Paper Code No: M25

Question Booklet No. 100035

ENTRANCE EXAMINATION – 2021 – 22

SET – C

Roll No. M 2 5 1 0 0 3 5

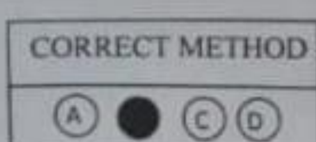
Signature of Invigilator

Time: 1 Hour 30 Minutes

Total Marks: 100

Instructions to Candidates

1. Do not write your name or put any other mark of identification anywhere in the OMR Response Sheet. IF ANY MARK OF IDENTIFICATIONS IS DISCOVERED ANYWHERE IN OMR RESPONSE SHEET, the OMR sheet will be cancelled, and will not be evaluated.
2. **This Question Booklet contains the cover page and a total of 100 Multiple Choice Questions of 1 mark each.**
3. Space for rough work has been provided at the beginning and end. Available space on each page may also be used for rough work.
4. There is negative marking in Multiple Choice Questions. For each wrong answer, 0.25 marks will be deducted.
5. USE/POSSESSION OF ELECTRONIC GADGETS LIKE MOBILE PHONE, iPhone, iPad, pager ETC. is strictly PROHIBITED.
6. Candidate should check the serial order of questions at the beginning of the test. If any question i found missing in the serial order, it should be immediately brought to the notice of the Invigilator. No pages should be torn out from this question booklet.
7. Answers must be marked in the OMR Response sheet which is provided separately. OMR Response sheet must be handed over to the invigilator before you leave the seat.
8. The OMR Response sheet should not be folded or wrinkled. The folded or wrinkled OMR/Response Sheet will not be evaluated.
9. Write your Roll Number in the appropriate space (above) and on the OMR Response Sheet. Any other details, if asked for, should be written only in the space provided.
10. There are four options to each question marked A, B, C and D. Select one of the most appropriate options and fill up the corresponding oval/circle in the OMR Response Sheet provided to you. The correct procedure for filling up the OMR Response Sheet is mentioned below.



1) The black body spectrum of an object A is such that its radiation is maximum at a wavelength of 160 nm. Another object B has the maximum radiation intensity at 640 *nm*. The ratio of power emitted per unit area by A to that of B is

(A) 1/256 (B) 1/16

(C) 16 (D) 256

2) In photoelectric experiment both sodium (work function = 2 .3 eV) and tungsten (work function = 4.5 eV) metals were illuminated by an ultraviolet light of same wavelength. If the stopping potential for tungsten is measured to be 1.8V, the value of the stopping potential for sodium will be

(A) 4 V (B) 4.2 V

(C) 4.3 V (D) 5 V

3) The de Broglie wavelength of a relativistic electron having 1 MeV of energy (Given mass of electron 0.511MeV and $hc = 1.24 \times 10^{-12}$ MeV -m) is

(A) 1.34×10^{-12} m (B) 1.43×10^{-12} m

(C) 1.54×10^{-12} m (D) 1.3×10^{-12} m

4) A photon of energy 1.02 MeV is scattered through 90° by a free electron. Considering the mass of the electron to be 0.511 MeV, the energy of the photon after interaction will be

(A) 0.5 MeV (B) 0.44 MeV

(C) 0.4 MeV (D) 0.34 MeV

5) Consider a 75 W light bulb. If the wavelengths of the radiation it emits is 500 nm estimate the number of photons emitted per second

(A) 303×10^{36} (B) $251 \text{X} 10^{36}$

(C) $207 \text{X} 10^{36}$ (D) 289×10^{36}

6). Calculate the longest wavelength of the Balmer series of the Hydrogen atom. (R_H =

1.097×10^{-3} Å^{-1},)

(A) ~3647 Å (B) ~9120 Å

(C) ~6565 Å (D) ~8207 Å

7) Which of the following hypotheses is supported by the observations in the Stem-Gerlach Experiment?

(A) Wave-particle duality of matter

(B) Quantization of angular momentum orientation

(C) The Correspondence principle

(D) Existence of electron spin

8) Which of the following atomic state transitions in Hydrogen is NOT allowed by the selection rules for radiative transitions?

(A) $2s \rightarrow 1s$ (B) $2p \rightarrow 1s$

(C) $3s \rightarrow 1s$ (D) $3d \rightarrow 1s$

9). A beam of electrons enters a uniform magnetic field of 1.2 T. What is the energy difference between the electrons parallel and anti-parallel to the field? ($\hbar = 6.626 \times 10^{-34}$ J.sec, $e = 1.602 \times 10^{-19}$ C)

(A) 1.4×10^{-3} eV (B) 2.8×10^{-3} eV

(C) 0.7×10^{-3} eV (D) 7×10^{-3} eV

10) For a diatomic molecule with reduced mass μ, and equilibrium internuclear distance r, with total angular momentum J, the rotational energy E_{rot} is given by:

(A) $E_{rot} = (\hbar^2/\mu r^2)(J^2 + 1)$ (B) $E_{rot} = (\hbar/2\mu r^2)(J^2 + 1)$

(C) $E_{rot} = (2\hbar/\mu r^2)(J(J + 1))$ (D) $E_{rot} = (\hbar^2/2\mu r^2)(J(J + 1))$

11) Which one of the following statements regarding the binding energy of the nuclei is correct?

