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FOR KUET EXAM PREPARATION

KUET 2022 Question Paper · M.Sc. Physics

EXAM	YEAR	TYPE	SUBJECT
KUET	2022	Question Paper	M.Sc. Physics

Sr. No. 354

ENTRANCE TEST-2022

SCHOOL OF PHYSICAL & MATHEMATICAL SCIENCES

PHYSICS

Total Questions : 60
Time Allowed : 70 Minutes

Question Booklet Series B

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. A given amount of heat cannot be completely converted into work. However, it is possible to convert a given amount of work completely into heat. This statement results from :

(A) Zeroth law of thermodynamics

(B) First law of thermodynamics

(C) Second law of thermodynamics

(D) Third law of thermodynamics

2. For a thermodynamic system, work done in a given process depends upon :

(A) The path

(B) State of the system

(C) External pressure

(D) Nature of the system

3. In a refrigerator, the heat exhausted to the outer atmosphere is :

(A) Less than that absorbed from the contents of the refrigerator

(B) Same as that absorbed from the contents

(C) More than that absorbed from the contents

(D) Any of the above depending upon the working substance

4. The internal energy of a perfect monoatomic gas at 27°C is :

(A) Only kinetic

(B) Only potential

(C) Partly kinetic and potential

(D) Only vibrational

5. Which of the following relations is correct where γ is specific heat ratio, f is the number of degrees of freedom ?

(A) $\gamma = 1 + f$

(B) $\gamma = 1 - f$

(C) $\gamma = 1 + \frac{f}{2}$

(D) $\gamma = 1 + \frac{2}{f}$

6. The thermodynamical potential, enthalpy is $H = U + pV$, where U is the internal energy, p the pressure and V is the volume. Then :

(A) $T = -\left(\frac{\partial H}{\partial S}\right)_V$ and $V = \left(\frac{\partial H}{\partial p}\right)_S$

(B) $T = \left(\frac{\partial H}{\partial S}\right)_V$ and $V = \left(\frac{\partial H}{\partial p}\right)_S$

(C) $T = -\left(\frac{\partial H}{\partial p}\right)_S$ and $V = \left(\frac{\partial H}{\partial S}\right)_V$

(D) $T = \left(\frac{\partial H}{\partial p}\right)_S$ and $V = \left(\frac{\partial H}{\partial S}\right)_V$

7. A fluid at high pressure is throttled through a narrow porous opening in a region of lower pressure without any transfer of heat. In such a process :

(A) The entropy does not change

(B) The Gibbs free energy remains constant

(C) The entropy is decreased

(D) The enthalpy of the fluid is constant

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8. Under equilibrium conditions, the thermodynamic variable associated with the black body radiation at temperature T which reduces to zero is :
   (A) Entropy
   (B) Helmholtz free energy
   (C) Gibbs free energy
   (D) Pressure

9. The spectrum of radiation emitted by a black body at a temperature 1000K peaks in the region :
   (A) Visible range of frequencies
   (B) Infrared range of frequencies
   (C) Ultraviolet range of frequencies
   (D) Microwave range of frequencies

10. The average value of velocity v in Maxwellian distribution of speeds is :
   (A) Zero
   (B) $\frac{1}{2}$
   (C) $\frac{kT}{m}$
   (D) $\sqrt{\frac{kT}{m}}$

11. The mean translational kinetic energy per molecule of an ideal gas is :
   (A) kT
   (B) $\frac{1}{2}kT$
   (C) $\frac{3}{2}kT$
   (D) $\frac{2}{3}kT$

12. According to the Fermi-Dirac statistics the number of particles in a phase cell can be :
   (A) Any number
   (B) Only two
   (C) Only three
   (D) Only one

13. Two tuning forks A and B of nearly equal frequencies are employed in an optical experiment to produce Lissajous figures. On slightly loading fork A, it is observed that the cycle of change of figure slows down from 10 to 20 seconds. If the frequency of fork B is 256 Hz, the frequency of fork A after loading is :
   (A) 256.05 Hz
   (B) 200.05 Hz
   (C) 156.05 Hz
   (D) 100.05 Hz

14. A plane wave traverses a medium, the displacement of particles is given by $\psi(x, t) = 0.01 \sin(4\pi t - 0.02\pi x)$, ($\psi$ and x are measured in meters and seconds), then the amplitude and wavelength of the wave are respectively :
   (A) 0.01 m and 100 m
   (B) 0.01 s and 100 m
   (C) 0.01 m and 100 s
   (D) 1 m and 100 m

