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Solution-Mathematical Methods

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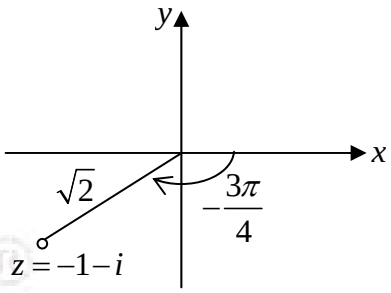
Q3. The argument of $(-1-i)$ is

(a) $\frac{-\pi}{4}$ (b) $\frac{-4}{3\pi}$ (c) $\frac{-3\pi}{4}$ (d) $\frac{3\pi}{4}$

Ans.: (c)

Solution.: $z=-1-i$, then its polar form is

$$z=\sqrt{2}\left[\cos\left(-\frac{3\pi}{4}\right)+i\sin\left(-\frac{3\pi}{4}\right)\right]$$



Hence $|z|=\sqrt{2}$ and $\arg z=-\frac{3\pi}{4}\pm 2n\pi$, $n=0,1,2....$

$Arg\, z=-\frac{3\pi}{4}$ (the principal value) $\because -\pi<-\frac{3\pi}{4}\le\pi$

Q25. If $u=\log\frac{x^2}{y}$, then $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}$ is equal to

(a) $2u$ (b) u (c) 0 (d) 1

Ans.: (d)

Solution.: $\because u=\log\frac{x^2}{y}$ then $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=x\frac{1}{x^2/y}\frac{2x}{y}+y\frac{1}{x^2/y}\left(-\frac{x^2}{y^2}\right)=2-1=1$

Q30. If $J=\frac{\partial(u,v)}{\partial(x,y)}$ and $J'=\frac{\partial(x,y)}{\partial(u,v)}$, then JJ' is equal to

(a) 0 (b) -1 (c) ∞ (d) 1

Ans.: (d)

Solution.: $\because \frac{\partial(u,v)}{\partial(x,y)}.\frac{\partial(x,y)}{\partial(u,v)}=1\Rightarrow JJ'=1$

Q39. The determinant $\begin{vmatrix}1&3&7\\4&9&1\\2&7&6\end{vmatrix}$ is

(a) 45 (b) 49 (c) 51 (d) 53

Ans.: (c)

Solution.: $\begin{vmatrix}1&3&7\\4&9&1\\2&7&6\end{vmatrix}=1(54-7)-3(24-2)+7(28-18)=47-66+70=51$

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Q41. Arrange the following differential equations in ascending order in accordance to degree

(A). $\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}=\frac{d^2y}{dx^2}$ (B). $\left(\frac{dy}{dx}\right)^5+y=0$

(C). $\frac{d^2y}{dx^2}+a^2x=0$ (D). $x^2\left(\frac{d^2y}{dx^2}\right)^3+y\left(\frac{dy}{dx}\right)^4+y^4=0$

Choose the ***correct*** answer from the options given below:

(a). (C), (A), (D), (B) (b). (B), (A), (C), (D)

(c). (B), (A), (D), (C) (d). (C), (D), (B), (A)

Ans.: (a)

Solution.: (A). $\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}=\frac{d^2y}{dx^2}\Rightarrow\left[1+\left(\frac{dy}{dx}\right)^2\right]^3=\left(\frac{d^2y}{dx^2}\right)^2$, Degree $=2$

(B). $\left(\frac{dy}{dx}\right)^5+y=0$, Degree $=5$; (C). $\frac{d^2y}{dx^2}+a^2x=0$, Degree $=1$

(D). $x^2\left(\frac{d^2y}{dx^2}\right)^3+y\left(\frac{dy}{dx}\right)^4+y^4=0$, Degree $=3$

Q55. The vector $r^n\vec{r}$ is solenoidal, if

(a) $n=3$ (b) $n=1$ (c) $n=-1$ (d) $n=0$

Ans.: (c)

Solution.: $\vec{r}=x\hat{x}+y\hat{y}+z\hat{z}$, $r=|\vec{r}|=\sqrt{x^2+y^2+z^2}\Rightarrow r^n=\left(x^2+y^2+z^2\right)^{n/2}$

$$\vec{\nabla}.\left(r^n\vec{r}\right)=\frac{\partial}{\partial x}\left(x^2+y^2+z^2\right)^{n/2}x+\frac{\partial}{\partial y}\left(x^2+y^2+z^2\right)^{n/2}y+\frac{\partial}{\partial z}\left(x^2+y^2+z^2\right)^{n/2}z$$

$$\frac{\partial}{\partial x}\left(x^2+y^2+z^2\right)^{n/2}x=\left(x^2+y^2+z^2\right)^{n/2}.1+x\frac{n}{2}\left(x^2+y^2+z^2\right)^{\frac{n}{2}-1}\times 2x$$

$$\Rightarrow\frac{\partial}{\partial x}\left(x^2+y^2+z^2\right)^{n/2}x=\left(x^2+y^2+z^2\right)^{\frac{n}{2}}+n\left(x^2+y^2+z^2\right)^{\frac{n}{2}-1}x^2$$

Similarly, $\frac{\partial}{\partial y}\left(x^2+y^2+z^2\right)^{n/2}y=\left(x^2+y^2+z^2\right)^{\frac{n}{2}}+n\left(x^2+y^2+z^2\right)^{\frac{n}{2}-1}y^2$

$$\frac{\partial}{\partial z}\left(x^2+y^2+z^2\right)^{n/2}z=\left(x^2+y^2+z^2\right)^{\frac{n}{2}}+n\left(x^2+y^2+z^2\right)^{\frac{n}{2}-1}z^2$$

Thus $\vec{\nabla}.\left(r^n\vec{r}\right)=3\left(x^2+y^2+z^2\right)^{\frac{n}{2}}+n\left(x^2+y^2+z^2\right)^{\frac{n}{2}-1}\left(x^2+y^2+z^2\right)$

$$\vec{\nabla}.\left(r^n\vec{r}\right)=3\left(x^2+y^2+z^2\right)^{\frac{n}{2}}(1+n)$$

The vector $r^n\vec{r}$ is solenoidal, if $\vec{\nabla}.\left(r^n\vec{r}\right)=0\Rightarrow 3\left(x^2+y^2+z^2\right)^{\frac{n}{2}}(1+n)=0\Rightarrow n=-1$