(A) The mass of the nucleus must be less than the sum of the masses of the constituent neutrons and protons.

(B) The mass of the nucleus must be equal to the sum of the masses of the constituent neutrons and protons

(C) The mass of the nucleus must be greater than the sum of the masses of the constituent neutrons and protons.

(D) The mass of the nucleus must be equal to only the masses of the constituent neutrons

12) Which element has the highest binding energy per nucleon?

(A) 60Fe (B) 56Fe

(C) 56As (D) 56Si

13) Why GM counter cannot be used for energy measurement of the incident radiation?

(A) Because it is a gas detector

(B) Because a quenching gas is filled inside

(C) Incident radiation ionizes the whole filled gas

(D) Incident radiation ionizes part of the filled gas

14) A radioactive element disintegrates for an interval of time equal to its mean life. What fraction of element remains?

(A) 1/e (B) 1-1/e

(C) 1 + 1 /e (D) None of the above

15) The $^{238}U_{92}$ decays into a stable isotope of some element through successive emission of 8 alpha particles and 6 beta particles. Identify the stable element,

(A) $^{208}Pb_{82}$
(B) $^{206}Pb_{82}$
(C) $^{200}Pb_{82}$
(D) $^{205}Pb_{82}$

16) The canonical partition function is a function of the following thermodynamic variables

(A) T, P, N
(B) T, V, N
(C) S, V, N
(D) S, P, V

17) Which of the following thermodynamic potentials is a function of the entropy S, volume V and the number of particles N?

(A) Gibbs Free energy
(B) Enthalpy
(C) Helmholtz Free energy
(D) Internal Energy

18) Consider a system of N non-interacting distinguishable particles. Each particle has only two accessible energy states, 0 and ε. If the total energy of the system is E, then the total number of microstates available to the system is

(A) $\frac{N!}{(E/\varepsilon)!(N-E/\varepsilon)!}$

(B) $\frac{1}{(E/\varepsilon)!(N-E/\varepsilon)!}$

(C) $\frac{N!}{(N-E/\varepsilon)!}$

(D) $\frac{E!}{(E/\varepsilon)!(N-E/\varepsilon)!}$

19) The canonical partition function of a relativistic classical ideal gas (E = pc), is given by

(A) $\left[\frac{8\pi V}{(\beta hc)^3}\right]$

(B) $\left[\frac{8\pi V\,KT}{(hc)^3}\right]$

(C) $\left[\frac{8\pi V}{(\beta hc)^3}\right]^N$

(D) $\left[\frac{8\pi VKT}{(\beta hc)^3}\right]^N$

20) The average energy of a one-dimensional classical linear harmonic oscillator with frequency co is given by

(A) $\frac{1}{2}KT$

(B) kT

(C) NkT

(D) $\frac{3}{2}NkT$

21) Consider the operator $a = x + \frac{d}{dx}$. The commutator $[a, \cos x]$ is

(A) $-\sin x$

(B) $\cos x$

(C) $-\cos x$

(D) 0

22) A particle of mass m is in a potential $V = \frac{1}{2}m\omega^2 x^2$, where ω is a constant.

If $\hat{a} = \sqrt{\frac{m\omega}{2\hbar}}\left(\hat{x} + \frac{i\hat{p}}{m\omega}\right)$, then $\frac{d\hat{a}}{dt}$ is given by

(A) $\omega\hat{a}$

(B) $-i\omega\hat{a}$

(C) $\omega\hat{a}^\dagger$

(D) $i\omega\hat{a}^\dagger$

23) The Eigen states corresponding to Eigen values E_1 and E_2 of a time dependent Hamiltonian are $|1>$ and $|2>$ respectively. If at $t = 0$, the system is in a state $|\Psi(t=0)> = \sin\theta|1> + \cos\theta|2>$, then the value of $<\Psi(t)|\Psi(t)>$ at time t will be

(A) 1

(B) $\frac{(E_1 \sin^2\theta + E_2\cos^2\theta)}{\sqrt{E_1^2 + E_2^2}}$

(C) $e^{iE_1 t/\hbar}\sin\theta + e^{iE_2 t/\hbar}\cos\theta$

(D) $e^{iE_1 t/\hbar}\sin^2\theta + e^{iE_2 t/\hbar}\cos^2\theta$

24) Suppose the Coulomb potential of the hydrogen atom is changed by adding a term such that the total potential is $V(\vec{r}) = -\frac{Ze^2}{r} + \frac{g}{r^2}$, where g is a constant. The energy Eigen values E in the modified potential

(A) depend on n and l, but not on m

(B) depend on n but not on l and m

(C) depend on n and m but not on l

(D) depend on all three quantum numbers n, l, m.

