

AIEEE 2007 Solved Paper

Mathematics

Q. 1. In a geometric progression consisting of positive terms, each term equals the sum of the next two terms. Then the common ratio of this progression equals

a. $\frac{1}{2}(1 - \sqrt{5})$

b.

$\frac{1}{2}\sqrt{5}$

c.

$\sqrt{5}$

d.

$\frac{1}{2}(\sqrt{5} - 1)$

Sol: Let geometric progression is a, ar, ar^2, \dots ; ($a, r > 0$)

$$\ominus a = ar + ar^2 \Rightarrow r^2 + r - 1 = 0 \Rightarrow r = \frac{-1 \pm \sqrt{5}}{2} \Rightarrow r = \frac{\sqrt{5} - 1}{2}$$

Correct choice: (4)

$$-1\left(\frac{x}{5}\right) + \cos^{-1}\left(\frac{5}{4}\right) = \frac{\pi}{2}$$

Q. 2. If $\sin^{-1}\left(\frac{x}{5}\right) + \cos^{-1}\left(\frac{5}{4}\right) = \frac{\pi}{2}$ then a value of x is.

a. 1

b. 3

c. 4

d. 5

$$\sin^{-1}\left(\frac{x}{5}\right) + \cos^{-1}\left(\frac{5}{4}\right) = \frac{\pi}{2} \Rightarrow \sin^{-1}\left(\frac{x}{5}\right) = \frac{\pi}{2} - \cos^{-1}\left(\frac{5}{4}\right) \Rightarrow x = 3$$

Sol:

Correct choice: (2)

Q. 3. In the binomial expansion of

$(a - b)^n$, $n \geq 5$, the sum of 5th and 6th terms is zero, then $\frac{a}{b}$ equals

a. $\frac{5}{n-4}$

b.

$$\frac{6}{n-5}$$

b.

$$\frac{n-5}{6}$$

c.

$$\frac{n-4}{6}$$

d.

$$\ominus T_5 + T_6 = 0 \Rightarrow {}^nC_4 a^{n-4} (-b)^4 + {}^nC_5 a^{n-5} (-b)^5 = 0 \Rightarrow \frac{a^{n-4} b^4}{a^{n-5} b^5} = \frac{{}^nC_5}{{}^nC_4} \Rightarrow \frac{a}{b} = \frac{n-4}{5}$$

Sol:

orrect choice: (4)

Q. 4. The set $S : \{1, 2, 3, \dots, 12\}$ is to be partitioned into three sets A, B, C of equal size.

$$A \cup B \cup C = S, A \cap B = B \cap C = A \cap C = \phi$$

Thus,

The number of ways to partition S is

$$\frac{12!}{3! (4!)^3}$$

a.

$$\frac{12!}{3! (3!)^4}$$

b.

$$\frac{12!}{(4!)^3}$$

c.

$$\frac{12!}{(3!)^4}$$

d.

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Sol: 12 different objects are to be divided into 3 groups of equal size, which are named as set A, B and

$$\Rightarrow \text{Number of ways} = \frac{12!}{(4!)^3 \cdot 3!} \times 3! = \frac{(12)!}{(4!)^3}$$

C.

Correct choice: (3)

$$\left(-\frac{\pi}{2}, \frac{\pi}{2} \right)$$

Q. 5. The largest interval lying in for which the function

$\left[f(x) = 4^{-x^2} + \cos^{-1} \left(\frac{x}{2} - 1 \right) + \log (\cos x) \right]$ is defined, is

a. $[0, \pi]$

b.

$\left(-\frac{\pi}{2}, \frac{\pi}{2} \right)$

c.

$\left[-\frac{\pi}{4}, \frac{\pi}{2} \right)$

d.

$\left[0, \frac{\pi}{2} \right)$

a.

Sol:

$$f(x) = 4^{-x^2} + \cos^{-1} \left(\frac{x}{2} - 1 \right) + \log (\cos x)$$

4^{-x^2} is defined for $\forall x \in R$(i)

$\cos^{-1} \left(\frac{x}{2} - 1 \right)$ is defined when $-1 \leq \frac{x}{2} - 1 \leq 1$, i.e when $0 \leq x \leq 4$(ii)

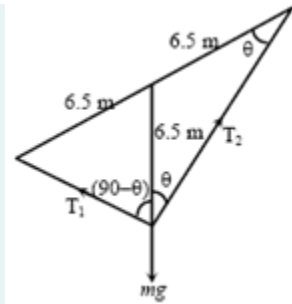
$\log \cos x$ is defined when $\cos x > 0$, i.e when $x \in \left(-\frac{\pi}{2}, \frac{\pi}{2} \right)$(iii)

from (i), (ii) and (iii), we have domain of $f(x)$ as $\left[0, \frac{\pi}{2} \right)$

Correct choice: (4)

Q. 6. A body weighing 13 kg is suspended by two strings 5 m and 12 m long, their other ends being fastened to the extremities of a rod 13 m long. If the rod be so held that the body hangs immediately below the middle point. The tensions in the strings are

- 12 kg and 13 kg
- 5 kg and 5 kg
- 5kg and 12 kg
- 5 kg and 13 kg



$$T_2 \cos \theta + T_1 \sin \theta = mg, \quad T_2 \sin \theta + T_1 \cos \theta = mg \cos \theta$$

$$T_1 = mg \sin \theta, \quad \tan \theta = \frac{5}{12}$$

$$T_1 = (13 \text{ kg}) \frac{5}{13} = 5 \text{ kg}, \quad T_2 = (13 \text{ kg}) \frac{12}{13} = 12 \text{ kg}$$

Sol:

So tension in the strings are 5 kg and 12 kg. Correct choice: (3)

Q. 7. A pair of fair dice is thrown independently three times. The probability of getting a score of exactly 9 twice is

a. $\frac{1}{729}$

b. $\frac{8}{9}$

c. $\frac{8}{729}$

d. $\frac{8}{243}$

$$= \frac{1}{9}$$

Sol: Probability of getting sum of nine in a single throw

$$= {}^3C_2 \left(\frac{1}{9}\right)^2 \left(\frac{8}{9}\right) = \frac{8}{243}$$

Probability of getting sum nine exactly two times out of three draws

correct choice: (4)

Q. 8. Consider a family of circles which are passing through the point $(-1, 1)$ and are tangent to x-axis. If (h, k) , are the co-ordinates of the centre of the circles, then the set of values of k is given by the interval

$$0 < k < \frac{1}{2}$$

a.

$$k \geq \frac{1}{2}$$

b.

$$-\frac{1}{2} \leq k \leq \frac{1}{2}$$

c.

$$\leq \frac{1}{2}$$

d.

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$$= |k|$$

Sol: Centre of circle is (h, k) and x-axis is tangent. Radius of the family of circle

Also circle passes through

$$(-1, 1) \Rightarrow (1+h)^2 + (1-k)^2 = k^2 \Rightarrow h^2 + 2h + 2 - 2k = 0 \text{ for real } h, k \geq \frac{1}{2}$$

Correct choice: (2)

Q. 9. Let L be the line of intersection of the planes $2x + 3y + z = 1$ and $x + 3y + 2z = 2$. If L makes an angle α with the positive x-axis, then $\cos \alpha$ equals

$$\frac{1}{\sqrt{3}}$$

a.

$$\frac{1}{2}$$

b.

c. 1

$$\frac{1}{\sqrt{2}}$$

d.