Q56. A and B are two matrices of the same order. If $AB = 0$ and $BA \neq 0$, then necessarily

(A) $A = 0$ (B) $A \neq 0$ (C) $B = 0$ (D) $B \neq 0$

Choose the ***correct*** answer from the options given below:

(a) (B) and (C) only (b) (A) and (C) only (c) (A) and (D) (d) (B) and (D) only

Ans.: (d)

Q59. The equation $\left(x^2y - 2xy^2\right)dx + 3x^2y - x^3 = 0$

(A). is exact

(B). is inexact

(C). The solution is $\frac{y}{x} - 2\log x + 3\log y = \text{Constant}$

(D). The solution is $\frac{x}{y} - 2\log x + 3\log y = \text{Constant}$

Choose the ***correct*** answer from the options given below:

(a). (B) and (C) only (b). (B) and (D) only

(c). (A) and (D) only (d). (A) and (C) only

Ans.: Drop

Q70. Match List I with List II

	List I (Circular functions)		**List II (Hyperbolic functions)**
A.	$\sin x$	I.	$\cosh lx$
B.	$\cos x$	II.	$-l\tanh lx$
C.	$\tan x$	III.	$\sec hlx$
D.	$\sec x$	IV.	$= -l\sinh lx$

Choose the correct answer from the options given below:

a. (A)-(I), (B)-(II), (C)-(III), (D)-(IV) b. (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

c. (A)-(I), (B)-(II), (C)-(IV), (D)-(III) d. (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

Ans.: (b)

Q71. If $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ is a position vector. Match List I with List II

	List I		**List II**
A.	$\text{div}\,\vec{r}$	I.	$-\frac{\vec{r}}{\lvert\vec{r}\rvert^3}$
B.	$\text{curl}\,\vec{r}$	II.	3
C.	$\text{grad}\lvert\vec{r}\rvert$	III.	0
D.	$\text{grad}\frac{1}{\lvert\vec{r}\rvert}$	IV.	$\frac{\vec{r}}{\lvert\vec{r}\rvert}$

Choose the correct answer from the options given below:

a. (A)-(III), (B)-(II), (C)-(I), (D)-(IV) b. (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

c. (A)-(II), (B)-(III), (C)-(IV), (D)-(I) d. (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

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Ans.: (c)

Solution.: $\vec{r} = x\hat{x} + y\hat{y} + z\hat{z}$ and $r = |\vec{r}| = \sqrt{x^2 + y^2 + z^2}$

$$\text{div}\,\vec{r} = \frac{\partial x}{\partial x} + \frac{\partial y}{\partial y} + \frac{\partial z}{\partial z} = 1+1+1 = 3\,; \quad \text{curl}\,\vec{r} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ x & y & z \end{vmatrix} = 0$$

$$\text{grad}\,|\vec{r}| = \hat{x}\frac{\partial}{\partial x}\sqrt{x^2 + y^2 + z^2} + \hat{y}\frac{\partial}{\partial y}\sqrt{x^2 + y^2 + z^2} + \hat{z}\frac{\partial}{\partial z}\sqrt{x^2 + y^2 + z^2}$$

$$\because \frac{\partial}{\partial x}\sqrt{x^2 + y^2 + z^2} = \frac{1}{2\sqrt{x^2 + y^2 + z^2}}2x = \frac{x}{\sqrt{x^2 + y^2 + z^2}}\,; \quad \frac{\partial}{\partial y}\sqrt{x^2 + y^2 + z^2} = \frac{y}{\sqrt{x^2 + y^2 + z^2}}$$

$$\frac{\partial}{\partial z}\sqrt{x^2 + y^2 + z^2} = \frac{z}{\sqrt{x^2 + y^2 + z^2}} \quad \Rightarrow \text{grad}\,|\vec{r}| = \frac{x\hat{x} + y\hat{y} + z\hat{z}}{\sqrt{x^2 + y^2 + z^2}} = \frac{\vec{r}}{r}$$

$$\text{grad}\,\frac{1}{|\vec{r}|} = \hat{x}\frac{\partial}{\partial x}\frac{1}{\sqrt{x^2 + y^2 + z^2}} + \hat{y}\frac{\partial}{\partial y}\frac{1}{\sqrt{x^2 + y^2 + z^2}} + \hat{z}\frac{\partial}{\partial z}\frac{1}{\sqrt{x^2 + y^2 + z^2}}$$

$$\because \frac{\partial}{\partial x}\frac{1}{\sqrt{x^2 + y^2 + z^2}} = -\frac{1}{2}\left(x^2 + y^2 + z^2\right)^{-3/2} \times 2x = -\frac{x}{\left(x^2 + y^2 + z^2\right)^{3/2}}$$

$$\frac{\partial}{\partial y}\frac{1}{\sqrt{x^2 + y^2 + z^2}} = -\frac{y}{\left(x^2 + y^2 + z^2\right)^{3/2}}, \quad \frac{\partial}{\partial z}\frac{1}{\sqrt{x^2 + y^2 + z^2}} = -\frac{z}{\left(x^2 + y^2 + z^2\right)^{3/2}}$$

$$\Rightarrow \text{grad}\,\frac{1}{|\vec{r}|} = -\frac{x\hat{x} + y\hat{y} + z\hat{z}}{\left(x^2 + y^2 + z^2\right)^{3/2}} = -\frac{\vec{r}}{r^3}$$

Q73. If $\vec{A} = ax\hat{i} + by\hat{j} + cz\hat{k}$ where a, b, c are constants, then $\iint_S \vec{A}.d\vec{S}$ where S is the surface of a unit sphere, is

(a) $\frac{4}{3}\pi(a+b+c)^2$ (b) $\frac{4}{3}\pi(a+b+c)$ (c) 0 (d) $\frac{4}{3}\pi\left(a^2+b^2+c^2\right)$

Ans.: (b)

Solution.: $\iint_S \vec{A}.d\vec{S} = \int_V \left(\vec{\nabla}.\vec{A}\right)d\tau = \frac{4}{3}\pi(a+b+c) \qquad \because \vec{A} = ax\hat{i} + by\hat{j} + cz\hat{k} \Rightarrow \vec{\nabla}.\vec{A} = a+b+c$

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Solution- Mechanics and General Properties of Matter

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Q16. Arrange the gravitational potential of a point mass (M) in ascending order for the following distance from a point:

(A). $2r$ (B). $4r$ (C). $8r$ (D). $16r$

Choose the ***correct*** answer from the options given below:

(a). (A), (B), (C), (D) (b). (A), (C), (B), (D)

(c). (B), (A), (D), (C) (d). (D), (C), (B), (A)

Ans.: (d)

Solution.: $V=-\frac{GM}{r}$; $\left(-\frac{GM}{2r}\right)<\left(-\frac{GM}{4r}\right)<\left(-\frac{GM}{8r}\right)<\left(-\frac{GM}{16r}\right)$

Q19. A satellite is revolving round the earth with a speed of 7.6 km/s. What is your estimation of the height of the satellite from the earth surface. Consider the mass of the earth $=6.10^{24}$kg and radius of the earth = 6400 km

(a) 500 km (b) 550 km (c) 600 km (d) 650 km

Ans.: (b)

Solution.: $v_0=\sqrt{\frac{GM}{r}}\Rightarrow r=\frac{GM}{v_0^2}=\frac{6.67\times10^{-11}\times6\times10^{24}}{(7600)^2}$ $\because v_0=7600\,m/s$

$$r=\frac{40.02\times10^{13}}{57.76\times10^{6}}=0.692867\times10=6928.67\times10^{3}m=6928.67\text{ km}$$

$r=R+h=6928.67\,\text{km}\Rightarrow h=6928.67-6400\Rightarrow h=528.67\,\text{km}$

Q34. According to Kepler's laws, the square of the orbital period T of a plane is proportional to

(a) the square of its eccentricity (b) the cube of its eccentricity

(c) the square of its semimajor axis (d) the cube of its semi-major axis

Ans.: (d)

Solution.: $T^2\propto\alpha^3$

Q36. In an inelastic collision

(a). the initial kinetic energy is equal to final kinetic energy.

(b). the kinetic energy remains constant.

(c). the final kinetic energy is less than the initial kinetic energy.

(d). the final kinetic energy is more than the initial kinetic energy.

Ans.: (c)

Solution.: During inelastic collision, some energy is lost in the form of heat energy.

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Q43. A block moving in air breaks in two parts and the parts separate: Consider the following correct statements

(A). The total momentum must be conserved

(B). The total kinetic energy must be conserved

(C). The total momentum must change

(D). The total kinetic energy must be changed

Choose the ***correct*** answer from the options given below:

(a). (A), (B) and (D) only (b). (A) and (C) only

(c). (A), (B), (C) and (D) (d). (A) and (D) only

Ans.: (d)

Solution.:

Total momentum will remain conserved but kinetic energy will change. One can consider this event as the opposite of perfectly inelastic collision.

Q44. Two planets P_1 and P_2 having masses M_1 and M_2 revolve around the sun in elliptical orbits with time period T_1 and T_2 respectively. The minimum and maximum distances of planets P_1 from the sun are R and $3R$ respectively. Whereas for planet P_2, these are $2R$ and $4R$ respectively. Where R is the constant. Assuming M_1 and M_2 are much smaller than the mass of the sun, the magnitude of T_2/T_1 is

(a) $\frac{3}{2}\sqrt{\frac{3}{2}}$ (b) $\frac{2}{3}\sqrt{\frac{3}{2}}$ (c) $\frac{3}{2}\sqrt{\frac{3M_1}{2M_2}}$ (d) $\frac{2}{3}\sqrt{\frac{2M_1}{3M_2}}$

Ans.: (a)

Solution.: Semi-major axis for P_1 is $a_1 = \frac{1}{2}\left(r_{\min} + r_{\max}\right) = \frac{1}{2}\left(R + 3R\right) = 2R$

Semi-major axis for P_2 is $a_2 = \frac{1}{2}\left(2R + 4R\right) = 3R$

$$\frac{T_2}{T_1} = \left(\frac{a_2}{a_1}\right)^{3/2} = \left(\frac{3}{2}\right)^{3/2} = \frac{3}{2}\sqrt{\frac{3}{2}}$$

Q47. Arrange the following in the correct sequence of chronological order:

(A). Bernoulli's theorem (B). Conservation of energy

(C). Newton's law of motion (D). Kepler's laws

Choose the CORRECT answer from the given option below

(a). (D), (B), (C), (A) (b). (D), (C), (B), (A)

(c). (B), (A), (D), (C) (d). (C), (B), (D), (A)

Ans.: (b)

Solution.:

Bernoulli's theorem (1738)

Newton's laws of motion (1687)

Kepler's laws (1609, 1619)

Q53. Find the force of attraction between two balls each of mass 1 kg when their centers are 10 cm apart?

(a) $66.7\times10^{-9}\,N$ (b) $6.67\times10^{-9}\,N$ (c) $0.667\times10^{-9}\,N$ (d) $667\times10^{-9}\,N$

Ans.: (b)

Solution.:

$$F=\frac{Gm_1m_2}{r^2}=\frac{6.67\times10^{-11}\times1\times1}{(0.1)^2}\Rightarrow F=6.67\times10^{-9}\,N$$

Q58. The conservation of linear momentum leads to Newton's

(a) First law (b) Second law

(c) Third law (d) Not related to any Newton's law

Ans.: (c)

Solution.:

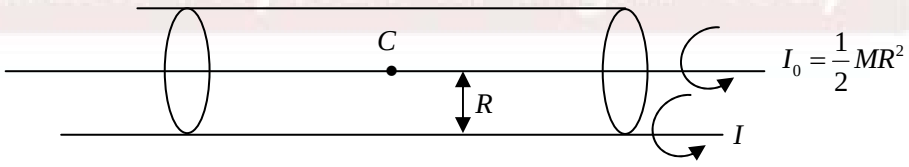
$$\vec{F}_{21}=-\vec{F}_{12}\Rightarrow\frac{d\vec{p}_2}{dt}=-\frac{d\vec{p}_1}{dt}\Rightarrow\frac{d}{dt}(\vec{p}_1+\vec{p}_2)=0\Rightarrow\vec{p}_1+\vec{p}_2=\text{constant}$$

Q66. Consider a solid cylinder of mass M and radius R. What will be the moment of inertia on the surface of the cylinder?

(a) $\frac{1}{2}MR^2$ (b) $\frac{3}{5}MR$ (c) $\frac{2}{5}MR$ (d) $\frac{3}{2}MR^2$

Ans.: (d)

Solution.:



Use parallel axis theorem

$$I=I_0+MR^2=\frac{1}{2}MR^2+MR^2=\frac{3}{2}MR^2$$

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Solution- Oscillations, Waves and Optics

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Q12. What is the phase difference between the driving force and the velocity in a forced harmonic oscillator at resonance?