15. An object of mass 2 kg hangs from a spring of negligible mass. The spring is extended by 2.5 cm when the object is attached. The top end of the spring is oscillating up and down in SHM with an amplitude of 2 mm. If $g = 10 ms^{-2}$, then the angular frequency of the oscillations is :
   (A) 200 rad s^{-1}
   (B) 20 rad s^{-1}
   (C) 10 rad s^{-1}
   (D) 100 rad s^{-1}

16. The fringe width in terms of wavelength (λ), distance between the slits and screen (D) and distance of separation of slits (d) is :

(A) $\frac{\lambda d}{D}$

(B) $\frac{\lambda^2 D}{d}$

(C) $\frac{\lambda D^2}{d}$

(D) $\frac{\lambda D}{d}$

17. In a double slit interference experiment, one of the slits is covered by thin mica sheet whose refractive index is 1.58. The distance d = 0.1 cm and D = 50 cm. Due to introduction of mica, the central fringe gets shifted by 0.2 cm. The thickness of mica sheet is :

(A) 6.7×10^{-4} cm

(B) 2.2×10^{-4} cm

(C) 1.1×10^{-4} cm

(D) 0.1×10^{-4} cm

18. Monochromatic light of wavelength 600 nm is used in a Young's double slit experiment. One of the slits is covered by a transparent sheet of thickness 1.8×10^{-5} m made up of material of refractive index 1.6. The number of fringes that shift due to introduction of sheet is :

(A) 6

(B) 12

(C) 18

(D) 20

19. Consider two waves passing through the same string. Principle of superposition for displacement says that the net displacement of a particle on the string is the sum of the displacements produced by the two waves individually. Suppose we state the similar principle for the net velocity and the net kinetic energy of the particle. Such a principle will be valid for :

(A) Both the velocity and the kinetic energy

(B) The velocity but not for the kinetic energy

(C) The kinetic energy but not the velocity

(D) Neither the velocity nor the kinetic energy

20. The positions of the principal maxima are given by grating equation :

(A) $d^2\sin\theta = m\lambda$, m = 0,1,2,....

(B) $\lambda \sin\theta = md$, m = 0,1,2,....

(C) $d\sin^2\theta = m^2\lambda$, m = 0,1,2,....

(D) $d\sin\theta = m\lambda$, m = 0,1,2,....

21. The de-Brogile wavelength of a particle with charge q and mass m is accelerated through a potential difference V is :

(A) $\lambda = \frac{h}{\sqrt{mqV}}$

(B) $\lambda = \frac{hm}{\sqrt{qV}}$

(C) $\lambda = \frac{h}{\sqrt{2mqV}}$

(D) $\lambda = 0$

22. An electron and a proton each having energy 5 eV are incident on a barrier of 10 eV high and 1 angstrom wide. The correct statement is :
(A) The electron will have greater transmission probability
(B) The proton will have greater transmission probability
(C) Both electron and proton have the same transmission probability
(D) None of them penetrate the potential

23. Which one of the following is correct in respect of an electron and a proton having the same de-Broglie wavelength of 2 angstrom ?
(A) Both have same kinetic energy
(B) The kinetic energy of the proton is more than that of the electron
(C) Both have the same velocity
(D) Both have the same momentum

24. The energy of n^{th} level of the hydrogen atom is proportional to :
(A) n
(B) n^2
(C) $\frac{1}{n^2}$
(D) $\frac{1}{n}$

25. A sample of a certain element is placed in a 0.300-T magnetic field and suitably excited. How far apart are the Zeeman components of the 450-nm spectral line of this element ?
(A) 0.00283 nm
(B) 0.0283 nm
(C) 0.283 nm
(D) No Zeeman effect takes place

26. The magnitude the angular momentum due to electron spin for spin $-\frac{1}{2}$ is :
(A) $\frac{\sqrt{3}}{2}\hbar$
(B) $\frac{\sqrt{3}}{2}\hbar^2$
(C) $\frac{\sqrt{3}}{4}\hbar^2$
(D) $\frac{\sqrt{3}}{4}\hbar$

27. The maximum number of electrons a shell can hold is (n is a principal quantum number) :
(A) $4n^2$
(B) $2n^2$
(C) $(2n+1)^2$
(D) $2n+1$

