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FOR KUET EXAM PREPARATION

KUET 2021 Question Paper · M.Sc. Physics

EXAM	YEAR	TYPE	SUBJECT
KUET	2021	Question Paper	M.Sc. Physics

Sr. No. .....

ENTRANCE TEST-2021

SCHOOL OF PHYSICAL & MATHEMATICAL SCIENCES

PHYSICS

Total Questions : 60
Time Allowed : 70 Minutes

Question Booklet Series **A**

Roll No. : | | | | | | |

Instructions for Candidates :

1. Write your Entrance Test Roll Number in the space provided at the top of this page of Question Booklet and fill up the necessary information in the spaces provided on the OMR Answer Sheet.
2. OMR Answer Sheet has an Original Copy and a Candidate's Copy glued beneath it at the top. While making entries in the Original Copy, candidate should ensure that the two copies are aligned properly so that the entries made in the Original Copy against each item are exactly copied in the Candidate's Copy.
3. All entries in the OMR Answer Sheet, including answers to questions, are to be recorded in the Original Copy only.
4. Choose the correct / most appropriate response for each question among the options A, B, C and D and darken the circle of the appropriate response completely. The incomplete darkened circle is not correctly read by the OMR Scanner and no complaint to this effect shall be entertained.
5. Use only blue/black ball point pen to darken the circle of correct/most appropriate response. In no case gel/ink pen or pencil should be used.
6. Do not darken more than one circle of options for any question. A question with more than one darkened response shall be considered wrong.
7. There will be **'Negative Marking'** for wrong answers. Each wrong answer will lead to the deduction of 0.25 marks from the total score of the candidate.
8. Only those candidates who would obtain positive score in Entrance Test Examination shall be eligible for admission.
9. Do not make any stray mark on the OMR sheet.
10. Calculators and mobiles shall not be permitted inside the examination hall.
11. Rough work, if any, should be done on the blank sheets provided with the question booklet.
12. OMR Answer Sheet must be handled carefully and it should not be folded or mutilated in which case it will not be evaluated.
13. Ensure that your OMR Answer Sheet has been signed by the Invigilator and the candidate himself/herself.
14. At the end of the examination, hand over the OMR Answer Sheet to the invigilator who will first tear off the original OMR sheet in presence of the Candidate and hand over the Candidate's Copy to the candidate.

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1. Choose the incorrect statement :

   (A) If total linear momentum of a system of particles is zero, the angular momentum of the system is the same around all origins

   (B) Even if total linear momentum of a system of particles is not zero, the angular momentum of the system is same around all origins

   (C) If the total force on a system of particles is zero, the torque on the system is the same around all origins

   (D) When a rigid body rotates around an axis, every particle in the body remains at a fixed distance from the axis

2. If F is the time-dependent force $F = A - Bt$, where A and B are positive constants, the velocity v(t) in terms of A, B, m (mass), v_0 (initial velocity) and x_0 (initial position) is given by :

   (A) $v(t) = v_0 + At/m - Bt^2/2m$

   (B) $v(t) = v_0 + At^2/m - Bt/2m$

   (C) $v(t) = v_0 + Bt^2/2m$

   (D) $v(t) = v_0 - Bt^2/2m$

3. How far approximately will a small boat move, when a man with mass 64 kg moves from back to front of the boat ? Given that length of boat is 2.7 m, its mass is 92 kg. (Water resistance and tilt of the boat is negligible)

   (A) 1.03 m

   (B) 1.40 m

   (C) 2.74 m

   (D) 1.10 m

4. The Michelson–Morley experiment was designed to show :

   (A) The difference in the speed of light between directions parallel and perpendicular to the Earth's motion

   (B) The speed of light in vacuum is not invariant

   (C) That Galilean transformation equations are valid for the speed of light to be invariant

   (D) None of the above

5. An astronaut sees two spaceships flying apart with speed 0.99c. The speed of one spaceship as viewed by the other nearly is :