(a) 0° (b) 90° (c) 180° (d) 270°

Ans.: (b)

Solution.: $F = F_0 \sin pt\,;\; x = \dfrac{f_0}{\sqrt{\left(\omega^2 - p^2\right)^2 + 4p^2r^2}} \sin\left(pt - \theta\right)$

$$v = \frac{dx}{dt} = \frac{f_0 p}{\sqrt{\left(\omega^2 - p^2\right)^2 + 4p^2r^2}} \cos\left(pt - \theta\right)$$

so, the phase difference between the driving force is $\pi/2$.

Q22. The physical significance of the quality factor (Q) in a damped oscillator is:

(a) Determines the initial amplitude
(b) Indicates the degree of damping
(c) Influences the natural frequency
(d) Represents the total energy

Ans.: (b)

Solution.: Quality factor is a measure of damping. Higher the damping, greater is the energy loss per period and smaller is Q-number.

$$Q = 2\pi \frac{\text{Energy stored in system}}{\text{Energy loss per period}}$$

Q26. The maximum number of intensity minima that can be observed in the Fraunhofer diffraction pattern of a single slit (width $10\,\mu m$) illuminated by laser beam (wavelength (wavelength $0.630\ \mu m$) will be

(a) 5 (b) 10 (c) 12 (d) 15

Ans.: (d)

Solution.: $e\sin\theta = n\lambda \Rightarrow n_{\max} = \dfrac{e}{\lambda} = \dfrac{10}{0.63} = 15.87 \simeq 15$

Q28. A mass-spring system is used to model the vibrations of a building during an earthquake. How can the natural frequency of the system be tuned to reduce the risk of resonance with earthquake frequencies?

(a) Increase the mass (b) Decrease the spring constant
(c) Add additional springs in parallel (d) Add additional springs in series

Ans.: (c)

Solution.:

For spring mass system $\omega = \sqrt{\dfrac{k}{m}}$, one can increase the frequency of the system by increasing *k*. [k can be increased by using additional springs in parallel]. Higher frequency of system reduces the risk of earthquake as frequencies involved in earthquake are low frequencies.

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Q29. In sound waves, which property is determined by the amplitude of the wave?

(a) Pitch (b) Loudness (c) Frequency (d) Quality

Ans.: (b)

Solution.: The perception of sound intensity by human ears is called loudness level.

Q62. Which of the following statements about Lissajous figures is TRUE?

(a) They represent the trajectory of a single harmonic oscillator.

(b) The shape depends only on the amplitudes of the oscillations.

(c) Circular Lissajous figures occur when the frequencies are incommensurate.

(d) Lissajous figures are not affected by phase differences.

Ans.: (c)

Solution.:

The shape of Lissajous figures depends upon the following factors of oscillations:

(i) the ratio of amplitudes

(ii) the ratio of frequencies

(iii) the phase difference

Q74. Match List I with List II

	List I		**List II**
A.	Interference	I.	Zone Plate
B.	Double Refraction	II.	Double Slit Grating
C.	Fraunhofer Diffraction	III.	Babinet Compensator
D.	Fresnel Diffraction	IV.	Llyod mirror

Choose the correct answer from the options given below:

a. (A)-(I), (B)-(II), (C)-(III), (D)-(IV) b. (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

c. (A)-(I), (B)-(II), (C)-(IV), (D)-(III) d. (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

Ans.: (b)

Solution.:

(A) Interference	(IV) Llyod mirror
(B) Double Refraction	(III) Babinet Compensator
(C) Fraunhofer Diff	(II) Double Slit Grating
(D) Fresnel Diffraction	(I) Zone Plate

Q75. A parallel beam light with wave length λ is incident normally on a thin film of thickness t. The condition for observed bright rings,

(a) $2t = n\lambda$ (b) $t = n\lambda$ (c) $2t = (2n-1)\lambda$ (d) $t = (2n-1)\lambda$

Ans.: (a)

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Solution- Electricity and Magnetism

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Q5. The cyclotron frequency (ω) at which a particle of mass m and charge q would revolved in the absence of any electric field (E).

(a) $\omega = \frac{qB}{m^2}$ (b) $\omega = \frac{qB}{m}$ (c) $\omega = \frac{q^2B}{m}$ (d) $\omega = \frac{qB}{\sqrt{m}}$

Ans.: (b)

Solution.: $\frac{mv^2}{R} = qvB \Rightarrow R = \frac{mv}{qB}$; $T = \frac{2\pi R}{v} = \frac{2\pi m}{qB} \Rightarrow \omega = \frac{2\pi}{T} = \frac{qB}{m}$

Q13. An electron moving towards x-axis. An electric field is along y-direction then path of electron is

(a) Circular (b) Parabola (c) Rectangular (d) Elliptical

Ans.: (b)

Q17. An AC circuit consists of a resistor (R), a capacitor (C), and an inductor (L) in series. What is the power factor of this circuit if $X_L = X_C$?

(a) -1 (b) $1/\sqrt{2}$ (c) 0 (d) 1

Ans.: (d)

Solution.: Power factor $\cos\phi = \frac{R}{\sqrt{R^2 + (X_L - X_C)^2}} = \frac{R}{\sqrt{R^2 + 0}} = \frac{R}{R} = 1$

Q20. If the frequency of an AC circuit is increased, what happens to the inductive reactance (X_L) of an inductor?

(a) Becomes zero (b) Remains constant

(c) Decreases (d) Increases

Ans.: (d)

Solution.: Inductive reactance $X_L = \omega L \propto \omega$

Q27. The ratio of charge (q) to potential (V) of a body is known as

(a) Resistance (b) Conductance

(c) Inductance (d) Capacitance

Ans.: (d)

Solution.: Capacitance $C = \frac{q}{V}$.