25) Let x and p denote the position and momentum operator of a particle of mass m. The commutator $\left[\frac{p}{2m} + bx, \frac{p}{m} + cx\right]$ is zero, where b and c are constants, if

(A) $c = b$

(B) $c = 2b$

(C) $c = \sqrt{2}b$

(D) $2c = b$

26) If the expectation value of the momentum is $< p >$ for the wave function $\Psi(x)$, then the expectation value of momentum for the wave function $e^{-ikx/\hbar}\,\Psi(x)$, is

(A) k

(B) $<p> - k$

(C) $<p> + k$

(D) $<p>$

27) The wave function of a free particle in one dimension is given by $\Psi(x) = A \cos x + B \cos 3x$. Then $\Psi(x)$ is an Eigen state of

(A) the position operator

(B) the momentum operator

(C) the Hamiltonian operator

(D) the parity operator

28) A particle of mass m is confined in a three-dimensional cubic box of side a. The potential inside the box is zero and is $\propto$ otherwise. The number of Eigen states with energy $E = \frac{9\pi^2 h^2}{2ma^2}$ is

(A) 1

(B) 6

(C) 3

(D) 4

29) Consider the state $\phi = \frac{1}{4}\left[2\,\psi 1,1 + \sqrt{10}\,\psi 1,0 + \sqrt{2}\,\psi 1,-1\right]$ where ψ_{lm} is a simultaneous normalized eigenfunction of angular momentum operator L^2 and L_z. The expectation value of L_z in the state $\emptyset$ in units of $\hbar$, is

(A) 1/8 (B) 1/4

(C) 1/2 (D) 3/4

30) The hermitian conjugate of the operator $(i\frac{d}{dx})$ is

(A) $i\frac{d}{dx}$ (B) $-i\frac{d}{dx}$

(C) $-\frac{d}{dx}$ (D) $\frac{d}{dx}$

31) Four fair coins are flipped. If the outcomes are assumed independent, what is the probability that two heads and two tails are obtained

(A) 1/2 (B) 1/4

(C) 3/8 (D) 5/8

32) The volume of the solid that lies below the surface given by $z = 16xy + 200$ and lies above the region in the xy-plane bounded by $y = x^2$ and $y = 8 - x^2$ is

(A) 2267 (B) 3267

(C) 4267 (D) 5267

33) The residue of a complex function $f(z) = \frac{1}{Z(Z^2+1)(Z-2)^2}$ at $z = 2$ is:

(A) $\frac{13}{100}$

(B) $\frac{11}{100}$

(C) $-\frac{11}{100}$

(D) $-\frac{13}{100}$

34) Ifa matrix $A = \begin{pmatrix} 9 & 0 \\ 5 & -9 \end{pmatrix}$ and $I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$, than the value of A^{60} is

(A) $3^{120} I$

(B) $3^{60} I$

(C) $2^{60} I$

(D) $2^{120} I$

35) A basis for the vector subspace S, which is the intersection of U and V, where U=

$span\left\{\begin{pmatrix} 1 \\ -2 \\ 0 \\ 3 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \\ -1 \end{pmatrix}\right\}$ and $V = span\left\{\begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 0 \\ 1 \\ 0 \end{pmatrix}\right\}$ is

(A) $\begin{pmatrix} 1 \\ 1 \\ 0 \\ 0 \end{pmatrix}$

(B) $\begin{pmatrix} 0 \\ 1 \\ 0 \\ 1 \end{pmatrix}$

(C) $\begin{pmatrix} 0 \\ 0 \\ 1 \\ 1 \end{pmatrix}$

(D) $\begin{pmatrix} 0 \\ 1 \\ 1 \\ 0 \end{pmatrix}$

36) What is the ratio of the Fourier coefficients of the first and the third harmonic of the Fourier series expansion of the periodic function

$$F(x) = \begin{cases} -1, & for -\pi < x < 0 \\ 1 & for\ 0 < x < \pi \end{cases}$$

(A) 3 (B) 5

(C) 7 (D) 9

37) $\frac{d^2y}{dt^2} + \alpha\frac{dy}{dt} + \beta y = 0$ describes damped oscillations of a system with α and β are being constants. If α is kept fixed and β is decreased, then,

(A) the oscillations decay faster.

(B) the oscillations decay slower.

(C) the frequency of oscillations decreases.

(D) the frequency of oscillations increases.

38) For positive integer values of β the series $\sum_m^\infty = 0\ \frac{\beta!}{(\beta-m)!(\beta+m)!}\ x^{2m}$ terminates and becomes a polynomial when

(A) $m = -\beta$ (B) $m = \beta$

(C) $m = 0$ (D) $\beta = 0$

39) A vector is

(A) a tensor of rank 0
(B) a tensor of rank 1.
(C) a tensor of rank 2.
(D) not a tensor.

40) The Dirac delta function $\delta(|a|x)$, where α is a constant, equals to

(A) $\frac{1}{|a|}\delta(x)$
(B) $|a|\,\delta(x)$
(C) $\frac{1}{\sqrt{|a|}}\delta(x)$
(D) $\sqrt{|a|}\,\delta(x)$

41) In interference, the amplitude of two waves emanating from the slits cancel in the dark region. Therefore, there is zero intensity in these regions and no photon arrives at these regions. Which of the statements is true?

(A) Since no photon arrives at the dark regions. Energy conservation principle is violated
(B) The energy in the dark regions is converted into heat. Energy conservation principle is not violated.
(C) The total energy leaving the slits is distributed among dark and bright areas and energy is conserved.
(D) None of the above

42) Two immiscible liquids float on top of the surface of water and form thin films on the water surface. One of the liquids looks bright and the other look dark in reflected light. Which one of the following statements is correct?