28. The number N of undecayed nuclei at the time t in terms of the decay probability per unit time λ of the nuclide involved and the number N_0 of undecayed nuclei at $t = 0$ is :
(A) $N = N_0 e^{-\lambda t}$
(B) $N = N_0 e^{\lambda t}$
(C) $N = N_0 e^{-\lambda t^2}$
(D) $N = N_0 e^{\lambda t^2}$

29. The coordination number in case of simple cubic structure is :
(A) 12
(B) 6
(C) 2
(D) 1

30. Electronic contribution to specific heat of metals at low temperature is proportional to :
(A) $T^{\frac{3}{2}}$
(B) T^2
(C) $T^{\frac{1}{2}}$
(D) T^3

31. The valence electrons do not directly determine the following property of the metal :
(A) Electrical conductivity
(B) Thermal conductivity
(C) Shear modulus
(D) Metallic lustre

32. Electrical conductivity of a metal in terms of mass (m), charge (e), concentration (n) and relaxation time (τ) of electron is :
(A) $mne\tau$
(B) $\frac{mne}{\tau}$
(C) $\frac{ne^2\tau}{m}$
(D) $\frac{ne^2\tau^2}{m}$

33. The impurity atoms with which pure silicon should be doped to make a p-type semiconductor are :
(A) Phosphorus and boron
(B) Boron and aluminium
(C) Boron and antimony
(D) Antimony and aluminium

34. The Fermi level of an intrinsic semiconductor is pinned at the center of the band gap. The probability of occupation of the highest electron state in valence band at room temperature will be :
(A) Zero
(B) $\frac{1}{4}$
(C) $\frac{1}{2}$
(D) Infinity

35. The avalanche breakdown in a pn-junction is due to :
(A) Shift of Fermi level
(B) Cumulative effect of conduction band electron collisions
(C) Widening of forbidden gap
(D) None of the above

36. The depletion layer in a pn-junction diode consists of layers of :
(A) Positively charged donors on the p-side and negatively charged acceptors on the n-side
(B) Negatively charged donors on the p-side and positively charged acceptors on the n-side
(C) Positively charged donors on the n-side and negatively charged acceptors on the p-side
(D) Negatively charged donors on the p-side and positively charged acceptors on the n-side

37. If a transistor amplifier has a gain of 20dB, then the ratio of output to input power is :
    (A) 100
    (B) 10
    (C) 20
    (D) 200

38. The DC load line of an amplifier circuit :
    (A) Has a positive slope
    (B) Has a curvature
    (C) Does not contain the Q-point
    (D) Has a negative slope

39. An increase in diode voltage leads to :
    (A) Increase in diode resistance
    (B) Decrease in diode resistance
    (C) No change in diode resistance
    (D) Increase or decrease depending on the nature of diode

40. A junction field effect transistor behaves as :
    (A) Voltage controlled current source
    (B) Voltage controlled voltage source
    (C) Current controlled voltage source
    (D) Current controlled current source

41. A body of charge q starts from rest and acquires a velocity v = 0.5c. The new charge of the body is :
    (A) $\frac{q}{\sqrt{1-(0.5)^2}}$
    (B) $q\sqrt{1-(0.5)^2}$
    (C) $q\sqrt{1-(0.5)^3}$
    (D) q

42. The principle of relativity states :
    (A) The Laws of Physics are same for any two non-inertial observers
    (B) The Laws of Physics are not same for inertial observers
    (C) The Laws of Physics are same for all inertial observers in uniform motion relative to each other
    (D) No relativity exists

43. A particle of mass m released from a height h falls under gravity. Assuming that the resistance offered by air is mkv^2, where k is a constant, v the velocity of particle. The terminal speed of the particle is :
    (A) $\frac{g}{k}$
    (B) $\sqrt{\frac{g}{k}}$
    (C) $\sqrt{gk}$
    (D) $\sqrt{\frac{k}{g}}$

44. The kinetic energy of a particle continuously increases with time, then :
    (A) The resultant force on the particle must be parallel to the velocity at all times
    (B) The angle between force and velocity is acute all the time
    (C) Its height above the ground continuously increases
    (D) The angle between force and velocity is 90° always

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45. A sphere of radius r and mass m rolls without slipping on a surface with speed v. The ratio of translational kinetic energy and rotational kinetic energy is :

(A) $\frac{1}{5}$

(B) $\frac{2}{5}$

(C) $\frac{1}{2}$

(D) $\frac{5}{8}$

46. In the case of geostationary satellite, the :

(A) Rotation of the earth and revolution of the satellite will be in the same direction