Q31. The angle between the dipole moment and electric field at any point on the equatorial plane is

(a) 0° (b) 45° (c) 90° (d) 180°

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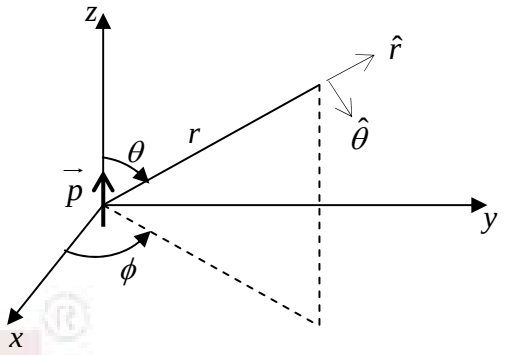
Ans.: (d)

Solution.: If we choose coordinates so that $\vec{p}$ (dipole moment) lies at the origin and points in the z-direction, then the electric field of a dipole:



$$\vec{E}_{dip}(r,\theta)=\frac{p}{4\pi\varepsilon_0 r^3}\left(2\cos\theta\,\hat{r}+\sin\theta\hat{\theta}\right).$$

At any point on the equatorial plane $\theta=\frac{\pi}{2}$,

$$\vec{E}_{dip}\left(r,\frac{\pi}{2}\right)=\frac{p}{4\pi\varepsilon_0 r^3}\left(2\cos\frac{\pi}{2}\hat{r}+\sin\frac{\pi}{2}\hat{\theta}\right)$$

$$\Rightarrow\vec{E}_{dip}\left(r,\frac{\pi}{2}\right)=\frac{p}{4\pi\varepsilon_0 r^3}\hat{\theta}=\frac{p}{4\pi\varepsilon_0 r^3}\left(-\hat{z}\right).$$

So the angle between the dipole moment and electric field at any point on the equatorial plane is 180^0.

Q49. Gauss's law is valid for

(a). Any closed surface (b). Only regular closed surface

(c). Only open surface (d). Only irregular open surface

Ans.: (a)

Q60. When the phase velocity of an electromagnetic wave depends on frequency in any medium, the phenomenon is called

(a) Absorption (b) Dispersion

(c) Polarization (d) Scattering

Ans.: (b)

Q69. The law, governing the force between electric charges is known as

(a) Ampere's law (b) Coulomb's law

(c) Faraday's law (d) Ohm's law

Ans.: (b)

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Solution- Kinetic Theory, Thermodynamics

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Q4. If the ratio of isothermal and adiabatic elasticities is $\frac{E_S}{E_T}$ then which of the following are not true?

(A) $\frac{E_S}{E_T}=\frac{C_P}{C_V}$ (B) $\frac{E_S}{E_T}=\frac{C_V}{C_P}$ (C) $\frac{E_S}{E_T}=C_P-C_V$ (D) $\frac{E_S}{E_T}=C_PC_V$

Choose the correct answer from the options given below:

a. (A), (B) and (D) only b. (A), (B) and (C) only

c. (A), (B), (C) and (D) d. (B), (C) and (D) only

Ans.: (d)

Q8. Arrange following gases for ascending order of the C_p/C_V :

(A). Ar (B). Ne (C). H_2 (D). H_2O

Choose the CORRECT answer from the options given below:

(a). (D), (C), (B), (A) (b). (A), (D), (C), (B)

(c). (A), (B), (C), (D) (d). (D), (C), (A), (B)

Ans.: (a)

Solution.: $\gamma=1+\frac{2}{f}$ where f is degree of freedom.

Q11. In a heat engine based on the carnot cycle, heat is added to the working substance at constant

(a) Entropy (b) Temperature (c) Volume (d) Pressure

Ans.: (b)

Q14. The door of a running refrigerator inside a room is left open. Choose the incorrect statements:

(A). the room will be cooled slightly

(B). the room will be warmed up gradually

(C). the room will be cooled to the temperature inside the refrigerator

(D). the temperature of the room will remain unaffected

Choose the correct answer from the options given below:

(a). (A), (C) and (D) only (b). (A), (B) and (C) only

(c). (B), (C) and (D) only (d). (A), (B) and (D) only

Ans.: (a)

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Q32. A system consists of two phases maintained at constant temperature (T) and pressure (p). The number of moles present in phase 1 and phase 2 of the system is represented by n_i (where $i=1,2$) and Gibbs free energy per mole of phase i at this temperature and pressure is $g_{i(T,p)}$. The necessary condition for equilibrium:

(a) $g_1(T,p) > g_2(T,p)$ (b) $g_1(T,p) = g_2(T,p)$

(c) $g_1(T,p) < g_2(T,p)$ (d) $g_1(T,p) = -g_2(T,p)$

Ans.: (b)

Q33. Arrange the following substance in descending order of specific heat

(A). Aluminium (B). Carbon (C). Copper (D). Lead

Choose the correct answer from the options given below:

(a). (A), (B), (C), (D) (b). (A), (C), (B), (D)

(c). (B), (A), (D), (C) (d). (C), (B), (D), (A)

Ans.: (a)

Q40. Match List I with List II

	List I		**List II**
A.	U	I.	$-T\left(\frac{\partial^2 F}{\partial T^2}\right)_V$
B.	C_p	II.	$-T\left(\frac{\partial^2 G}{\partial T^2}\right)_P$
C.	H	III.	$-T^2\left(\frac{\partial F/T}{\partial T}\right)_V$
D.	C_v	IV.	$-T^2\left(\frac{\partial G/T}{\partial T}\right)_P$

Internal energy (U), Specific heats (C_v, C_p), Enthalpy (H), Helmholtz free energy (F) and Gibbs free energy (G) are the thermodynamic variables.

Choose the correct answer from the options given below:

(a). (A)-(I), (B)-(II), (C)-(III), (D)-(IV)

(b). (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

(c). (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

(d). (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

Ans.: (c)

Solution.: $dF = -SdT - pdV$ and $dG = -SdT + Vdp$. Thus $S = -\left(\frac{\partial F}{\partial T}\right)_V$ and $S = -\left(\frac{\partial G}{\partial T}\right)_p$

$$U = F + TS = F - T\left(\frac{\partial F}{\partial T}\right)_V = -T^2\left(\frac{\partial F/T}{\partial T}\right)_V;$$

$$H = G + TS = G - T\left(\frac{\partial G}{\partial T}\right)_p = -T^2\left(\frac{\partial G/T}{\partial T}\right)_p$$

$$C_V = T\left(\frac{\partial S}{\partial T}\right)_V = -T\left(\frac{\partial^2 F}{\partial^2 T}\right)_V \text{ and } C_p = T\left(\frac{\partial S}{\partial T}\right)_p = -T\left(\frac{\partial^2 G}{\partial^2 T}\right)_p$$

Q46. The reversible engine and an irreversible engine are working between the same temperatures. The efficiency of:

(a). both is same (b). reversible is greater

(c). irreversible is greater (d). irreversible is twice to the reversible

Ans.: (b)

Q50. Let's consider nitrogen gas obeys the Van der Waals equation of state with best fit value of the parameters $a = 0.14\,Pa.m^6/mol^2$ and $b = 39.0\,cm^3/mol$. Estimate approximate diameter of the nitrogen gas molecules. Assume each molecule is a sphere.