(A) The dark film has higher refractive index than that of water.

(B) The dark film has lower refractive than that of water.

(C) Both the immiscible liquids have higher refractive index than that of water.

(D) Both the immiscible liquids have lower refractive index than that of water.

43) A glass (μ=1.5) wedge of angle 0.01 radian is illuminated by monochromatic light of wavelength 6000 Å falling normally on it. The distance from the edge of the wedge at which the 10^{th} bright fringes observed in the reflected light is-

(A) 0.02 cm

(B) 0.03 cm

(C) 0.05 cm

(D) 0.04 cm

44) Find the angular width of the central bright maximum in the Fraunhofer diffraction of a slit of width 12×10^{-5} cm when the slit is illuminated by monochromatic light of wavelength 6000 Å

(A) Angular width of the central maximum is 60°

(B) Angular width of the central maximum is 30°

(C) Angular width of the central maximum is 90°

(D) Angular width of the central maximum is 45°

45) Unpolarized light is incident on a polarizer, followed by a half wave plate, quarter wave plate. If the axes of all these optical components are parallel to each other, the output light is

(A) Linearly polarized
(B) Elliptically polarized
(C) Circularly polarized
(D) Unpolarized

46) The ratio of force constants of two springs is 1:5. The equal mass suspended at the free ends of both springs is performing S.H.M. If the maximum acceleration for both springs is equal, the ratio of amplitude for both springs is

(A) $\frac{1}{\sqrt{5}}$
(B) $\frac{1}{5}$
(C) 5
(D) $\sqrt{5}$

47) Which of the following equation given below represents a S.H.M.? [Here k, k_o and k_1 are force constants and unit of "x" and "a" is meter]

(A) Acceleration = $-k\,(x + a)$

(B) Acceleration = $k\,(x + a)$

(C) Acceleration = kx

(D) Acceleration = $-k_0\,(x) + k_1(x^2)$

48) The work done by the string of a simple pendulum during one complete oscillation is equal to

(A) Total energy of the pendulum

(B) Kinetic energy of the pendulum

(C) Potential energy of the pendulum

(D) Zero

49) If ω is the natural frequency of the system and ω_d is the frequency of the external force that acts on a forced oscillating system, then at resonance

(A) $\omega_d \geq \omega$

(B) $\omega_d = \omega$

(C) $\omega_d \leq \omega$

(D) $\omega_d \neq \omega$

50) From the following, the example of a longitudinal wave is

(A) Radio wave
(B) Sound wave
(C) Water waves
(D) none of the above

51) The continuity equation for the flow of a fluid is the result of application of the following law to the flow field:

(A) First law of thermodynamics
(B) Conservation of energy
(C) Newton's second law of motion
(D) Conservation of mass

52) For flow of fluid in a pipe the critical Reynolds number is about

(A) 640
(B) 5×10^5
(C) 2000
(D) 64000

53) For a given material, the rigidity modulus is (1/3) of Young's modulus. Its Poisson's ratio is

(A) 0 (B) 0.25

(C) 0.3 (D) 0.5

54) At the critical temperature, the surface tension of the liquid

(A) is zero

(B) is infinity

(C) is the same as that at the other temperature

(D) Cannot be determined

55) In an experiment to determine the Young's modulus of the material of a wire, the length of the wire and the suspended mass are doubled. Then the Young's modulus of the wire

(A) becomes double (B) becomes four time

(C) remain unchanged (D) becomes half

56) A sphere of mass M_1 moving with some speed u along a line collides elastically with another sphere of mass M_2 at rest. After collision the two spheres move in opposite directions with the same speed v. The ratio of the masses M_1/M_2 is

(A) 1/2 (B) 2/3

(C) 1/3 (D) 2/5

57) The horizontal range of a projectile fired at an angle of 15° is 50m. If it is fired with the same speed at an angle of 45°, its range will be,

(A) 60 m (B) 71 m

(C) 141 m (D) 100 m

58) The displacement of a particle executing simple harmonic motion is given by

$x = a \cos \omega t + b \sin \omega t$. The amplitude of the SHM is given by

(A) $\sqrt{a^2 + b^2}$ (B) a

(C) b (D) $a^2 + b^2$

59) As the speed of a particle increases, its rest mass

(A) increases (B) remains the same

(C) decreases (D) can't be determined

60) A spaceship is moving away from the earth with a velocity $c/2$. It fires a rocket whose velocity relative to the spaceship is $c/2$ away from the earth. What the velocity of the rocket is as observed from the earth?

(A) $c/\sqrt{2}$ (B) 4c/5

(C) 3c/4 (D) 0

61) Which of the following symmetry properties leads to the conservation of linear momentum?

(A) Isotropy of time (B) Homogeneity of time

(C) Isotropy of space (D) Homogeneity of space

62) A particle is moving on an elliptical path under inverse square law central force. Choose the correct statements-

(i) The eccentricity of the orbit is a function of total energy

(ii) The eccentricity of the orbit is a function of angular momentum

(iii) The eccentricity of the orbit is independent of total energy

(iv) The eccentricity of the orbit is independent of angular momentum

(A) (i) and (ii) (B) (i) and (iv)

(C) (ii) and (iii) (D) (iii) and (iv)

63) Two particles are connected by a rod of length $l = f(t)$. What is the nature of the constraint?

