 28.-(b) 29.-(c)
30.-(a)