(a) $3.9\times10^{-7}\,cm$ (b) $7.8\times10^{-7}\,cm$ (c) $1.9\times10^{-8}\,cm$ (d) $4.0\times10^{-8}\,cm$

Ans.: (d)

Solution.: $\because b = 4N_A V_m \Rightarrow 39.0\,cm^3/mol = 4\times6\times10^{23}\times\frac{4}{3}\pi r^3$

$$\Rightarrow r^3 = \frac{39.0\,cm^3}{32\times3.14}\times10^{-23} = \frac{390}{32\times3.14}\times10^{-24}\,cm^3 = 3.9\times10^{-24}\,cm^3 \Rightarrow r \approx 1.574\times10^{-8}\,cm$$

So approximate diameter of the nitrogen gas molecules is

$2r \approx 1.574\times10^{-8}\,cm \approx 3.15\times10^{-8}\,cm$

Q61. Match List I with List II

	List I **Thermodynamic process**		**List II** **Features**
A.	Adiabatic	I.	Volume constant
B.	Isothermal	II.	Pressure constant
C.	Isobaric	III.	Temperature constant
D.	Isochoric	IV.	No heat flow between systems and surroundings

Choose the correct answer from the options given below:

a. (A)-(II), (B)-(I), (C)-(III), (D)-(IV) b. (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

c. (A)-(I), (B)-(II), (C)-(IV), (D)-(III) d. (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

Ans.: (b)

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Q67. Let $N_{MB} : N_{BE} : N_{FD}$ denote the number of ways in which two particles can be distributed in two energy states according to Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics respectively, then $N_{MB} : N_{BE} : N_{FD}$ is

(a) 4:1:3 (b) 4:3:1 (c) 4:2:3 (d) 4:3:2

Ans.: (b)

Solution.:

Maxwell-Boltzmann allows all four configurations because the particles are distinguishable and have no restrictions on occupancy.

(i) Particle 1 in E1 , Particle 2 in E1 (ii) Particle 1 in E1, Particle 2 in E2

(iii) Particle 1 in E2, Particle 2 in E1 (iv) Particle 1 in E2, Particle 2 in E2

Bose-Einstein allows configurations where both particles can occupy the same state.

(i) Both particles in E1 (ii) Both particles in E2 (iii) One particle in E1 and the other in E2

Fermi-Dirac restricts the particles to different states due to the Pauli Exclusion Principle

(i) One particle in E1E_1E1 and the other in E2

Q68. Arrange the following ferromagnetic materials in Ascending order of Curie temperatures:

(A). Cobalt (B). Gadolinium (C). Iron (D). Nickel

Choose the correct answer from the options given below:

(a). (A), (B), (C), (D) (b). (B), (A), (D), (C)

(c). (B), (A), (C), (D) (d). (B), (D), (C), (A)

Ans.: (d)

Q72. If the temperature of the source is increased, the efficiency of Carnot engine:

(a) increases (b) decreases

(c) remains constant (d) first increases and remains constant

Ans.: (a)

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Solution- Modern Physics

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Q1. Find the wavelength shift in the relativistic Doppler effect for the $H\alpha(6563\text{Å})$ line emitted by a star receding from the earth with a relative velocity $0.1c$.

(a) 7256Å (b) 6563Å (c) 1693Å (d) 693Å

Ans.: (a)

Solution.: $\lambda' = \lambda\sqrt{\frac{1+v/c}{1-v/c}} = 6563\sqrt{\frac{1+0.1}{1-0.1}} \Rightarrow \lambda' = 6563\times 1.105 = 7256\text{Å}$

Q2. According to Schrodinger a particle is equivalent to:

(a) a single wave (b) a wave packet

(c) a light wave (d) can not behave as wave

Ans.: (b)

Solution.: Every moving particle has a wave character called matter wave. The matter wave can be best described by a group of waves, having group velocity equal to the velocity of the moving particle. This group of waves is called wave packet.

Q6. Choose the incorrect statements:

(A). A particle can travel in free space faster than the velocity of light in free space.

(B). A particle can travel in a material medium faster than the velocity of light in free space.

(C). A particle cannot travel in the material medium.

(D). The velocity of light in free space is an absolute constant.

Choose the correct answer from the options given below:

a. (A), (B) and (D) only b. (A), (B) and (C) only

c. (A), (B), (C) and (D) d. (B), (C) and (D) only

Ans.: (b)

Solution.: The velocity of light in free space is $c = 3\times 10^8$ m/s.

Q7. Select the correct alternative (s): The heavier of the two particles has smaller de-Broglie wavelength when both of them:

(A). move with same velocity (B). move with same momentum

(C). move with same kinetic energy (D). fall through same height

(a). (A), (B) and (D) only (b). (A), (B) and (C) only

(c). (A), (B), (C) and (D) (d). (A), (C) and (D) only

Ans.: (d)

Solution.: Given $m_2 > m_1$ and $\lambda_2 < \lambda_1$.

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(A) $\lambda_1 = \frac{h}{m_1 v}$, $\lambda_2 = \frac{h}{m_2 v}$ $\Rightarrow \frac{\lambda_2}{\lambda_1} = \frac{m_1}{m_2} < 1$.

(B) $\lambda_1 = \frac{h}{p}$, $\lambda_2 = \frac{h}{p}$ $\Rightarrow \lambda_2 = \lambda_1$.

(C) $\lambda_1 = \frac{h}{\sqrt{2m_1 K}}$, $\lambda_2 = \frac{h}{\sqrt{2m_2 K}}$ $\Rightarrow \frac{\lambda_2}{\lambda_1} = \sqrt{\frac{m_1}{m_2}} < 1$.

(D) $\lambda_1 = \frac{h}{\sqrt{2m_1 K_1}}$, $\lambda_2 = \frac{h}{\sqrt{2m_2 K_2}}$. $\because K_2 = K_1 = mgh$ $\Rightarrow \frac{\lambda_2}{\lambda_1} = \sqrt{\frac{m_1}{m_2}} < 1$.