Sol:

Vector normal to the plane $2x + 3y + z = 1$ is $\vec{p}_a = 2\hat{i} + 3\hat{j} + \hat{k}$

Vector normal to the plane $x + 3y + 2z = 2$ is $\vec{p}_b = \hat{i} + 3\hat{j} + 2\hat{k}$

Vector parallel to line of intersection of given planes $= \vec{p}_a \times \vec{p}_b = 3\hat{i} - 3\hat{j} + 3\hat{k}$

Angle α between $3\hat{i} - 3\hat{j} + 3\hat{k}$ and \hat{i} is given by $\cos \alpha = \frac{1}{\sqrt{3}}$

Correct choice: (1)

Q. 10. The differential equation of all circles passing through the origin and having their centres on the x-axis is

$$x^2 = y^2 + xy \frac{dy}{dx}$$

a.

$$x^2 = y^2 + 3xy \frac{dy}{dx}$$

b.

$$y^2 = x^2 + 2xy \frac{dy}{dx}$$

c.

$$y^2 = x^2 - 2xy \frac{dy}{dx}$$

d.

Sol: Equation of family of circles passing through origin and having their centres on x-axis is

$$x^2 = y^2 - 2xh = 0 \dots (i)$$

Differentiating w.r.t x we have $2x + 2y \frac{dy}{dx} - 2h = 0 \dots (ii)$

Eliminating 'h' from (i) and (ii), we have $y^2 = x^2 + 2xy \frac{dy}{dx}$

Correct choice: (3)

$$p^2 + q^2 = 1,$$

Q. 11. If p and q are positive real numbers such that then the maximum value of (p + q) is

a. 2

$$1/2$$

b.

$$1/\sqrt{2}$$

c.

$$\sqrt{2}$$

d.

$$\text{Let } p = \cos \theta \text{ and } q = \sin \theta, \theta \in \left(0, \frac{\pi}{2}\right) \Rightarrow p + q = \cos \theta + \sin \theta \leq \sqrt{2}$$

Sol:

Correct choice: (4)

Q. 12. A tower stands at the centre of a circular park. A and B are two points on the boundary of the park such

$$AB (= a)$$

that AB subtends an angle of 60° at the foot of the tower, and the angle of elevation of the top of the tower from A or B is 30° . The height of the tower is

$$\frac{2a}{\sqrt{3}}$$

a.

$$2a\sqrt{3}$$

b.

$$\frac{a}{\sqrt{3}}$$

c.

$$a\sqrt{3}$$

d.

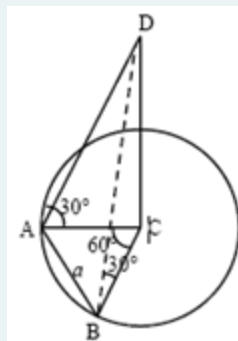
$$\ominus \angle ACB = 60^\circ$$

\Rightarrow Triangle ABC is an equilateral triangle

\Rightarrow Radius of circle = a

$$\text{Now } \frac{DC}{AC} = \tan 30^\circ \Rightarrow DC = \frac{a}{\sqrt{3}}$$

Sol:



Correct choice: (3)

$${}^{20}C_0 - {}^{20}C_1 + {}^{20}C_2 - {}^{20}C_3 + \dots + {}^{20}C_{10} \text{ is}$$

Q. 13. The sum of the series

a. $- {}^{20}C_{10}$

b. $\frac{1}{2} {}^{20}C_{10}$

c. 0

d. ${}^{20}C_{10}$

Sol:

$$\begin{aligned} & \ominus {}^{20}C_0 - {}^{20}C_1 + {}^{20}C_2 - {}^{20}C_3 + \dots - {}^{20}C_9 + {}^{20}C_{10} - {}^{20}C_{11} + {}^{20}C_{12} - \dots + {}^{20}C_{20} = 0 \\ \Rightarrow & 2 \left\{ {}^{20}C_0 - {}^{20}C_1 + {}^{20}C_2 - \dots - {}^{20}C_9 \right\} + {}^{20}C_{10} = 0 \\ \Rightarrow & 2 \left\{ {}^{20}C_0 - {}^{20}C_1 + {}^{20}C_2 - \dots - {}^{20}C_9 + {}^{20}C_{10} \right\} = {}^{20}C_{10} \\ \Rightarrow & {}^{20}C_0 - {}^{20}C_1 + {}^{20}C_2 - \dots + {}^{20}C_{10} = \frac{1}{2} {}^{20}C_{10} \end{aligned}$$

Correct choice: (2)

Q. 14. The normal to a curve at P(x, y) meets the x-axis at G. If the distance of G from the origin is twice the abscissa of P, then the curve is a

- a. ellipse
- b. parabola
- c. circle
- d. hyperbola

Sol:

$$\begin{aligned} & \ominus |x + my| = 2x \Rightarrow x + my = \pm 2x \Rightarrow ydy = xdx \text{ or } ydy \\ & = -3xdx \Rightarrow \frac{y^2}{2} = \frac{x^2}{2} + \text{(which is hyperbola)} \\ & \text{or } \frac{3x^2}{2} + \frac{y^2}{2} = k \text{ (which is an ellipse)} \end{aligned}$$

Correct choice: (1, 4)

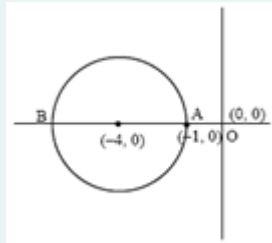
If $|z + 4| \leq 3$, then the maximum value of $|z + 1|$ is

Q. 15.

- a. 4
- b. 10
- c. 6
- d. 0

Sol:

If $|z + 4| \leq 3$, then the maximum value of $|z + 1|$ is
 $\Rightarrow z$ lies inside or on the circle of radius 3 and centre at $(-4, 0)$
 \Rightarrow maximum value of $|z + 1|$ is 6.



Correct choice: (3)

Q. 16. The resultant of two forces P N and 3 N is a force of 7 N. If the direction of 3 N force were reversed, the resultant would be $\sqrt{19}$ N. The value of P is

- a. 5 N
- b. 6 N
- c. 3 N
- d. 4 N

Sol:

$$\begin{aligned} \ominus 7^2 &= P^2 + 9 + 6P \cos \theta \Rightarrow 6P \cos \theta = 40 - P^2 \\ \text{and } 19 &= P^2 + 9 + 6P \cos (\pi - \theta) \Rightarrow 19 = P^2 + 9 - 6P \cos \theta \\ \Rightarrow 19 &= P^2 + 9 - 40 + P^2 \{u \sin g (i)\} \\ \Rightarrow P &= 5 \text{ N} \end{aligned}$$

Correct choice: (1)

Q. 17. Two aeroplanes I and II bomb a target in succession. The probabilities of I and II scoring a hit correctly are 0.3 and 0.2 , respectively. The second plane will bomb only if the first misses the target. The probability that the target is hit by the second plane is

- a. 0.06
- b. 0.14
- c. 0.2
- d. 0.7

Sol:

$$P(I) = 0.3, P(II) = 0.2$$

$$\begin{aligned} \text{Required probability} &= P(\bar{I}) \cdot P(II) + P(I) \cdot P(\bar{II}) + \dots \\ &= (0.7)(0.2) + (0.3)(0.8) + \dots \\ &= \frac{7}{22} \end{aligned}$$

No choice is correct

$$\text{If } D = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+x & 1 \\ 1 & 1 & 1+y \end{vmatrix} \text{ for } x \neq 0, y \neq 0 \text{ then } D \text{ is}$$

Q. 18.

- divisible by neither x nor y
- divisible by both x and y
- divisible by x but not y
- divisible by y but not x

Sol:

$$\begin{aligned} D &= \begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+x & 1 \\ 1 & 1 & 1+y \end{vmatrix} \begin{array}{l} C_3 \rightarrow C_3 - C_1 \\ C_2 \rightarrow C_2 - C_1 \end{array} \\ &= \begin{vmatrix} 1 & 0 & 0 \\ 1 & x & 0 \\ 1 & 0 & y \end{vmatrix} \end{aligned}$$

Correct choice: (2)

$$\frac{x^2}{\cos^2 \alpha} - \frac{y^2}{\sin^2 \alpha} = 1,$$

Q. 19. For the hyperbola

which of the following remains constant when α varies?