(A) holonomic, scleronomic
(B) non-holonomic, rheonomic
(C) holonomic, rheonomic
(D) non-holonomic, scleronomic

64) Which of the following represents the Lagrange's equations of motion?

(A) $\frac{\partial L}{\partial qk} = \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}k}\right)$
(B) $\frac{\partial L}{\partial qk} + \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}k}\right) = 0$
(C) $\frac{\partial L}{\partial \dot{q}k} = \frac{d}{dt}\left(\frac{\partial L}{\partial qk}\right)$
(D) $\frac{\partial L}{\partial \dot{q}k} + \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}k}\right) = 0$

65) The Hamiltonian of a charged particle in an electromagnetic field is given by

(A) $H = \frac{1}{2m}(\vec{p} + q\vec{A})^2 + q\varphi$
(B) $H = \frac{\vec{p}^2}{2m} + q\varphi$
(C) $H = \frac{1}{2m}(\vec{p} - q\vec{A})^2 + q\varphi$
(D) $H = \frac{\vec{p}^2}{2m} - q\varphi$

66) A dielectric sphere of radius R carries polarization $\vec{P} = kr^2\hat{r}$, where r is the distance from the center and k is a constant. The surface bound charge density (σ_b) and the volume bound charge density (ρ_b) at a distance d from the center of the sphere

(A) $\sigma_b = kR$ and $\rho_b = -4k$
(B) $\sigma_b = kR^2$ and $\rho_b = -4kd$
(C) $\sigma_b = kR^2$ and $\rho_b = -4k$
(D) $\sigma_b = kR$ and $\rho_b = -4kd$

67) If for a series R-L circuit, the voltage drops across R and L are 5 V and 12 V, respectively, than the magnitude and the phase angle of the input ac-source is given as

(A) 13 V and $\tan^{-1}0.42$
(B) 17 V and $\tan^{-1}2.4$
(C) 13 V and $\tan^{-1}2.4$
(D) 17 V and $\tan^{-1}0.42$

68) Two point charges $+q_1$ and $+q_2$ are fixed with a finite distance d between them. It is desired to put a third charge q_3 in between these two charges on the line joining them so that the charge q_3 is in equilibrium. This is

(A) possible only if q_3 is positive
(B) possible only if q_3 is negative
(C) possible irrespective of the sign of q_3
(D) not possible at all

69) Tesla is the unit for which of the following quantity

(A) Magnetic flux

(B) Magnetic flux density

(C) Magnetization

(D) Magnetic field strength

70) For a nonuniformly magnetized sphere, the bound current density $\vec{Jb}$in the material, is equal to

(A) $\vec{\nabla} \times \vec{M}$, where $\vec{M}$ is the magnetization in the material

(B) $\vec{\nabla} . \vec{M}$,, where $\vec{M}$ is the magnetization in the material

(C) $\vec{M} \times \hat{n}$, where $\vec{M}$ is the magnetization and $\hat{n}$ is the unit normal to surface

(D) -$\vec{M} \times \hat{n}$, where $\vec{M}$ is the magnetization and $\hat{n}$ is the unit normal to surface

71) Magnetic permeability has units

(A) Wb/A/m

(B) Wb/m2

(C) A/m

(D) Tesla/m

72) Which is an example of paramagnetic material?

(A) Superconductors

(B) alkali metals

(C) Transitional metals

(D) ferrites

73) The magnetic field associated with the electric field vector $\vec{E} = E_0 \sin(Kz - \omega t)\hat{j}$ is given by

(A) $\vec{B} = -\frac{E_0}{c}\sin(Kz - \omega t)\hat{i}$

(B) $\vec{B} = \frac{E_0}{c}\sin(Kz - \omega t)\hat{i}$

(C) $\vec{B} = \frac{E_0}{c}\sin(Kz - \omega t)\hat{j}$

(D) $\vec{B} = \frac{E_0}{c}\sin(Kz - \omega t)\hat{k}$

74) Equipotential surface corresponding to a particular charge distribution is given by $4x^2 + (y - 2)^2 + z^2 = V$ where V is constant. The electric field $\vec{E}$ at the origin is

(A) $\vec{E} = 0$

(B) $\vec{E} = 2\hat{x}$

(C) $\vec{E} = 4\hat{y}$

(D) $\vec{E} = -4\hat{y}$

75) In a series LCR circuit at resonance frequency, rms value of current is

(A) minimum and in phase with voltage

(B) maximum and in phase with voltage

(C) minimum and out of phase with voltage

(D) maximum and out of phase with voltage

76) A gas of molecular mass m is at temperature T. If the gas obeys Maxwell-Boltzmann velocity distribution. The root mean square speed of molecules is

(A) $\sqrt{\frac{KT}{m}}$ (B) $\sqrt{\frac{3KT}{m}}$

(C) Zero (D) $\sqrt{\frac{8KT}{m}}$

77) The specific internal energy of an ideal gas is dependent on its

(A) Pressure (B) Volume

(C) Temperature (D) All of these

78) Second order phase transition is accompanied by a change in:

(A) Entropy (B) Volume

(C) Isothermal compressibility (D) none of these

79) The mean free path ($\lambda_{P,T}$) of the molecules of a gas kept at a pressure p and temperature T is 3×10^7 m. Which of the following statements is true?