Q9. The zero-point energy of harmonic oscillator is:

(a) $\hbar\omega$ (b) $\frac{1}{2}\hbar\omega$ (c) $2\hbar\omega$ (d) $\frac{1}{4}\hbar\omega$

Ans.: (b)

Solution.: For one dimensional, quantum harmonic oscillator

$$E_n = \left(n + \frac{1}{2}\right)\hbar\omega \text{ where } n = 0,1,2,$$

For $n = 0$, $E_0 = \frac{1}{2}\hbar\omega$ is called zero-point energy.

Q10. Arrange the viscosities of the following fluids in descending order

(A). Glycerine (B). Honey (C). Machine oil (D). Blood

Choose the correct answer from the options given below

(a) (A), (B), (C), (D) (b) (A), (C), (B), (D)

(c) (B), (A), (D), (C) (d) (C), (B), (D), (A)

Ans.: (a)

Q15. Which one of the following pairs of phenomena illustrates the particle aspect of wave particle duality?

(a). Compton effect and Bragg's law

(b). Photoelectric effect and Compton effect

(c). Compton effect and Pauli's principle

(d). Bragg's law and Photoelectric effect

Ans.: (b)

Solution.:

Particle nature

(i) **Compton effect**: Scattering of photon by an electron.

(ii) **Photoelectric effect**: emission of photo electrons from metal surface by the absorption of light photon.

Wave nature

(i) **Bragg's law**: diffraction of X-rays by crystal planes.

(ii) Interference, Diffraction, Polarisation

Q21. Match List I with List II

	List I **Physical quantity**		**List II** **Symbols have their usual meaning**
A.	Stopping potential =	I.	$\frac{h}{\sqrt{2mK_{max}}}$
B.	Work function =	II.	$\frac{\phi_0}{h}$
C.	Threshold frequency =	III.	$E-K_{max}$
D.	De-Broglie wavelength =	IV.	$\frac{K_{max}}{e}$

Choose the correct answer from the options given below:

(a). (A)-(I), (B)-(II), (C)-(III), (D)-(IV) (b). (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

(c). (A)-(III), (B)-(II), (C)-(IV), (D)-(I) (d). (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

Ans.: (d)

Solution.:

(A) $K_{max}=eV_s$ (B) $W=E-K_{max}=h\nu-eV_s$

(C) $W=h\nu_{th}$ (D) $\lambda=\frac{h}{\sqrt{2mK}}$

Q23. Arrange the following materials in the descending order of resistivity:

(A). Aluminium (B). Copper

(C). Silver (D). Tungsten

Choose the correct answer from the options given below:

(a). (A), (B), (C), (D) (b). (B), (A), (C), (D)

(c). (B), (A), (D), (C) (d). (D), (A), (B), (C)

Ans.: (d)

Q24. Arrange the following in ascending order of energy

(A). Radio waves (B). Microwaves (C). Infrared rays (D). X-rays

Choose the correct answer from the options given below:

(a). (A), (B), (C), (D) (b). (A), (C), (B), (D)

(c). (B), (A), (D), (C) (d). (C), (B), (D), (A)

Ans.: (a)

Solution.: Ascending order of energy:

Radiowaves < Microwaves < Infrared waves < X-rays

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Q38. Match List I with List II

	List I Physical quantity		List II Dimensions
A.	Planck's constant	I.	$\left[ML^2T^{-2}\right]$
B.	Stopping potential	II.	$\left[ML^2T^{-3}A^{-1}\right]$
C.	Work functions	III.	$\left[ML^2T^{-1}\right]$
D.	de-Broglie wavelength	IV.	$[L]$

Choose the correct answer from the options given below:

(a). (A)-(I), (B)-(II), (C)-(III), (D)-(IV) (b). (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

(c). (A)-(I), (B)-(II), (C)-(IV), (D)-(III) (d). (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

Ans.: (b)

Solution.:

(A) $h=\dfrac{E}{\nu}\Rightarrow[h]=\dfrac{[E]}{[\nu]}=\dfrac{\left[ML^2T^{-2}\right]}{\left[T^{-1}\right]}\Rightarrow[h]=\left[ML^2T^{-1}\right]$

(B) $\left[V_s\right]=\dfrac{[K]}{[q]}=\dfrac{\left[ML^2T^{-2}\right]}{[AT]}=\left[ML^2T^{-3}A^{-1}\right]$

(C) $[W]=[K]=\left[ML^2T^{-2}\right]$

(D) $[\lambda]=[L]$

Q45. Two particles are moving in opposite directions each other with a speed of $0.9c$ in laboratory frame of reference. The relative velocity of one particle to other is:

(a) $0.90c$ (b) $0.99c$ (c) $1.8c$ (d) $0.81c$

Ans.: (b)

Solution.:

$$v_{AB}=\frac{(0.9c)-(-0.9c)}{1-\dfrac{(0.9c)(-0.9c)}{c^2}}=\frac{1.8c}{1.81}\Rightarrow v_{AB}=0.99c$$

Q63. The following particle are moving with the same velocity, arrange their associated de-Broglie wavelength in increasing order:

(A) electron (B) proton (C) neutron (D) α -particle

Choose the correct answer from the options given below:

a. (A), (D), (C), (B) b. (D), (C), (D), (A)

c. (B), (A), (D), (C) d. (C), (B), (D), (A)

Ans.: (b)

Solution.:

$m_\alpha > m_n > m_p > m_e$

$\because \lambda=\dfrac{h}{mv}\Rightarrow \lambda_\alpha < \lambda_n < \lambda_p < \lambda_e$

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Solution- Solid State Physics, Devices and Electronics

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Q18. If a *Si* wafer with an intrinsic carrier concentration of 10^{10}cm^{-3} is doped with $5\times10^{15}\text{cm}^{-3}$ Phosphorus (P) and 10^{16}cm^{-3} Boron (B) at room temperature (300 K), then what is the doping in the resultant silicon?

(a) Intrinsic (b) n-type (c) p-type (d) unpredictable

Ans.: (c)

Solution.:

Phosphorus (P) is pentavalent impurity so $N_D = 5\times10^{15}\text{cm}^{-3}$

Boron (B) is trivalent impurity so $N_A = 10^{16}\text{cm}^{-3} = 10\times10^{15}\text{cm}^{-3}$.

Thus $N_A > N_D$ then resulting silicon is p-type.