- Eccentricity
- Directrix
- Abscissae of vertices
- Abscissae of foci

Sol:

$$\frac{x^2}{\cos^2 \alpha} - \frac{y^2}{\sin^2 \alpha} = 1,$$

$$\ominus b^2 = a^2 (e^2 - 1) \Rightarrow \sin^2 \alpha = \cos^2 \alpha (e^2 - 1) \Rightarrow e^2 = \tan^2 \alpha + 1 = \sec^2 \alpha \\ \Rightarrow e = \sec \alpha$$

$$\text{Directrix : } x = \pm \frac{a}{e} = \pm \cos^2 \alpha$$

$$\text{Abscissae of vertices} = \pm a = \pm \cos \alpha$$

$$\text{ABSCISSAE F FOCI} = \pm ae = \pm \cos \alpha \cdot \sec \alpha = \pm 1$$

Correct choice: (4)

$$\frac{\pi}{4}$$

Q. 20. If a line makes an angle of $\frac{\pi}{4}$ with the positive directions of each of x-axis and y-axis, then the angle that the line makes with the positive direction of the z-axis is

$$\frac{\pi}{6}$$

a.

$$\frac{\pi}{3}$$

b.

$$\frac{\pi}{4}$$

c.

$$\frac{\pi}{2}$$

d.

Sol:

$$\ominus \cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = 1 \Rightarrow \frac{1}{2} + \frac{1}{2} + \cos^2 \gamma = 1 \text{ as } \alpha = \beta = \frac{\pi}{4}$$

$$\Rightarrow \cos^2 \gamma = 0 \Rightarrow \gamma = \frac{\pi}{2}$$

Correct choice: (4)

$$f(x) = \log_e x$$

Q. 21. A value of C for which the conclusion of Mean Value Theorem holds for the function $f(x) = \log_e x$ on the interval [1, 3] is

$$2 \log_3 e$$

a.

$$\frac{1}{2} \log_e 3$$

b.

$$\log_3 e$$

c.

$$\log_e 3$$

d.

$$f'(C) = \frac{f(3) - f(1)}{2} \Rightarrow \frac{1}{C} = \frac{\log_e 3}{2} \Rightarrow C = 2 \log_3 e$$

Sol:

Correct choice: (1)

$$f(x) = \tan^{-1}(\sin x + \cos x)$$

Q. 22. The function

is an increasing function in

$$\left(\frac{\pi}{4}, \frac{\pi}{2}\right)$$

a.

$$\left(-\frac{\pi}{2}, \frac{\pi}{4}\right)$$

b.

$$\left(0, \frac{\pi}{2}\right)$$

c.

$$\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$$

d.

Sol:

$f(x) = \tan^{-1}(\sin x + \cos x)$ is increasing if $(\sin x + \cos x)$ is increasing

$$\Rightarrow \cos x - \sin x > 0 \Rightarrow \cos x > \sin x \Rightarrow x \in \left(-\frac{\pi}{2}, \frac{\pi}{4}\right)$$

Correct choice: (2)

$$\text{Let } A = \begin{bmatrix} 5 & 5\alpha & \alpha \\ 0 & \alpha & 5\alpha \\ 0 & 0 & 5 \end{bmatrix}. \text{ If } |A^2| = 25, \text{ then } |\alpha| \text{ equals}$$

$$5^2$$

a.

b. 1

$$\frac{1}{5}$$

- c.
d. 5

Sol:

$$A = \begin{bmatrix} 5 & 5\alpha & \alpha \\ 0 & \alpha & 5\alpha \\ 0 & 0 & 5 \end{bmatrix} \Rightarrow |A.A| = |A||A| = (25\alpha)^2 = 25 \Rightarrow \alpha^2 = \frac{1}{25} \Rightarrow \alpha = \pm \frac{1}{5}$$

Correct choice: (3)

The sum of series $\frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} - \dots$ upto infinity is

Q. 24.

$$e^{-2}$$

a.

$$e^{-1}$$

b.

$$e^{-\frac{1}{2}}$$

c.

$$e^{+\frac{1}{2}}$$

d.

Sol:

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots \quad \text{Put } x = -1$$

$$\Rightarrow \frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} - \dots = e^{-1}$$

Correct choice: (2)

\hat{u} and \hat{v}

$$2\hat{u} \times 3\hat{v}$$

Q. 25. If are unit vectors and θ is the acute angle between them, then is a unit vector for

$$\theta$$

a. Exactly two values of

$$\theta$$

b. More than two values of

$$\theta$$

c. No value of

$$\theta$$

d. Exactly one value of

Sol:

$$|2\hat{u} \times 3\hat{v}| \cdot 6|\hat{u} \times \hat{v}| = 1$$

$$\Rightarrow |\hat{u} \times \hat{v}| = \frac{1}{6} \Rightarrow \sin \theta = \pm \frac{1}{6}$$

As θ is acute angle for $\sin \theta = \frac{1}{6}$. So θ can take only one Value.

Correct choice: (4)

Q. 26. A particle just clears a wall of height b at a distance a and strikes the ground at a distance c from the point of projection. The angle of projection is

$$\tan^{-1} \frac{b}{ac}$$

a.

$$45^\circ$$

b.

$$\tan^{-1} \frac{bc}{a(c-a)}$$

c.

$$\tan^{-1} \frac{bc}{a}$$

d.

Sol:

$$b = a \tan \alpha - \frac{1}{2} \frac{ga^2}{u^2 \cos^2 \alpha} \text{ (equation of trajectory)}$$

$$\text{So, } c = \frac{u^2 \sin 2\alpha}{g} \Rightarrow \frac{g}{u^2} = \frac{\sin 2\alpha}{c}$$

$$\text{So, } b = a \tan \alpha - \frac{1}{2} \times \frac{a^2 \sin 2\alpha}{c \cos^2 \alpha} \Rightarrow b = a \tan \alpha - \frac{a^2}{c} \tan \alpha$$

$$\Rightarrow b = \left(\frac{ac - a^2}{c} \right) \tan \alpha \Rightarrow \tan \alpha = \frac{bc}{a(c-a)}$$

Correct choice: (3)

Q. 27. The average marks of boys in a class is 52 and that of girls is 42. The average marks of boys and girls combined is 50. The percentage of boys in the class is

a. 40

b. 20

c. 80

d. 60

Sol: Let there are x boys and y girls in the class. So, total marks are $52x + 42y$ and according to second condition total marks = $(x + y) 50$

$$52x + 42y = 50x + 50y \Rightarrow 2x = 8y \Rightarrow x = 4$$

Now,

So percentage of boys is 80.

Correct choice: (3)

$$y^2 = 8x \text{ is } y = x + 2.$$

Q. 28. The equation of a tangent to the parabola tangent to the parabola is perpendicular to the given tangent is

The point on this line from which the other

- a. $(-1, 1)$
- b. $(0, 2)$
- c. $(2, 4)$
- d. $(-2, 0)$

Sol: Point of intersection of two perpendicular tangents to the parabola lies on directrix of the parabola. Equation of directrix is $x + 2 = 0$

So point is $(-2, 0)$ Correct choice: (4)

$$x^2 + y^2 + z^2 - 6x - 12y - 2z + 20 = 0,$$

Q.29. If $(2, 3, 5)$ is one end of a diameter of the sphere coordinates of the other end of the diameter are

then the

- a. $(4, 9, -3)$
- b. $(4, -3, 3)$
- c. $(4, 3, 5)$
- d. $(4, 3, -3)$

Sol: Centre $(3, 6, 1)$

$$(\alpha, \beta, \gamma)$$

$$\text{So, } \frac{\alpha + 2}{2} = 3, \frac{\beta + 3}{2} = 6, \frac{\gamma + 5}{2} = 1 \Rightarrow \alpha = 4, \beta = 9, \gamma = -3$$

Let other end is

Correct choice: (1)

$$\text{Let } \vec{a} = \hat{i} + \hat{j} + \hat{k}, \vec{b} = \hat{i} - \hat{j} + 2\hat{k} \text{ and } \vec{c} = x\hat{i} + (x-2)\hat{j} - \hat{k}.$$

If the vector \vec{c} lies in the plane of \vec{a} and \vec{b} , then x equals

Q. 30.

- a. 0
- b. 1
- c. -4
- d. -2

Sol:

$$\begin{vmatrix} 1 & 1 & 1 \\ 1 & -1 & 2 \\ x & x-2 & -1 \end{vmatrix} = 0 \Rightarrow 1(1-2(x-2)) - 1(-1-2x) + 1(x-2+x) = 0$$

$$\Rightarrow 2x + 4 = 0 \Rightarrow x = -2$$

Correct choice: (4)

Q. 31. Let A (h, k), B (1, 1) and C (2, 1) be the vertices of a right angled triangle with AC as its hypotenuse. If the area of the triangle is 1, then the set of values which 'k' can take is given by

$\{1, 3\}$

a.