(A) If the temperature (T) is double ($\lambda_{P,2T}$) = 3×10^7 m

(B) If the pressure (p) is doubled ($\lambda_{2P,T}$) = 1.5×10^7 m

(C) If both the pressure (p) and temperature are doubled ($\lambda_{2P,2T}$) = 12×10^7 m

(D) If both the pressure (p) and temperature are halved ($\lambda_{P/2,T/2}$) = $3/16 \times 10^7$ m

80) Which of the following statement is true for vander Waals gas equation $(p + \frac{a}{v^2})(V-b) = RT$, where a and b are vander Waal's gas constants, R is the universal gas constant. P and V are pressure of the gas and volume of the gas container. Which of the following statements is true?

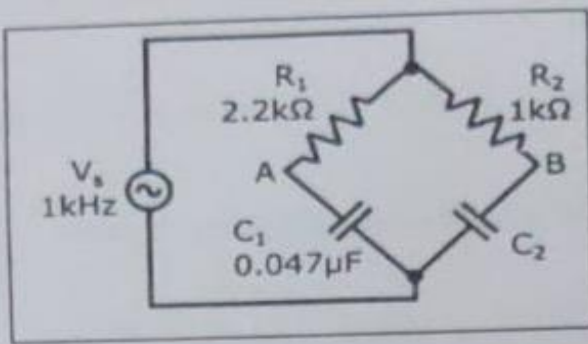
(A) All gas obeys vander Waals equation at all temperature and pressure.

(B) The vander Waal's gas equation can be expanded in third order equations with respect to V. It has three real roots at temperatures below the critical temperature.

(C) The vander Waal's gas equation can be expanded in third order equations with respect to V. It has three real roots at temperatures above the critical temperature.

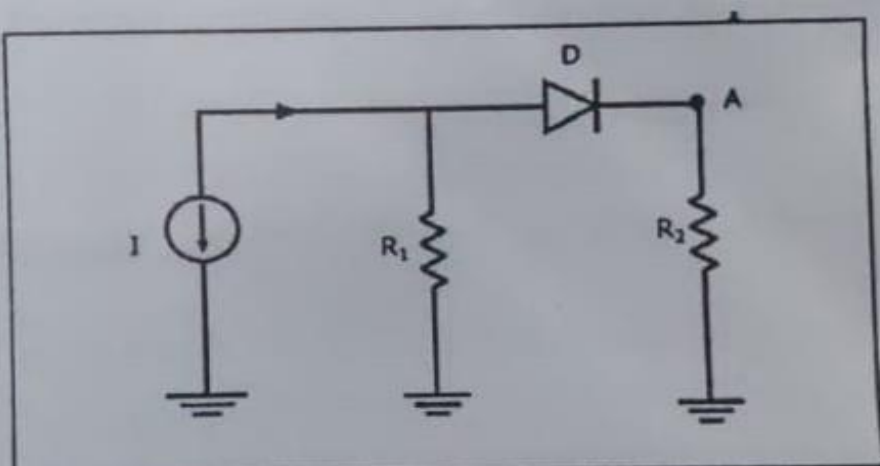
(D) The vander Waal's gas equation can be expanded in third order equations with respect to V. It has one real root and two imaginary roots at all temperatures.

81) When the voltages at the points A and B are equal (V_A=V_B), then the value of capacitor C_2 is



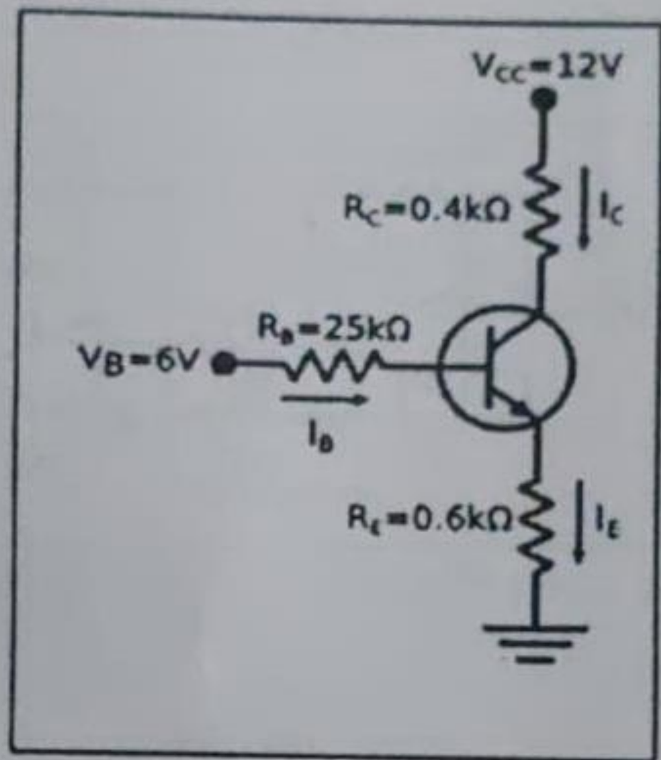
(A) 0.100 μF
(B) 0.102 μF
(C) 0.103 μF
(D) 0.094 μF

82) Consider the circuit shown in the figure where R_1 = 2.07 $k\Omega$ and R_2 = 1.93 $k\Omega$. Current source I delivers 10mA current. The potential across the diode D is 0.7V. What is the potential at A?