   (A) 0.99995c

   (B) c

   (C) 0.95555c

   (D) 0 c

6. A particle moves in a circular orbit with the potential energy $U(r) = -A/r^n$, where $A > 0$. For what values of 'n' are the circular orbits stable :

   (A) $n > 2$

   (B) $n \leq 2$

   (C) Only for $n = 2$

   (D) Only for $n = 1$

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7. A particle of mass 'm' is located in the y-z plane at $x = 0, y = 3, z = 3$. Its moment and products of inertia relative to the origin written in the form of an Inertia matrix are :

(A) $I = 9m\begin{bmatrix} 2 & 0 & -1 \\ 0 & 1 & 0 \\ -1 & 0 & 1 \end{bmatrix}$

(B) $I = 9m\begin{bmatrix} -1 & 0 & -1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$

(C) $I = m\begin{bmatrix} 2 & 0 & -1 \\ 0 & 1 & 0 \\ -1 & 0 & 1 \end{bmatrix}$

(D) $I = m\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ -1 & 0 & -1 \end{bmatrix}$

8. A marble of mass 0.1 kg and radius 0.25 m is rolled up a plane of angle 30^o. If the initial velocity of the marble is 2 m/s, the distance 'd' it travels up the plane before it begins to roll back down is equal to :

(A) 4 m

(B) 4/5 m

(C) 4/7 m

(D) 4/9 m

9. A thin sheet of mass M is in the shape of an equilateral triangle with side L. The moment of inertia around an axis through a vertex, perpendicular to the sheet is :

(A) 5/7 ML^2

(B) 5/12 ML^2

(C) 5/9 ML^2

(D) 1/2 ML^2

10. The graph of the function as shown in Fig.1 is best described by :

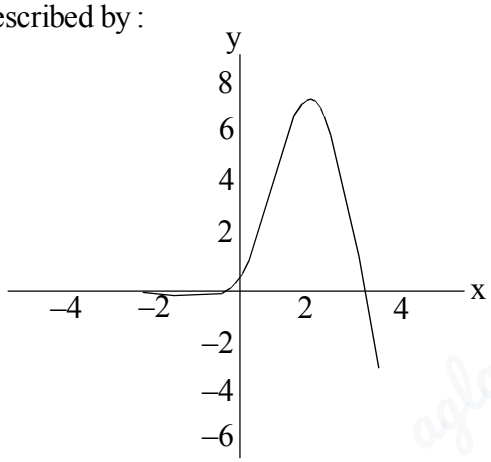


Fig. 1

(A) $e^x \cos(x)$

(B) $e^{-x} \cos(x)$

(C) $e^x \sin(x)$

(D) $e^{-x} \sin(x)$

11. If a force F is derivable from a potential function V(r), where r is the distance from the origin of the coordinate system, it follows that :

(A) $\nabla \times F = 0$

(B) $\nabla \cdot F = 0$

(C) $\nabla V = 0$

(D) $\nabla^2 V = 0$

12. Which of the following expressions for a vector potential $\vec{A}$ does represent a uniform magnetic field of magnitude B along the z-direction ?

(A) $\vec{A} = x\, B\hat{j}$

(B) $\vec{A} = \frac{1}{2} xB\hat{i} + \frac{1}{2} y\, B\hat{j}$

(C) $\vec{A} = -\frac{1}{2} yB\hat{i} + \frac{1}{2} xB\hat{j}$

(D) $\vec{A} = -zB\hat{i}$

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13. For a particle moving in a central force field, which one of the following statements is correct ?