$\{0, 2\}$

b.

$\{-1, 3\}$

c.

$\{-3, -2\}$

d.

$$A = \frac{1}{2} \cdot 1 \cdot |k-1| = 1 \Rightarrow k-1 = 2 \text{ or } -2 \Rightarrow k = 3, -1$$

Sol:

Correct choice: (3)

Let $P = (-1, 0)$, $Q = (0, 0)$ and $R = (3, 3\sqrt{3})$

Q. 32. be three points. The equation of the bisector of the angle PQR is

$\sqrt{3}x + y = 0$

a.

$x + \frac{\sqrt{3}}{2}y = 0$

b.

$\frac{\sqrt{3}}{2}x + y = 0$

c.

$x + \sqrt{3}y = 0$

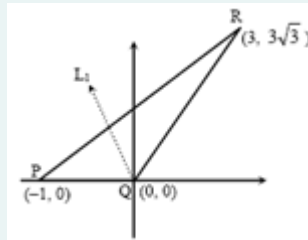
d.

Sol:

Slope of $QR = \sqrt{3}$. So, $\angle PQR = 120^\circ$

So $m_{L_1} = \tan 120^\circ = -\sqrt{3}$

So equation of L_1 is $y = -\sqrt{3}x$



Correct choice: (1)

$$my^2 + (1 - m^2)xy - mx^2 = 0$$

Q. 33. If one of the lines of is a bisector of the angle between the lines $xy = 0$, then m is

$$-\frac{1}{2}$$

- a.
- b. -2
- c. 1
- d. 2

Sol:

$$my^2 + (1 - m^2)xy - mx^2 = 0 \Rightarrow (y - mx)(my + x) = 0 \Rightarrow y = mx, -\frac{1}{m}x$$

So $m = 1$ or -1

Correct choice: (3)

$$\text{Let } F(x) = f(x) + f\left(\frac{1}{x}\right), \text{ where } f(x) = \int_1^x \frac{\log t}{1+t} dt. \text{ Then } F(e) \text{ equals}$$

Q. 34.

$$\frac{1}{2}$$

- a.
- b. 0
- c. 1
- d. 2

Sol:

$$F(x) = \int_1^x \frac{\log t}{1+t} dt + \int_1^{\frac{1}{x}} \frac{\log t}{1+t} dt = \int_1^x \frac{\log t}{1+t} dt + \int_1^x \frac{\log t}{t \cdot (1+t)} dt$$

$$= \int_1^x \frac{\log t}{1+t} dt \frac{(\log_e x)^2}{2}. \text{ So } F(e) = \frac{1}{2}$$

Correct choice: (1)

Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a function defined by $f(x) = \text{Min} \{x+1, |x|+1\}$.

Q. 35.

Then which of the following

is true?

$$f(x) \geq 1 \text{ for all } x \in \mathbb{R}$$

- a.
- b. $f(x)$ is not differentiable at $x = 1$.
- c. $f(x)$ is differentiable everywhere
- d. $f(x)$ is not differentiable at $x = 0$.

$$f(x) = x+1, \forall x \in \mathbb{R}$$

Sol:

Correct choice: (3)

$$\text{The function } f : \mathbb{R} \setminus \{0\} \rightarrow \mathbb{R} \text{ given by } f(x) = \frac{1}{x} - \frac{2}{e^{2x} - 1}$$

Q. 36.

can be made continuous at $x = 0$ by

defining $f(0)$ as

- a. 2
- b. -1
- c. 0
- d. 1

Sol:

$$f(0) = \lim_{x \rightarrow 0} \frac{e^{2x} - 1}{x(e^{2x} - 1)} = 2 \lim_{t \rightarrow 0} \frac{e^t - 1}{t(e^t - 1)}$$

$$= 2 \lim_{t \rightarrow 0} \frac{e^t - 1}{te^t + e^t - 1} \quad \text{By L'Hospital Rule}$$

$$= 2 \lim_{t \rightarrow 0} \frac{e^t - 1}{te^t + e^t + e^t} \quad \text{Again by L'Hospital Rule}$$

$$= 2 \times \frac{1}{2} = 1$$

Correct choice: (4)

$\int \frac{dx}{\cos x + \sqrt{3} \sin x}$ equals

37.

a. $\frac{1}{2} \log \tan \left(\frac{x}{2} + \frac{\pi}{12} \right) + C$

b.

b. $\frac{1}{2} \log \tan \left(\frac{x}{2} - \frac{\pi}{12} \right) + C$

c.

c. $\frac{1}{2} \log \tan \left(\frac{x}{2} - \frac{\pi}{12} \right) + C$

d.

d. $\log \tan \left(\frac{x}{2} + \frac{\pi}{12} \right) + C$

Sol:

$$\int \frac{dx}{\cos x + \sqrt{3} \sin x} = \frac{1}{2} \int \frac{dx}{\frac{\sqrt{3}}{2} \sin x + \frac{1}{2} \cos x} = \frac{1}{2} \int \frac{dx}{\sin \left(\frac{\pi}{6} + x \right)}$$

$$\Rightarrow \frac{1}{4} \int \frac{dx}{\sin \left(\frac{\pi}{12} + \frac{x}{2} \right) \cos \left(\frac{\pi}{12} + \frac{x}{2} \right)} = \frac{1}{2} \log \tan \left(\frac{\pi}{12} + \frac{x}{2} \right) + C$$

Correct choice: (1)

$y^2 = x$ and $y = |x|$ is

Q. 38. The area enclosed between the curves

a. $\frac{2}{3}$

b.

b. 1

c.

c. $\frac{1}{6}$

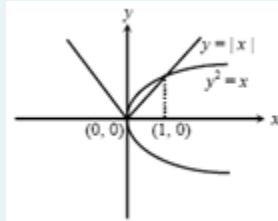
d.

d. $\frac{1}{3}$

Sol:

$$y^2 = x \text{ and } y = |x| \Rightarrow x^2 = x \Rightarrow x = 0 \text{ or } 1$$

$$\text{Required area} = \int_0^1 (\sqrt{x} - x) dx = \left[\frac{2}{3} x^{3/2} - \frac{x^2}{2} \right]_0^1 = \frac{2}{3} - \frac{1}{2} = \frac{1}{6}$$



Correct choice: (3)

$$x^2 + ax + 1 = 0 \text{ is less than } \sqrt{5}$$

Q. 39. If the difference between the roots of the equation $x^2 + ax + 1 = 0$ is less than $\sqrt{5}$ then the set of possible values of a is

- a. $(-3, 3)$
- b. $(-3, \infty)$
- c. $(3, \infty)$
- d. $(-\infty, -3)$

Sol:

$$\alpha + \beta = -a$$

$$|\alpha - \beta| < \sqrt{5} \Rightarrow (\alpha - \beta)^2 < 5 \Rightarrow a^2 - 4 < 5 \Rightarrow a \in (-3, 3)$$

Correct choice: (1)