(A) 10.35V
(B) 9.65V
(C) 19.30V
(D) 4.83V

83) A silicon transistor operated in common emitter (CE) mode has $\beta = 76$. Using the supply voltages and the resistors, the operating point (current and voltages) of the transistor is.



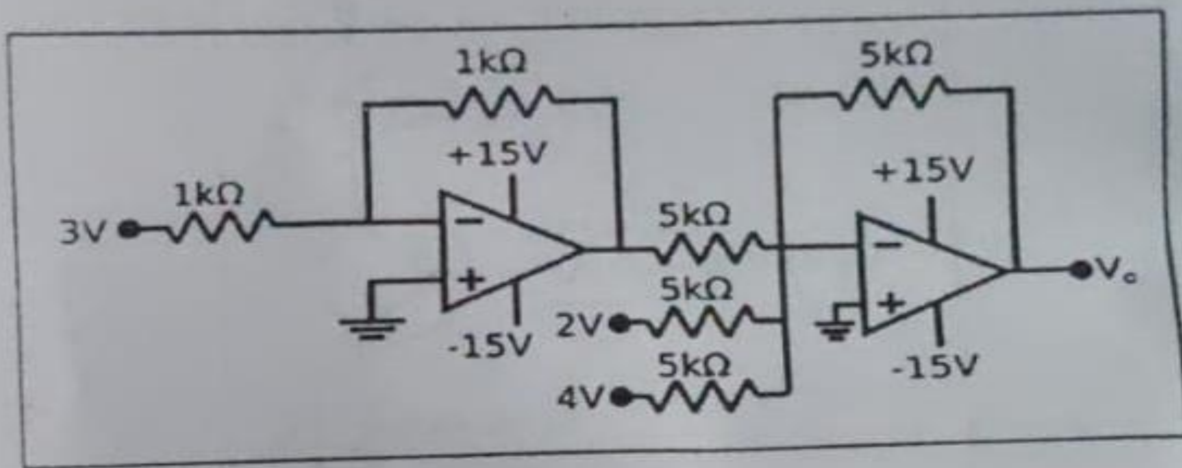
(A) 6.3 mA and 3.62V

(B) 5.63 mA and 6.32V

(C) 5.1 mA and 6.9V

(D) 6.63 mA and 5.63V

84) Two operational Amplifier are connected as shown in the figure below. The output of the first amplifier is fed to one of the inputs to the second Amplifier. The output (Vo) from the second amplifier is ....



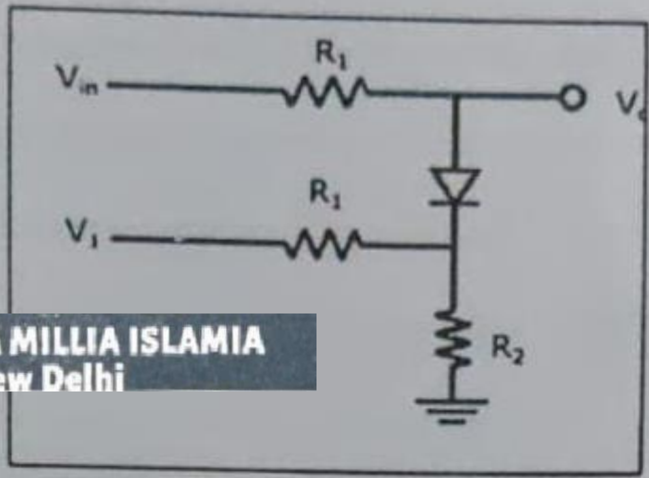
(A) -3V

(B) 3V

(C) +9V

(D) -9V

85) The circuit given below is fed by a sinusoidal voltage in $V_{in} = V_0 \sin\omega t$. Assume voltage of the diode is 0.7 volts and V_1 is a positive de voltage smaller than V_0. Choose the correct statements



(A) Positive part of V_{out} is restricted to a maximum voltage of $V_{out} = 0.7V + \frac{R_2}{R_1 + R_2} V_1$

(B) Negative part of V_{out} is restricted to a maximum voltage of $V_{out} = 0.7V + \frac{R_2}{R_1 + R_2} V_1$

(C) Positive part of V_{out} is restricted to a maximum voltage of $V_{out} = 0.7V + \frac{R_1}{R_1 + R_2} V_1$

(D) Negative part of V_{out} is restricted to a maximum voltage of $V_{out} = 0.7V + \frac{R_1}{R_1 + R_2} V_1$

86) A gas undergoes Joule-Thompson expansion. Which of the following statements is false?