(A) The motion is restricted to a plane due to the conservation of angular momentum

(B) The motion is restricted to a plane due to the conservation of energy only

(C) The motion is restricted to a plane due to the conservation of linear momentum

(D) The motion is not restricted to a plane

14. The magnetic field of a dipole can be written in the following coordinate free form :

(A) $\frac{3\mu_0}{4\pi r^2}\{[\vec{m}\cdot\hat{r}]\,\hat{r}-\vec{m}\}$

(B) $\frac{\mu_0}{4\pi r^3}\{[\vec{m}\cdot\hat{r}]\,\hat{r}-\vec{m}\}$

(C) $\frac{3\mu_0}{4\pi r^3}\{[\vec{m}\cdot\hat{r}]\,\hat{r}-\vec{m}\}$

(D) $\frac{1}{4\pi r^2}\{[\vec{m}\cdot\hat{r}]\,\hat{r}-\vec{m}\}$

15. Which of the following statement is incorrect ?

(A) Maxwell's equations in free space are not invariant under Lorentz transformation

(B) Maxwell's equations in free space are invariant under Lorentz transformation

(C) Maxwell's equation show that electromagnetic waves travel with the same speed in every inertial frame

(D) Maxwell's equations were able to unify the theories of electromagnetism and optics

16. A square loop of wire (side a) lies on a flat surface, a distance s from a very long straight wire, which carries a current I as shown in Fig. 2. The flux of B through the loop is :

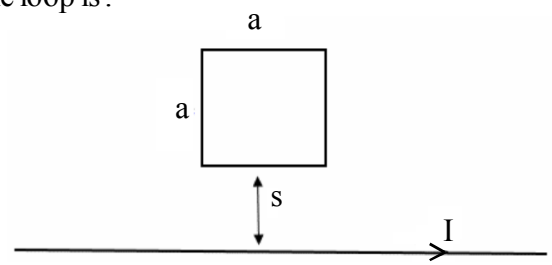


Fig.2

(A) $\frac{\mu_0}{4\pi} Ia\, ln\left(\frac{s+a}{s}\right)$

(B) $\frac{\mu_0}{4\pi} Ia\, ln\left(\frac{s+a}{s^2}\right)$

(C) $\frac{\mu_0}{2\pi} Ia\, ln\left(\frac{s+a}{s}\right)$

(D) $\frac{\mu_0}{4\pi} Ia\, ln\left(\frac{s^2+a^2}{s}\right)$

17. A stationary iron sphere of radius R carries a charge Q and a uniform magnetization M. The magnitude of angular momentum stored in the electromagnetic fields is :

(A) $\frac{2}{9}\,\mu_0 M\,Q\,R^2$

(B) $\frac{2}{9}\,\mu_0 M\,Q$

(C) $\frac{2}{9}\,\mu_0 M\,Q\,R$

(D) $\frac{1}{2}\,\mu_0 M\,R^2$

18. The electromagnetic theory suggests that the electric vector of an electromagnetic wave suffers a sudden phase change of 180^o on reflection from the plane reflecting surface but the magnetic vector suffers :
(A) A phase change of 180^o
(B) A phase change of 90^o
(C) A phase change of 270^o
(D) No phase change

19. In free space, the Poisson equation for electrostatics becomes :
(A) The Maxwell's equation $\nabla \cdot B = 0$
(B) The Laplace equation
(C) The steady state continuity equation
(D) The Ampere's circuital law

20. For an anisotropic dielectric media, the relative permittivity is a :
(A) Vector quantity
(B) Scalar quantity
(C) Tensor quantity
(D) None of the above because relative permittivity is only defined for isotropic media

21. Two ideal polyatomic gases of degrees of freedom f_1 and f_2 at temperatures T_1 and T_2 are mixed so that there is no loss of energy. If the masses and the number of molecules of the two gases are m_1, m_2 and n_1, n_2, respectively, the temperature of the mixture will be :