AIEEE 2007 Solved Paper

Physics

Q. 1. The displacement of an object attached to a spring and executing simple harmonic motion is given

$$x = 2 \times 10^{-2} \cos \pi t$$

by $\frac{1}{\pi}$ metres. The time at which the maximum speed first occurs is

- a. 0.5 s
- b. 0.75 s
- c. 0.125 s

d. 0.25 s

$$|v| = (2 \times 10^{-2}) (\pi) \sin \pi t$$

For $|v|$ to be maximum $\sin \pi t = 1$

$$\pi t = \frac{\pi}{2}, \frac{3\pi}{2}, \dots, t = \frac{1}{2} \text{ s}$$

Sol:

Correct choice: (1)

$$E = E_0 \sin \omega t$$

Q. 2. In an a.c. circuit the voltage applied is . The resulting current in the circuit

$$I = I_0 \sin \left(\omega t - \frac{\pi}{2} \right)$$

is . The power consumption in the circuit is given by

$$P = \frac{E_0 I_0}{\sqrt{2}}$$

a.

b. $P = \text{zero}$

$$P = \frac{E_0 I_0}{2}$$

c.

$$P = \sqrt{2} E_0 I_0$$

d.

$$P = i_{\text{rms}}, v_{\text{rms}} \cos \phi, \phi = 90^\circ, P_{\text{av}} = 0$$

Sol.

Correct choice: (2)

$$10^{-3} \mu\text{C}$$

Q. 3. An electric charge is placed at the origin (0, 0) of X – Y co-ordinate system. Two points A and B are

$$\sqrt{2}, \sqrt{2}$$

situated at and (2, 0) respectively. The potential difference between the points A and B will be

a. 9 volt

b. zero

c. 2 volt

d. 4.5 volt

$$V_A = 9 \times 10^9 \frac{10^{-9}}{(2+2)^{\frac{1}{2}}} = 4.5 \text{ Volt}, \quad V_B = 9 \times 10^9 \frac{10^{-9}}{(4+0)^{\frac{1}{2}}}$$

$$= 4.5 \text{ Volt}, \quad V_A - V_B = 0$$

Sol:

Correct choice: (2)

Q. 4. A battery is used to charge a parallel plate capacitor till the potential difference between the plates becomes equal to the electromotive force of the battery. The ratio of the energy stored in the capacitor and the work done by the battery will be

a. 1

b. 2

c. $\frac{1}{4}$

d. $\frac{1}{2}$

$$= (CV)V = CV^2$$

Sol: Work done by battery

$$= \frac{1}{2} CV^2$$

Energy stored in capacitor

$$\frac{\text{Energy stored in Capacitor}}{\text{Work done by battery}} = \frac{\frac{1}{2} CV^2}{CV^2} = \frac{1}{2}$$

Correct choice: (4)

$$5 \Omega$$

Q. 5. An ideal coil of 10 H is connected in series with a resistance of 5Ω and a battery of 5V. 2 seconds after the connection is made, the current flowing in amperes in the circuit is

a. $(1 - e)$

b. e

c. e^{-1}

d. $(1 - e^{-1})$

$$i = i_0 [1 - e^{-Rt/L}] \quad i = \frac{5}{5} [1 - e^{-5t/10}] \quad i = 1 - e^{-t/2} \quad i = (1 - e^{-1}) \quad (\text{at } t = 2 \text{ s})$$

Sol:

Correct choice: (4)

Q. 6. A long straight wire of radius a carries a steady current i . The current is uniformly distributed across its cross

$$\frac{a}{2}$$

section. The ratio of the magnetic field at $\frac{a}{2}$ and $2a$ is

a. $\frac{1}{4}$

b. 4

c. 1

$$\frac{1}{2}$$

d.

$$B_1 = \frac{\mu_0 i}{2\pi a^2} r \text{ Where } 0 \leq r \leq a, \quad B_1 = \frac{\mu_0 i}{2\pi a^2} \cdot \frac{a}{2} \left(\text{at } r = \frac{a}{2} \right)$$

$$B_1 = \frac{\mu_0 i}{4\pi a}, \quad B_2 = \frac{\mu_0 i}{2\pi (2a)} \quad (\text{at } r = 2a), \quad \frac{B_1}{B_2} = 1$$

Sol:

Correct choice: (3)

Q. 7. A current I flows along the length of an infinitely long, straight, thin walled pipe. Then

- the magnetic field is zero only on the axis of the pipe
- the magnetic field is different at different points inside the pipe
- the magnetic field at any point inside the pipe is zero
- the magnetic field at all points inside the pipe is the same, but not zero

Sol: Magnetic field inside the infinitely long pipe is zero at all points. Correct choice: (3)

$$M_o$$

$${}_8M^{17}, M_p \text{ and } M_n$$

Q. 8. If M_o is the mass of an oxygen isotope ${}_8M^{17}$, M_p and M_n are the masses of a proton and a neutron respectively, the nuclear binding energy of the isotope is

$$(M_o - 8M_p)C^2$$

a.

$$(M_o - 8M_p - 9M_n)C^2$$

b.

$$M_o C^2$$

c.

$$(M_o - 17M_n)C^2$$

d.

$$= [\text{mass of nucleus} - \text{mass of nucleons}] C^2 = (M_o - 8M_p - 9M_n) C^2$$

Sol: Nuclear binding energy

Correct choice: (2)

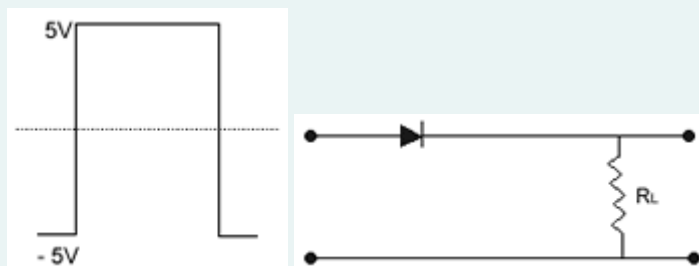
Q. 9. In gamma ray emission from a nucleus

- both the neutron number and the proton number change
- there is no change in the proton number and the neutron number
- only the neutron number changes
- only the proton number changes

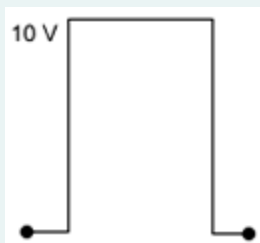
Sol: Gamma ray is electromagnetic radiation which does not involve any change in proton number or neutron number

Correct choice: (2)

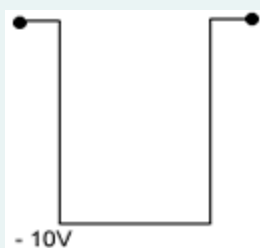
Q. 10. If in p-n junction diode, a square input signal of 10 V is applied as shown. Then the output signal across will be



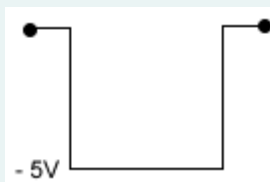
a.



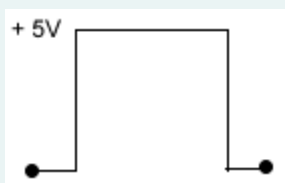
b.



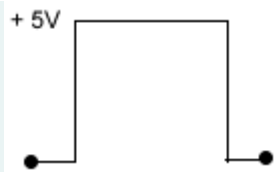
c.



d.