Q35. Which of the following are correct statements about logic gates and their combinations:

(A). The output of an EX-OR gate is a logic '1' when the inputs are unlike and a logic '0' when the inputs are like.

(B). The output of a NAND gate is a logic '1' when all its inputs are a logic '1'.

(C). The output of a two input EX-NOR gate is a logic '1' when the inputs are like and a logic '0' when they are unlike.

(D). The shorting the inputs of a NOR gate gives a NOT circuit.

Choose the ***correct*** answer from the options given below:

a. (A), (C) and (D) only b. (A), (B) and (C) only

c. (A), (B), (C) and (D) d. (B), (C) and (D) only

Ans.: (a)

Q37. Match List I with List II

	List I (Device)		**List II (Applications)**
A.	Diode	I.	Oscillator
B.	Zener diode	II.	Amplifier
C.	Tunnel diode	III.	Rectifier
D.	Transistor	IV.	Voltage Regulator

Choose the ***correct*** answer from the options given below:

(a). (A)-(I), (B)-(II), (C)-(III), (D)-(IV) (b). (A)-(I), (B)-(III), (C)-(II), (D)-(IV)

(c). (A)-(I), (B)-(II), (C)-(IV), (D)-(III) (d). (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

Ans.: (d)

Q42. The Fermi level in an n-type semiconductor at 0K lies

(a). below the donor level

(b). half way between the bottom of conduction band and donor level

(c). half way between the top of valence band and the acceptor level

(d). coincides with intrinsic Fermi level

Ans.: (b)

Q48. For a BJT, assume that V_{BE} varies between 0.6 and 0.8V from cutoff to saturation. Determine the percentage change in V_{CE} if V_{CB} is maintained constant at $5V$?

(a) 3.6% (b) 1.3% (c) 2.3% (d) No change

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Ans.: (a)

Solution.: $V_{CE} = V_{CB} + V_{BE}$; $V_{CE1} = 5V + 0.6V = 5.6V$, $V_{CE2} = 5V + 0.8V = 5.8V$

Percentage change in V_{CE} is $= \frac{V_{CE2} - V_{CE1}}{V_{CE1}} \times 100 = \frac{5.8 - 5.6}{5.6} \times 100 = 3.57\% \approx 3.6\%$

Q51. In a transistor, the emitter-base depletion layer is narrower than the collector-base depletion layer. The reason can be attributed to

(a). heavier doping in the emitter region and lighter doping in collector region

(b). heavier doping in the collector region and lighter doping in emitter region

(c). lighter doping in both emitter and collector region

(d). heavier doping in both emitter and collector region

Ans.: (a)

Q52. Consider the following statements:

(A). The output of a linear OP-amp circuit has the same shape as the input signal.

(B). At no time during the cycle does the OP-amp go into saturation.

(C). Non-inverting amplifier posses low input impedance and high output impedance.

(D). One advantage of inverting amplifier is that its voltage gain equals the ratio of the feedback resistance to the input resistance.

Choose the correct answer from the options given below:

(a). (A), (B) and (D) only

(b). (A), (B) and (C) only

(c). (A), (B), (C) and (D)

(d). (B), (C) and (D) only

Ans.: (a)

Q54. Arrange the following in ascending order in accordance to coordination number

(A). Face centered cubic structured *Au*

(B). Body centered cubic structured *Na*

(C). Diamond

(D). *NaCl*

Choose the ***correct*** answer from the options given below:

(a). (A), (B), (D), (C)

(b). (A), (B), (C), (D)

(c). (B), (A), (D), (C)

(d). (C), (B), (D), (A)

Ans.: (d)

Q57. Match List I with List II

	List I (Bravais lattice)		**List II (Features)**
A.	Triclinic	I.	$a \neq b \neq c,\ \alpha \neq \beta \neq \gamma \neq 90°$
B.	Tetragonal	II.	$a = b \neq c,\ \alpha = \beta = \gamma = 90°$
C.	Trigonal	III.	$a \neq b \neq c,\ \alpha = \gamma = 90° \neq \beta$
D.	Monoclinic	IV.	$a = b = c,\ \alpha = \beta = \gamma \neq 90°$

Choose the correct answer from the options given below:

(a). (A)-(I), (B)-(II), (C)-(III), (D)-(IV) (b). (A)-(I), (B)-(III), (C)-(II), (D)-(IV)

(c). (A)-(I), (B)-(II), (C)-(IV), (D)-(III) (d). (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

Ans.: (c)

Q64. Match List I with List II

	List I		**List II**
A.	$\bar{A}.E+A.\bar{E}$	I.	$(A+E).(A+\bar{E})$
B.	$A.E+\bar{A}.\bar{E}$	II.	$(A+E).(\bar{A}+\bar{E})$
C.	A	III.	$(A+\bar{E}).(\bar{A}+E)$
D.	A.E	IV.	$(A+\bar{E}).E$

Choose the correct answer from the options given below:

a. (A)-(I), (B)-(II), (C)-(III), (D)-(IV) b. (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

c. (A)-(II), (B)-(III), (C)-(I), (D)-(IV) d. (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

Ans.: (c)

Solution.:

I. $(A+E).(A+\bar{E}) = AA + A\bar{E}+EA+E\bar{E}=A+AE+A\bar{E}=A(1+E+\bar{E}) = A$ matches with C.

II. $(A+E).(\bar{A}+\bar{E}) = A\bar{A} + A\bar{E}+E\bar{A}+E\bar{E}=0+A\bar{E}+E\bar{A}=A\bar{E}+E\bar{A}$ matches with A.

III. $(A+\bar{E}).(\bar{A}+E) = A\bar{A} + AE+\bar{E}\bar{A}+\bar{E}E=0+AE+\bar{E}\bar{A}+0=AE+\bar{E}\bar{A} = \bar{E}$ matches with B.

IV. $(A+\bar{E}).E = AE+\bar{E}E=AE$ matches with D.

Q65. Determine the decimal equivalent of $(1100.1011)_2$

(a) 12.6875 (b) 12.6785 (c) 13.6875 (d) 11.6785

Ans.: (a)

Solution.: $(1100.1011)_2 = 1\times 2^3+1\times 2^2+0\times 2^1+0\times 2^0.1\times 2^{-1}+0\times 2^{-2}+1\times 2^{-3}+1\times 2^{-4}$

$(1100.1011)_2 = (8+4+0+0)+0.5+0+0.125+0.0625 = (12.6875)_{10}$

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