(A) $\dfrac{n_1 f_1 T_1 - n_2 f_2 T_2}{n_1 f_1 + n_2 f_2}$

(B) $\dfrac{n_1 f_1 T_1 + n_2 f_2 T_2}{n_1 f_1 + n_2 f_2}$

(C) $\dfrac{n_1 f_1 T_1 + n_2 f_2 T_2}{n_1 f_1 - n_2 f_2}$

(D) $\dfrac{n_1 T_1 + n_2 T_2}{n_1 f_1 + n_2 f_2}$

22. The van der Waal's equation of state for an ideal gas is given by :

$$\left(p + \frac{a}{V^2}\right)(V - b) = RT$$

The critical constants for such a gas are given as :

(A) $V_C = \dfrac{2}{3}b,\ p_c = \dfrac{a}{27b^2},\ T_C = \dfrac{8a}{27Rb^2}$

(B) $V_C = \dfrac{1}{3}b,\ p_c = \dfrac{a}{3b^2},\ T_C = \dfrac{8a}{27Rb^2}$

(C) $V_C = 3b,\ p_c = \dfrac{a}{27b^2},\ T_C = \dfrac{8a}{27Rb}$

(D) $V_C = \dfrac{1}{2}b,\ p_c = \dfrac{a}{3b^2},\ T_C = \dfrac{8a}{Rb^2}$

23. Which of the following shows the correct relationship between the thermodynamical variables ?

(A) $\left(\dfrac{\partial T}{\partial p}\right)_V \left(\dfrac{\partial S}{\partial V}\right)_p = \left(\dfrac{\partial T}{\partial V}\right)_p \left(\dfrac{\partial S}{\partial p}\right)_V$

(B) $\left(\dfrac{\partial T}{\partial p}\right)_V \left(\dfrac{\partial S}{\partial V}\right)_p = -\left(\dfrac{\partial T}{\partial V}\right)_p \left(\dfrac{\partial S}{\partial p}\right)_V$

(C) $\left(\dfrac{\partial p}{\partial T}\right)_S \left(\dfrac{\partial S}{\partial V}\right)_p = \left(\dfrac{\partial p}{\partial S}\right)_T \left(\dfrac{\partial V}{\partial T}\right)_S$

(D) $\left(\dfrac{\partial p}{\partial T}\right)_S \left(\dfrac{\partial S}{\partial V}\right)_p = -\left(\dfrac{\partial p}{\partial S}\right)_T \left(\dfrac{\partial V}{\partial T}\right)_S$

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24. The approximate number of modes of standing waves in a chamber of volume 100 cm^3 in the frequency range 4×10^{14} Hz to 4.001×10^{14} Hz are: (where $c = 3 \times 10^8 m/s$) :

(A) 1.5×10^{14}

(B) 1.5×10^{12}

(C) 1.5×10^{10}

(D) 1.5×10^{14}

25. Which of the following statement is not correct ?

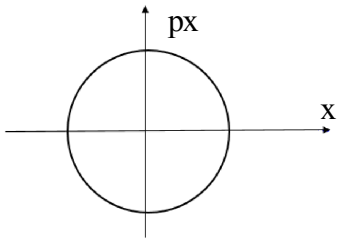
(A) Stefan-Boltzmann law states that the total rate of emission of radiant energy by a body per unit area is related to energy density as fourth power of its temperature

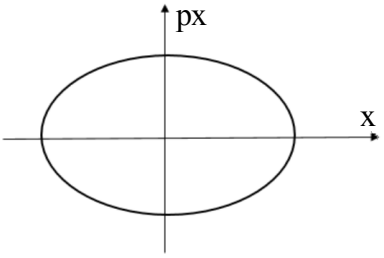
(B) Rayleigh-Jeans formula for the distribution of energy treats blackbody radiation as standing electromagnetic waves which arise due to multiple reflections at the walls of the enclosure and each mode

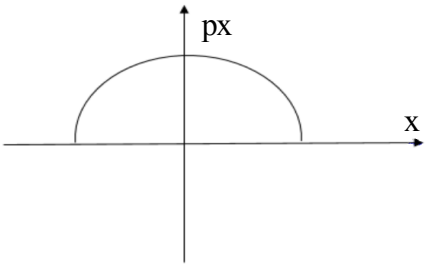
(C) According to Planck, blackbody radiation chamber is filled up not only with radiation but also with the molecules of a perfect gas, which exchange energy via resonators of molecular dimensions