Sol: Diode is forward biased in first half cycle and amplitude of signal is



Correct choice: (4)

Q. 11. Photon of frequency ν has a momentum associated with it. If c is the velocity of light, the momentum is

a. ν / c

b. $h\nu c$

c. $h\nu / c^2$

d.

d. $h\nu / c$

$$E = pc, h\nu = pc, p = \frac{h\nu}{c}$$

Sol:

Correct choice: (4)

$$\nu = \nu_0 + gt + ft^2$$

Q. 12. The velocity of a particle is $\nu = \nu_0 + gt + ft^2$. If its position is $x = 0$ at $t = 0$, then its displacement after unit time ($t = 1$) is

a. $\nu_0 + 2g + 3f$

b.

b. $\nu_0 + g/2 + f/3$

c.

c. $\nu_0 + g + f$

d.

d. $\nu_0 + g/2 + f$

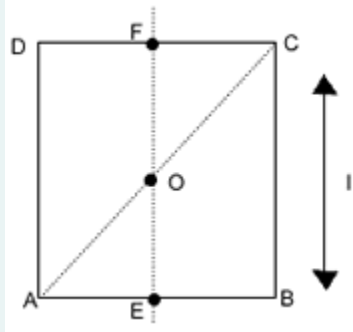
$$\nu = \nu_0 + gt + ft^2, \quad \frac{dx}{dt} = \nu_0 + gt + ft^2$$

$$\int_0^x dx = \int_0^1 (\nu_0 + gt + ft^2) dt, \quad x = \nu_0 + \frac{g}{2} + \frac{f}{3}$$

Sol:

, Correct choice: (2)

Q. 13. For the given uniform square lamina ABCD, whose centre is O,



$$\sqrt{21} I_{AC} = I_{EF}$$

a.

$$I_{AD} = 3I_{EF}$$

b.

$$I_{AC} = I_{EF}$$

c.

$$I_{AC} = \sqrt{21} I_{EF}$$

d.

$$I_{AC} = \frac{1}{2} \left(\frac{MI^2}{6} \right) = \frac{MI^2}{12}, \quad I_{EF} = \frac{MI^2}{12}, \quad I_{AC} = I_{EF}$$

Sol:

Correct choice: (3)

$$x = x_0 \cos(\omega t - \pi/4)$$

Q. 14. A point mass oscillates along the x-axis according to the law . If the acceleration

$$a = A \cos(\omega t + \delta), \text{ then}$$

of the particle is written as ,

$$A = x_0 \omega^2, \delta = -\pi/4$$

a.

$$A = x_0 \omega^2, \delta = \pi/4$$

b.

$$A = x_0 \omega^2, \delta = -\pi/4$$

c.

$$A = x_0 \omega^2, \delta = 3\pi/4$$

d.

$$x = x_0 \cos \left(\omega t - \frac{\pi}{4} \right), \quad v = -x_0 \omega \sin \left(\omega t - \frac{\pi}{4} \right)$$

$$a = x_0 \omega^2 \cos \left(\omega t - \frac{\pi}{4} \right), \quad a = x_0 \omega^2 \cos \left(\omega t - \frac{\pi}{4} + \pi \right)$$

$$a = x_0 \omega^2 \cos \left(\omega t + \frac{3\pi}{4} \right)$$

$$\text{Comparing with } a = A \cos (\omega t + \delta), \quad A = x_0 \omega^2 \text{ and } \delta = \frac{3\pi}{4}$$

Sol:

Correct choice: (4)

$\frac{P}{E}$

Q. 15. Charges are placed on the vertices of a square as shown. Let $\frac{P}{E}$ be the electric field and V the potential at the centre. If the charges on A and B are interchanged with those on D and C respectively, then

$\frac{P}{E}$

a. $\frac{P}{E}$ remains unchanged, V changes

$\frac{P}{E}$

b. Both $\frac{P}{E}$ and V change

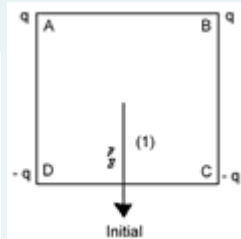
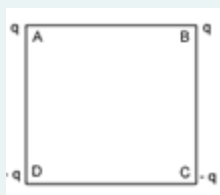
$\frac{P}{E}$

c. $\frac{P}{E}$ and V remain unchanged

$\frac{P}{E}$

d. $\frac{P}{E}$ changes, V remain unchanged

Sol: In initial case, $\frac{P}{E}$ is along (1) whereas in final case is along (2). Potential at centre remains same.



Correct choice: (4)

Q. 16. The half-life period of a radio-active element X is same as the mean life time of another radio-active element Y. Initially they have the same number of atoms. Then

- X will decay faster than Y
- Y will decay faster than X
- X and Y have same decay rate initially
- X and Y decay at same rate always

$$\frac{\ln 2}{\lambda_x} = \frac{1}{\lambda_y}, \lambda_y = 1.4\lambda_x, \lambda_y > \lambda_x$$

Sol: , Y will decay faster than X

Correct choice: (2)

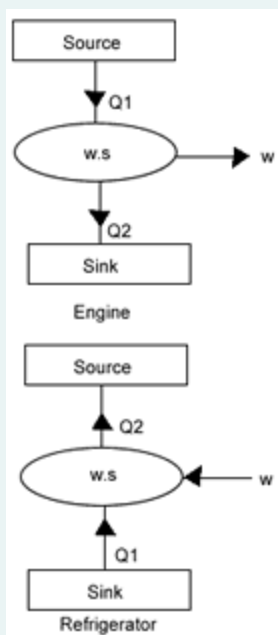
$$\eta = 1 / 10$$

Q. 17. A Carnot engine, having an efficiency of as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is

- 99 J
- 90 J
- 1 J
- 100 J

$$\frac{W}{Q_1} = \frac{1}{10} \Rightarrow Q_1 = 10 W$$

Sol:



$$Q_2 = 10 W, \\ \text{So } Q_1 = 9W = 90 J$$

If same carnot engine is used as refrigerator then

Correct choice: (2)

Q. 18. Carbon, silicon and germanium have four valence electrons each. At room temperature which one of the following statements is most appropriate?

- the number of free conduction electrons is significant in C but small in Si and Ge.
- the number of free conduction electrons is negligibly small in all the three.
- the number of free electrons for conduction is significant in all the three.

d. the number of free electrons for conduction is significant only in Si and Ge but small in C.

Sol: Correct choice: (4)

Q. 19. A charged particle with charge q enters a region of constant, uniform and mutually orthogonal fields \vec{E} and \vec{B} with a velocity \vec{v} perpendicular to both \vec{E} and \vec{B} , and comes out without any change in magnitude or direction of \vec{v} .

$$\vec{v} = \frac{\vec{E} \times \vec{B}}{B^2}$$

a.

$$\vec{v} = \frac{\vec{B} \times \vec{E}}{B^2}$$

b.

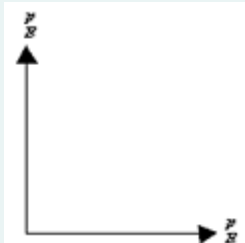
$$\vec{v} = \frac{\vec{E} \times \vec{B}}{E^2}$$

c.

$$\vec{v} = \frac{\vec{B} \times \vec{E}}{E^2}$$

d.

$$q \vec{v} \times \vec{B} = q \vec{E}$$

$$\vec{v} \times \vec{B} = \frac{\vec{E}}{B}$$


Sol:

$$\vec{v} = \frac{\vec{E}}{B}$$

Magnitude of \vec{v} and direction of \vec{v} should be such that net force on charge particle be zero. \vec{v} should be in the direction perpendicular to plane of \vec{E} and \vec{B} and coming out of plane. So direction of \vec{v} is in the direction of $\vec{E} \times \vec{B}$.
Correct choice: (1)

Q. 20. The potential at a point x (measured in μm) due to some charges situated on the x -axis is given by $V(x) = 20 / (x^2 - 4)$ Volts. The electric field is E at $x = 4 \mu m$ given by

$$\text{Volt} / \mu m$$

a. $5/3$ and in the $-ve$ x direction

$$\text{Volt} / \mu m$$

b. $5/3$ and in the $+ve$ x direction

$$\text{Volt} / \mu m$$

c. $10/9$ and in the $-ve$ x direction

$$\text{Volt} / \mu m$$

d. $10/9$ and in the $+ve$ x direction

$$V(x) = \frac{20}{x^2 - 4}, \quad E = -\frac{dv}{dx} = -\frac{d}{dx} \left[\frac{20}{x^2 - 4} \right] = \frac{20}{(x^2 - 4)^2} (2x)$$

$$E \text{ at } x = 4 \mu m, \quad \frac{(20)(2 \times 4)}{144} = \frac{10}{9} \text{ volt} / \mu m$$

Also as x increase V decrease. So \vec{E} is along $+ve x$ - axis.