(B) Rotation of the earth and revolution of the satellite will be in the opposite direction

(C) Angular velocity of the earth's rotation and angular velocity of revolution of the satellite will be equal and in the same direction

(D) Angular velocity of the earth's rotation and angular velocity of revolution of the satellite will be different and in the opposite direction

47. When a satellite moves around the earth, the quantity which remains constant :

(A) Angular velocity

(B) Kinetic energy

(C) Potential energy

(D) Areal velocity

48. Two particles initially at rest, move towards e other under a mutual force of attraction. If at instant, the speed of one particle is v and speed the other particle is 2v, then the speed of the ce of mass of the system is :

(A) Zero

(B) v

(C) 1.5v

(D) 3v

49. The electric field intensity on the surface charged conductor is :

(A) Zero

(B) Directed normally to the surface

(C) Directed tangentially to the surface

(D) Directed at 45° to the surface

50. For a particle executing simple harmonic mo then :

(A) Time average of the total energy is p kinetic energy

(B) Time average of the total energy is p potential energy

(C) Time average of potential energy is sa time average of kinetic energy

(D) Time average of potential energy is not as time average of kinetic energy

51. A sphere of radius R has a charge density ρ which varies with distance as $\rho = \alpha\sqrt{r}$, α is a constant. The electric field at a distance $r < R$ varies with r as :

(A) $E \propto \frac{1}{\sqrt{r}}$

(B) $E \propto \sqrt{r}$

(C) $E \propto r^{\frac{3}{2}}$

(D) $E \propto r^2$

52. A charge q sits at one of the corners of a cube of side a. The flux through one side of this cube is :

(A) Zero

(B) $\frac{q}{24\epsilon_0}$,

(C) $\frac{q}{16\epsilon_0}$

(D) $\frac{q}{2\epsilon_0}$

53. Two large metal plates each of area A are held a small distance d apart. The electric field is :

(A) Zero everywhere

(B) $E = 0$ between the plates and $E = \frac{\sigma}{\epsilon_0}$ outside the plates

(C) $E = 0$ outside the plates and $E = \frac{\sigma}{\epsilon_0}$ between the plates

(D) $E = \frac{\sigma}{\epsilon_0}$ everywhere

54. If magnetic field $\vec{B} = \nabla \times \vec{A}$, $\vec{A}$ being the vector potential, then for constant magnetic field we have :

(A) $\vec{A} = \frac{1}{2}(\vec{B} \times \vec{\Delta})$

(B) $\vec{A} = \frac{1}{2}(\vec{B} \times \vec{r})$

(C) $\vec{A} = (\vec{B} \times \vec{r}) \times \vec{r}$

(D) 0

55. A hollow sphere of radius R has a charge +q on its surface. If the charge on the sphere is doubled and its radius is halved, the energy associated with the electric field :

(A) Increases eight times

(B) Increases four times

(C) Remains same

(D) Decreases four times

56. Electric field inside a conductor carrying surface charge density σ is :

(A) Zero

(B) $\frac{\sigma}{\epsilon_0}$

(C) $\frac{\sigma}{2\epsilon_0}$

(D) $\sqrt{\frac{\sigma}{\epsilon_0}}$

57. In an electromagnetic wave, the direction of the magnetic field is :

(A) Parallel to the electric field

(B) Perpendicular to the electric field

(C) Completely random

(D) Antiparallel to the Poynting vector

58. A free electron is placed in the path of a plane electromagnetic wave. The electron will start moving :

(A) Along the electric field

(B) Along the direction of magnetic field

(C) Along the direction of propagation of wave

(D) Cannot move at all

59. The vector potential in a region is given as $\vec{A} = -y\hat{i} + 2x\hat{j}$. The associated magnetic field $\vec{B}$ is :

(A) $\hat{i} + \hat{k}$

(B) $3\hat{k}$

(C) $-\hat{i} + 2\hat{j}$

(D) $-\hat{i} + \hat{j} + \hat{k}$

60. If charge on a parallel plate capacitor is $q = q_0 \sin \omega t$, then the displacement current is :

(A) $\omega q_0 \cos \omega t$

(B) $\frac{q_0}{\omega} \cos \omega t$

(C) $-\frac{q_0}{\omega} \cos \omega t$

(D) $-\omega q_0 \cos \omega t$