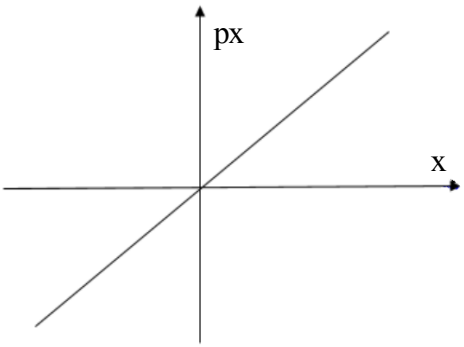
(D) According to Rayleigh-Jeans formula the energy density of Blackbody spectrum within the wavelength range λ and $\lambda + d\lambda$ is directly proportional to the fourth power of the wavelength

26. Which of the following represents the phase space of a linear harmonic oscillator ?

(A)


(B)


(C)


(D)


27. There are two identical particles and each particle can be in one of the three possible quantum states of energies 0, ε and 3ε. The number of microstates of the system for Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics are respectively :

(A) 6,6,3

(B) 3,6,3

(C) 3,3,6

(D) 6,6,6

28. For a Fermi–Dirac system, the thermodynamic probability of distributing N indistinguishable particles into various energy states subject to Pauli principle is given by :

(A) $\Pi_i \frac{g_i!}{n_i!(g_i+n_i)!}$

(B) $\Pi_i \frac{n_i!}{g_i!(g_i-n_i)!}$

(C) $\Pi_i \frac{(n_i+g_i-1)!}{n_i!(g_i-1)!}$

(D) $\Pi_i \frac{g_i!}{n_i!(g_i-n_i)!}$

Where n_i represents the number of particle in ith state and g_i, the degeneracy of the state.

29. The coefficient of viscosity for a gas having velocity gradient in a direction normal to the direction of mass motion is given by :

(A) $\eta = \frac{1}{3} m^2 n \bar{v} \lambda$

(B) $\eta = \frac{1}{3} mn \bar{v} \lambda$

(C) $\eta = \frac{1}{3} mn^2 \bar{v} \lambda$

(D) $\eta = \frac{1}{3} mn \bar{v} \lambda^2$

where m is the molecular mass, $\bar{v}$ is the average speed and λ is the mean free path of a molecule.

30. Choose the incorrect statement :

(A) A real gas shows deviation from perfect gas behaviour at high pressures

(B) The temperature above which a gas cannot be liquefied by applying pressure is known as critical temperature

(C) Every gas undergoing Joule–Thomson expansion at a temperature below the inversion temperature shows cooling

(D) van der Waals' equation is inconsistent with the statement that all gases approach ideal gas behaviour at low pressures

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31. Fig.3 shows the p-V diagram of an ideal engine. Assuming all the processes to be quasi-static and heat capacity at constant pressure, C_p to be constant. Then the efficiency of such an ideal engine is given by :

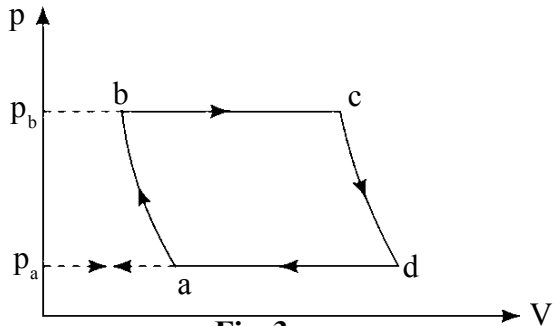


Fig. 3

(A) $\eta = 1 - \left(\frac{p_a}{p_b}\right)^{\frac{1}{\gamma}}$

(B) $\eta = 1 - \left(\frac{p_a}{p_b}\right)^{\frac{\gamma-1}{\gamma}}$

(C) $\eta = 1 - \left(\frac{p_a}{p_b}\right)^{\gamma}$

(D) $\eta = 1 - \left(\frac{p_a}{p_b}\right)^{\frac{1}{\gamma-1}}$

32. Which of the following equations correctly represents the change in the entropy of an ideal gas ?

(A) $\Delta S = C_V \, ln \left(\frac{T_2}{T_1}\right) + R \, ln \left(\frac{V_2}{V_1}\right)$