Sol:

Correct choice: (4)

Q. 21. Which of the following transitions in hydrogen atoms emit photons of highest frequency?

- a. $n = 2$ to $n = 6$
- b. $n = 6$ to $n = 2$
- c. $n = 2$ to $n = 1$
- d. $n = 1$ to $n = 2$

Sol:

$$\Delta E_{2-1} = 10.2 \text{ eV}, \quad \Delta E_{\infty-1} = 13.6 \text{ eV}$$

$$\Delta E_{\infty-2} = 3.4 \text{ eV}, \quad \Delta E_{6-2} < \Delta E_{\infty-2}, \quad \Delta E_{6-2} < \Delta E_{2-1}$$

So photons of highest frequency will be emitted for $n = 2$ to $n = 1$

Correct choice: (3)

Q. 22. A block of mass m is connected to another block of mass M by a spring (massless) of spring constant k . The blocks are kept on a smooth horizontal plane. Initially the blocks are at rest and the spring is unstretched. Then a constant force F starts acting on the block of mass M to pull it. Find the force on the block of mass m

$$\frac{mF}{M}$$

a.

$$\frac{(M + m) F}{m}$$

b.

$$\frac{mF}{(M + m)}$$

c.

$$\frac{MF}{(M + m)}$$

d.

Sol: In the question the state of spring is not mentioned. We are assuming acceleration of both blocks to be same.



$$a = \frac{F}{M + m}$$

$$\text{Force on } m = \frac{mF}{m + M}$$

Correct choice: (3)

Q. 23. Two lenses of power -15 D and $+5\text{ D}$ are in contact with each other. The focal length of the combination is

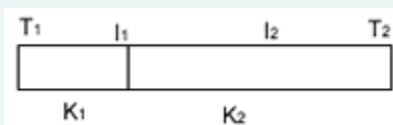
- a. -20 cm
- b. -10 cm
- c. $+20\text{ cm}$
- d. $+10\text{ cm}$

$$P = P_1 + P_2 = -10\text{ D}, \text{ so } -10 = \frac{1}{f \text{ (in m)}}, \quad f \text{ (in m)} = -\frac{1}{10}, \quad f = -10\text{ cm}$$

Sol:

Correct choice: (2)

Q. 24. One end of a thermally insulated rod is kept at a temperature T_1 and the other at T_2 . The rod is composed of two sections of lengths I_1 and I_2 and thermal conductivities k_1 and k_2 respectively. The temperature at the interface of the sections is



- a. $(k_2 I_2 T_1 + k_1 I_1 T_2) / (k_1 I_1 + k_2 I_2)$
- b. $(k_2 I_1 T_1 + k_1 I_2 T_2) / (k_2 I_1 + k_1 I_2)$
- c. $(k_1 I_2 T_1 + k_2 I_1 T_2) / (k_1 I_2 + k_2 I_1)$
- d. $(k_1 I_1 T_1 + k_2 I_2 T_2) / (k_1 I_1 + k_2 I_2)$

$$i = \frac{T_1 - T_2}{\frac{I_1}{k_1 A} + \frac{I_2}{k_2 A}} = \frac{T_1 - T_{\text{interface}}}{\frac{I_1}{k_1 A}}, \quad T_{\text{interface}} = \frac{k_1 I_2 T_1 + k_2 I_1 T_2}{k_1 I_2 + k_2 I_1}$$

Sol:

Correct choice: (3)

Q. 25. A sound absorber attenuates the sound level by 20 dB . The intensity decreases by a factor of

- a. 1000
- b. 10000

- c. 10
d. 100

$$dB = 10 \log_{10} \frac{1}{I_0}, \quad x = 10 \log_{10} \frac{I_1}{I_0}, \quad y = 10 \log_{10} \frac{I_2}{I_0}$$

$$x - y = 10 \log_{10} \frac{I_1}{I_2} \Rightarrow 20 = 10 \log_{10} \frac{I_1}{I_2} \Rightarrow \frac{I_1}{I_2} 10^2$$

$$I_1 = 100 I_2, \quad \text{so } \frac{I_2}{I_1} = \frac{1}{100}$$

Sol:

Correct choice: (4)

$$C_p \text{ and } C_v$$

Q. 26. If denote the specific heats of nitrogen per unit mass at constant pressure and constant volume respectively, then

$$C_p - C_v = R / 28$$

a.

$$C_p - C_v = R / 14$$

b.

$$C_p - C_v = R$$

c.

$$C_p - C_v = 28 R$$

d.

$$C_p' - C_v' = R, \text{ where } C_p \text{ and } C_v$$

Sol:

are molar specific heat capacities. For unit mass if specific heat

$$C_p \text{ and } C_v, \quad C_p = \frac{C_p'}{28}, \quad C_v = \frac{C_v'}{28}, \quad C_p - C_v = R / 28$$

capacities are

Correct choice: (1)

Q. 27. A charged particle moves through a magnetic field perpendicular to its direction. Then

- the momentum changes but the kinetic energy is constant
- both momentum and kinetic energy of the particle are not constant
- both, momentum and kinetic energy of the particle are constant
- kinetic energy changes but the momentum is constant

Sol: Magnetic force can not do any work, so kinetic energy remains constant.

Since initial velocity is perpendicular to magnetic field, hence momentum will change. Correct choice: (1)

Q. 28. Two identical conducting wires AOB and COD are placed at right angles to each other. The wire AOB carries

$$I_1$$

$$I_1$$

an electric current and COD carries a current . The magnetic field on a point lying at a distance d from O, in a direction perpendicular to the plane of the wires AOB and COD, will be given by

$$\frac{\mu_0}{2\pi} \left(\frac{I_1 + I_2}{d} \right)^{\frac{1}{2}}$$

a.

$$\frac{\mu_0}{2\pi d} \left(\frac{I_1^2 + I_2^2}{d} \right)^{\frac{1}{2}}$$

b.

$$\frac{\mu_0}{2\pi d} (I_1 + I_2)$$

c.

$$\frac{\mu_0}{2\pi d} (I_1^2 + I_2^2)$$

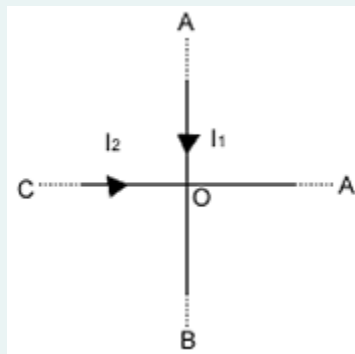
d.

$$\frac{\mu_0}{2\pi d} \text{ and } \frac{\mu_0 I_2}{2\pi d}$$

Sol: Magnetic field due to AB and CD are $\frac{\mu_0}{2\pi d}$ respectively and are in mutually perpendicular

$$B_{net} = \frac{\mu_0}{2\pi d} \sqrt{I_1^2 + I_2^2}$$

direction



Correct choice: (2)

50° C

100° C

0° C

Q. 29. The resistance of a wire is 5 ohm at 50° C and 6 ohm at 100° C . The resistance of the wire at 0° C will be

- 2 ohm
- 1 ohm
- 4 ohm
- 3 ohm

$$5 = R_0 (1 + 50 \alpha) \quad \dots(i), \quad 6 = R_0 (1 + 100 \alpha) \quad \dots(ii)$$

$$\frac{6}{5} = \frac{1 + 100 \alpha}{1 + 50 \alpha} \Rightarrow 6 + 300 \alpha = 5 + 500 \alpha \Rightarrow \alpha = \frac{1}{200}$$

$$\text{Substituting value of } \alpha \text{ in equation (i)} \quad 5 = R_0 \left(1 + \frac{1}{4}\right) \Rightarrow R_0 = 4\Omega$$