(A) All gases show cooling effect at sufficiently low temperatures

(B) For every gas, there exists a characteristic temperature, called temperature of inversion

(C) Joule Thompson expansion of a gas is a reversible process

(D) Joule Thompson expansion of a gas is an isenthalpic process

87) Two thermally insulated vessels 1 and 2 are filled with air. They are connected by a short tube equipped with a valve. The volumes of the vessels and the pressure and temperature of air in them are (V_1, p_1, T_1) and (V_2, p_2, T_2). The pressure established after the opening of the valve can be written as

(A) $p = (p_1V_1 + p_2V_2) / (V_1 + V_2)$

(B) $p = (p_1V_2 + p_2V_1) I (V_1 + V_2)$

(C) $p = (p_1V_1 + p_2V_2) / V_1$

(D) $p = (p_1V_1 + p_2V_2) / V_2$

88) The value of entropy at absolute zero of temperature would be

(A) zero for all the materials

(B) finite for all the materials

(C) zero for some materials and non-zero for others

(D) unpredictable for any material

89) A thermodynamic system is maintained at constant temperature and pressure. In Thermodynamic equilibrium, its

(A) Gibbs free energy is minimum

(B) Enthalpy is maximum

(C) Helmholtz free energy is minimum

(D) Internal energy is zero

90) An ideal gas undergoes an isothermal expansion (at temperature T) from volume V_1 to V_2. The entropy change per mole

(A) $-R(V_1/V_2)$

(B) $-R(V_2/V_1)$

(C) $-R\ln(V_2/V_1)$

(D) $-R\ln(V_1/V_2)$

91) For a face centered cubic lattice of side "a", the inter-planer spacing corresponding to low index planes (100), (110) and (111) are

(A) $a, \frac{a}{\sqrt{2}}, \frac{a}{\sqrt{3}}$

(B) $\frac{a}{2}, \frac{a}{\sqrt{2}}, \frac{a}{\sqrt{3}}$

(C) $a, \frac{a}{2\sqrt{2}}, \frac{a}{\sqrt{3}}$

(D) None of the above

92) The coordination number of simple cubic structure is

(A) 4

(B) 6

(C) 8

(D) 12

93) The number of point groups in a two dimensional crystal system is

(A) 5

(B) 10

(C) 15

(D) 20

94) The number of slip system in a bee crystal is

(A) 4

(B) 8

(C) 12

(D) 16

95) Hall constant can be defined as

(A) $R_H = \frac{1}{ne}$

(B) $R_H = -\frac{1}{ne}$

(C) $R_H = \frac{1}{\sqrt{ne}}$

(D) $R_H = -\frac{1}{\sqrt{ne}}$

96) In a multiplexer the output depends on its ____________

(A) Data inputs

(B) Select inputs

(C) Select outputs

(D) Enable pin

97) A full adder can be made out of ____________

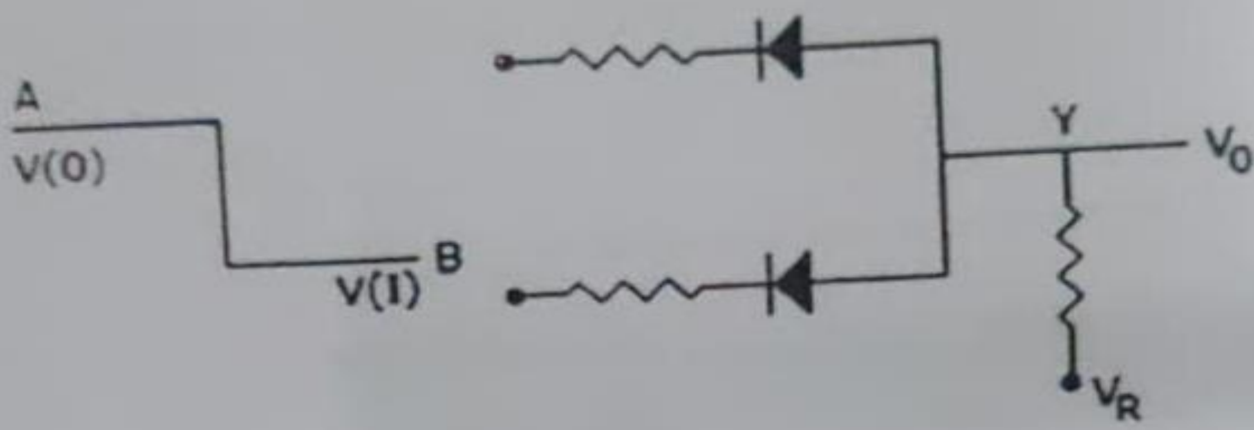
(A) two half adders

(B) two half adders and a OR gate

(C) two half adders and a NOT gate

(D) three half adders

98) The circuit in the given figure is a ________ gate.



(A). positive logic OR gate.
(B). negative logic OR gate.
(C). negative logic AND gate.
(D). positive logic AND gate.

99) Which of the following is not the advantage of MOS gates?

(A) Low power dissipation
(B) Small size
(C) Good immunity to noise
(D) High switching speeds

100) The following hexadecimal number (IE.43)16 is equivalent to

(A) $(36.506)_8$

(B) $(36.206)_8$

(C) $(35.506)_8$

(D) $(35.206)_8$