(B) $\Delta S = C_p \, ln \left(\frac{T_2}{T_1}\right) - R \, ln \left(\frac{p_2}{p_1}\right)$

(C) $\Delta S = C_p \, ln \left(\frac{V_2}{V_1}\right) + C_V \, ln \left(\frac{p_2}{p_1}\right)$

(D) All the above

33. Which of the following statements is CORRECT for a common emitter amplifier circuit ?

(A) There is 180^o phase shift between input and output voltages

(B) Both p-n junctions are forward biased

(C) There is 90^o phase shift between input and output voltages

(D) There is no phase shift between input and output voltages

34. For an ideal Fermi gas in three dimensions, the Fermi energy ε_f is proportional to n^{α}, where n is the number of electrons per unit volume , then α is equal to :

(A) 2/3

(B) 1/3

(C) 1/2

(D) 2

35. The order of magnitude of the energy gap of a typical semiconductor is :

(A) 1 MeV

(B) 10 eV

(C) 1 eV

(D) 10^{-3} eV

36. If the group velocity of waves in a certain medium is v_g, while its phase velocity is v, then which of the following is not correct :

(A) For a normal dispersive medium, $v > v_g$

(B) For a non-dispersive medium, $v = v_g$

(C) For an anomalously dispersive medium, $v < v_g$

(D) For a normal dispersive medium, $\frac{dv}{d\lambda} < 0$

where λ represents the wavelength.

37. Stern-Gerlach experiment verified the :

(A) Quantization of angular momentum

(B) Existence of electron spin

(C) That atoms can align themselves in a magnetic field only in a few directions

(D) All the above

38. An atom is placed in a magnetic field B. The change in the energy of the atom is :

(A) $\Delta E = -g(L + 2S) \cdot B$

(B) $\Delta E = -g(2L + S) \cdot B$

(C) 0

(D) $\Delta E = -g(L + S) \cdot B$

39. The average power of a harmonic wave, $y = A \sin(kx - \omega t)$, propagating with velocity, v, along a stretched string having mass per unit length, μ, is given by :

(A) $\mu\omega^2A^2v \sin^2(kx - \omega t)$

(B) $\mu\omega^2A^2v \cos^2(kx - \omega t)$

(C) $\frac{\mu}{2}\omega^2A^2v$

(D) Zero

40. Consider a standing wave, $y = 2A \cos(\omega t) \sin(kx)$ with 'n' antinodes, on a string of length L. If $k = \frac{n\pi}{L}$, then which of the following is not correct :

(A) The average energy of the wave is directly proportional to A^2

(B) The average energy of the wave is directly proportional to n^2

(C) The average energy of the wave is inversely proportional to L

(D) The average energy of the wave is inversely proportional to n^2

41. Which of the following statement is not correct ?

(A) The interference pattern in Young's two slit experiment is based on the principle of division of wave front

(B) The interference pattern in Michelson interferometer is based on the principle of division of amplitude

(C) A Michelson interferometer is basically a multi-wave interferometer

(D) Two-wave interference is characterized by a sinusoidal variation of light intensity with phase difference between the interfering waves

42. When a plane wave is incident normally on N parallel slits, the intensity distribution according to the Fraunhofer diffraction is given by :

(A) $I = I_0 \frac{\sin^2\beta}{\sin\gamma} \sin^2 N\gamma$

(B) $I = I_0 \frac{\sin^2\beta}{\beta^2} \frac{\sin^2 N\gamma}{\cos^2\gamma}$

(C) $I = I_0 \frac{\sin^2\beta}{\beta^2} \frac{\sin^2 N\gamma}{\sin^2\gamma}$

(D) $I = I_0 \frac{\sin^2\beta}{\beta^2} \cos^2\gamma$

where, $\beta = \frac{\pi b \sin\vartheta}{\lambda}$ and $\gamma = \frac{\pi d \sin\vartheta}{\lambda}$, and

λ is the wavelength ϑ, is the angle of diffraction 'b' represents the width of each slit and 'd' is the separation between two slits.

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43. Consider the following statements :

(1) In the process of diffraction from a circular aperture, if the source of light is at a finite distance from the diffracting aperture, then the wave fronts falling on the aperture are spherical wave fronts.

(2) Fresnel type of diffraction is defined such that distance between the source or the observation screen or both of them are at finite distances from the diffracting aperture.

(3) If the source of light or the observation screen or both of them are at infinite distances from the diffracting aperture, then diffraction falls under the category of Fresnel type of diffraction.

(4) If the source of light is at a finite distance from the diffracting aperture, then the wave fronts falling on the aperture or reaching the screen will be plane wave fronts.

Which of the above statement/s are true ?

(A) All the statements from (1) to (4) are true

(B) Only the statement (2) is true

(C) Only the statements (1) and (2) are true

(D) None of the above

44. X rays of wavelength 0.24 nm are Compton-scattered and the scattered beam is observed at an angle of 60^{o} relative to the incident beam. The energy of the scattered X-ray photons is :

(A) 5.14 keV

(B) 514 eV

(C) 5141 keV

(D) 5.1×10^{4} keV

45. Consider the following three experiments :

(a) The x component of the position of an electron is measured to within $\pm\Delta x$ and simultaneously the x component of its momentum is measured to within $\pm\Delta$ px

(b) The x component of the position of an electron is measured to within $\pm\Delta x$ and then later the x component of its momentum is measured to within $\pm\Delta px$

(c) The x component of the position of an electron is measured to within $\pm\Delta x$ and simultaneously the y component of its momentum is measured to within $\pm\Delta$ py.

In which of these cases does the Uncertainty Principle NOT impose a limitation on the outcome of the experiment ?

(A) (a) only

(B) (a) and (b) only

(C) (b) and (c) only

(D) (c) only

46. A beam of particles is incident from the negative x direction on a potential energy step at $x = 0$. When $x < 0$, the potential energy of the particles is zero and for $x > 0$ the potential energy has the constant positive value U_0. In the region $x < 0$, the particles have a kinetic energy K that is smaller than U_0. What is the form of the wave function in the region $x > 0$?

(A) $Ae^{kx} + Be^{-kx}$

(B) $Ae^{ikx} + Be^{-ikx}$

(C) Ae^{ikx}

(D) Ae^{-ikx}

47. The list of excited states to which the 4p state can make downward transitions are :

(A) $4p \rightarrow 3s$, $4p \rightarrow 4s$, $4p \rightarrow 2s$, $4p \rightarrow 1s$

(B) $4p \rightarrow 3s$, $4p \rightarrow 2s$, $4p \rightarrow 1s$, $4p \rightarrow 3d$

(C) $4p \rightarrow 3s$, $4p \rightarrow 4s$, $4p \rightarrow 2s$, $4p \rightarrow 4d$

(D) $4p \rightarrow 3s$, $4p \rightarrow 2s$, $4p \rightarrow 1s$, $4p \rightarrow 2d$

48. For a molecule, there are three different types of excited states : electronic, vibrational and rotational. Put these in increasing order according to the amount of energy generally required for each type of excitation :

(A) Vibrational, electronic, rotational

(B) Vibrational, rotational, electronic

(C) Electronic, vibrational, rotational

(D) Rotational, vibrational, electronic

49. The ratio of Fermi energy of a metal at temperature T, $\varepsilon_f(T)$, to its Fermi energy at absolute zero, $\varepsilon_f(0)$, is approximately equal to :

(A) 1

(B) $\frac{\pi^2}{12} kT$

(C) $\left[1-\frac{\pi^2}{12}\left(\frac{kT}{\varepsilon_f(0)}\right)\right]$

(D) $\left[1-\frac{\pi^2}{12}\left(\frac{kT}{\varepsilon_f(0)}\right)^2\right]$

50. A certain insulator has an energy gap of 6.0 eV. A visible light in the wavelength range 400 to 700 nm falls on this material. Now choose the correct statement :

(A) The material will strongly absorb the visible light

(B) The material will not absorb the visible light

(C) The material shines when the light falls on it

(D) The material will strongly absorb the infrared light

51. At the lowest temperatures, the molar heat capacity of metals can be explained primarily by the application of :

(A) The equipartition theorem

(B) Fermi-Dirac statistics of electrons

(C) Bose-Einstein statistics of vibrating atoms

(D) Maxwell-Boltzmann statistics

52. The temperature at which the lattice and electronic heat capacities of copper become equal to each other (Take Debye temperature, T_D = 343 K and Fermi energy = 7.03 eV) :

(A) 300 K

(B) 273 K

(C) 4.2 K

(D) 3.2 K

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53. Which of the following statement is not correct regarding the Nuclear Fusion ?

(A) Nuclei produced in the reaction are usually highly radioactive

(B) Energy release can be as large as several MeV per reacting nucleon

(C) It is usually necessary to overcome a Coulomb barrier for the reaction to occur

(D) Reacting nuclei come from commonly available chemical elements

54. In the decays and reactions of elementary particles, which of the following conservation laws is not followed strictly ?

(A) In any process, the lepton numbers for electron-type leptons, muon-type leptons and tau-type leptons must each remain constant

(B) In any process, the total baryon number must remain constant

(C) In processes governed by the strong or electromagnetic interactions, the total strangeness must remain constant

(D) In processes governed by the weak interaction, the strangeness must remain constant

55. In a p-n junction at room temperature, the ratio between the current with a forward bias of 2 V to the current with a forward bias of 1V is (approximately) :

(A) 1.7×10^{19}

(B) 1.7×10^{17}

(C) 2.1×10^{15}

(D) 2.1×10^{19}

56. Choose the incorrect statement :

(A) The small-signal hybrid-pi model applies to transistors operating in the forward-active mode in linear amplifier circuits

(B) The cut-off frequency of a transistor is the frequency at which the magnitude of the common-emitter current gain becomes equal to 100

(C) The frequency response of a transistor amplifier is a function of the emitter–base junction capacitance charging time

(D) When a transistor is biased in the forward-active mode of operation, the current at one terminal of the transistor (collector current) is controlled by the voltage applied across the other two terminals of the transistor (base–emitter voltage)

57. A typical transistor with $\beta = 100$, has a base-to-collector leakage current, I_{CBO}, of 5μA. If the transistor is connected for common-emitter operation then the collector current for $I_B = 40\ \mu A$:

(A) 4.5 mA

(B) 5.4 mA

(C) 1.5 mA

(D) 4.5 μA

58. The bandwidth of an amplifier is determined by :

(A) The mid range gain

(B) The critical frequencies

(C) The input capacitance

(D) The roll-off rate

59. A certain common emitter amplifier has a voltage gain of 100. If the emitter bypass capacitor is removed :

(A) The circuit will become unstable

(B) The voltage gain will decrease

(C) The voltage gain will increase

(D) The Q-point will shift.

60. A Voltage-divider bias :

(A) Cannot be independent of β_{dc}

(B) Is not widely used

(C) Requires fewer components than all the other methods

(D) Can be essentially independent of β_{dc}

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