Sol:

Correct choice: (3)

Q. 30. A parallel plate condenser with a dielectric of dielectric constant K between the plates has a capacity C and is charged to a potential V volts. The dielectric slab is slowly removed from between the plates and then reinserted. The net work done by the system in this process is

$$\frac{1}{2} (K - 1) CV^2$$

a.

$$CV^2 (K - 1) / K$$

b.

$$(K - 1) CV^2$$

c.

d. zero

Sol: No change in the energy of the system. Hence, net work done by the system is zero. Correct choice: (4)

$$g_E \text{ and } g_M$$

Q. 31. If _____ are the accelerations due to gravity on the surfaces of the earth and the moon respectively and if Millikan's oil drop experiment could be performed on the two surfaces, one will find the

$$\frac{\text{electronic charge on the moon}}{\text{electronic charge on the earth}}$$

ratio

a. 1

b. 0

$$g_E / g_M$$

c.

$$g_M / g_E$$

d.

Sol: Correct choice: (1)

Q. 32. A circular disc of radius R is removed from a bigger circular disc of radius 2R such that the circumferences of

$$\frac{\alpha}{R}$$

$$\alpha$$

the discs coincide. The centre of mass of the new disc is _____ from the centre of the bigger disc. The value of is

$$\frac{1}{3}$$

a.

$\frac{1}{2}$

b.

$\frac{1}{6}$

c.

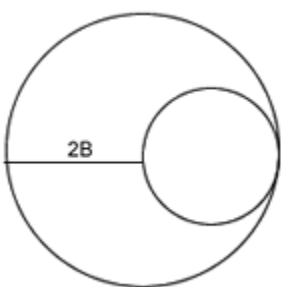
$\frac{1}{4}$

d.

$\frac{M}{4}$

Sol: If mass of circular disc is M , then mass of removed disc is $\frac{M}{4}$. Let centre of mass of remaining disc is at a distance x from centre, then

$$O = \frac{\left(\frac{3M}{4}\right)x + \left(\frac{M}{4}\right)R}{M}, \quad x = \frac{R}{3} = \alpha(R)$$



$\frac{\alpha}{R}$

$\frac{\alpha}{R}$

[In question x is given out to be αR . If we take that, then no choice is correct we believe in place of $\frac{\alpha}{R}$, it should be αR]

Correct choice: (1)

Q. 33. A round uniform body of radius R , mass M and moment of inertia I rolls down (without slipping) an inclined plane making an angle θ with the horizontal. Then its acceleration is

$\frac{g \sin \theta}{1 + I / MR^2}$

a.

$\frac{g \sin \theta}{1 + MR^2 I}$

b.

$$\frac{g \sin \theta}{1 - I / MR^2}$$

c.

$$\frac{g \sin \theta}{1 - MR^2 / I}$$

d.

$$mg \sin \theta - f = ma_{CM} \quad \dots(i)$$

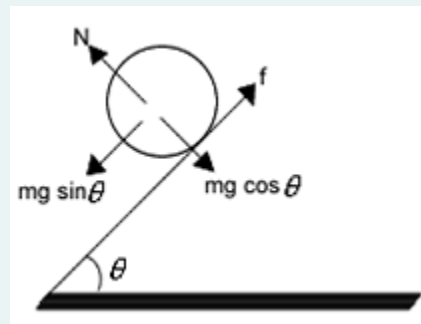
$$f \cdot R = I\alpha \quad \dots(ii)$$

$$a_{CM} = R\alpha \quad \dots(iii)$$

On solving (i), (ii) and (iii)

$$a_{CM} = \frac{g \sin \theta}{1 + \frac{I}{MR^2}}$$

Sol:



Correct choice: (1)

Q. 34. Angular momentum of the particle rotating with a central force is constant due to

- a. constant force
- b. constant linear momentum
- c. zero torque
- d. constant torque

Sol: Central force is directed towards a point, therefore torque of the central force is zero. Correct choice: (3)

Q. 35. A 2 kg block slides on a horizontal floor with a speed of 4 m/s. It strikes an uncompressed spring, and compresses it till the block is motionless. The kinetic friction force is 15 N and spring constant is 10,000 N/m. The spring compresses by

- a. 5.5 cm
- b. 2.5 cm
- c. 11.0 cm
- d. 8.5 cm

$$\frac{1}{2} (2) (4)^2 = \frac{1}{2} (10000) x^2 + (15) x, 16 = 5000 x^2 + 15 x, 5000 x^2 + 15 x - 16 = 0$$

$$x = \frac{-15 \pm \sqrt{225 + 320,000}}{2 \times 5000} m, \quad x \approx \frac{550}{2 \times 50} cm, \quad x \approx 5.5 cm$$

Sol:

Correct choice: (1)

$$60^\circ$$

Q. 36. A particle is projected at 60° to the horizontal with a kinetic energy K . The kinetic energy at the highest point is

- K
- Zero
- $K/4$
- $K/2$

$$\frac{1}{2} mv^2 = K, \quad \frac{1}{2} m (v \cos 60)^\circ = \frac{1}{2} m \left(\frac{v^2}{4} \right) = \frac{1}{4} \left(\frac{1}{2} mv^2 \right) = \frac{K}{4}$$

Sol:

Correct choice: (3)

$$\frac{\lambda}{6} \lambda$$

Q. 37. In Young's double slit experiment the intensity at a point where the path difference is $\frac{\lambda}{6}$ being the

$$\frac{I}{I_0}$$

wavelength of the light used) is I . If I_0 denotes the maximum intensity, $\frac{I}{I_0}$ is equal to

$$\frac{1}{\sqrt{2}}$$

a.

$$\frac{\sqrt{3}}{2}$$

b.

$$\frac{1}{2}$$

c.

$$\frac{3}{4}$$

d.

Sol: Let intensity of light from individual slits is

$$I_R = I' + I' + 2I' \cos \Delta\phi, \quad I_R = I' + I' + 2I' \cos \frac{2\pi}{\lambda} \cdot \frac{\lambda}{6} = 3I' = I,$$

$$I_0 = 4I' \Rightarrow \frac{I}{I_0} = \frac{3I'}{4I'} = \frac{3}{4}$$

I'

Correct choice: (4)

Q. 38. Two springs, of force constants k_1 and k_2 , are connected to a mass m as shown. The frequency of oscillation of the mass is f . If both k_1 and k_2 are made four times their original values, the frequency of oscillation becomes



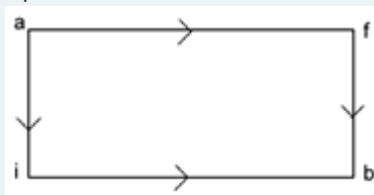
- a. $f/2$
- b. $f/4$
- c. $4f$
- d. $2f$

$$f = \frac{1}{2\pi} \sqrt{\frac{k_1 + k_2}{m}}, \quad f_{new} = \frac{1}{2\pi} \sqrt{\frac{4k_1 + 4k_2}{m}} = 2f$$

Sol:

Correct choice: (4)

Q. 39. When a system is taken from state i to state f along the path iaf , it is found that $Q = 50$ cal and $W = 20$ cal. Along the path ibf $Q = 36$ cal. W along the path ibf is



- a. 6 cal
- b. 16 cal
- c. 66 cal
- d. 14 cal

$$\text{For } iaf, 50 = 20 + \Delta U \Rightarrow \Delta U = 30 \text{ cal. For } ibf, 36 = W + 30, \quad W = 6 \text{ cal}$$

Sol:

Correct choice: (1)

Q. 40. A particle of mass m executes simple harmonic motion with amplitude a and frequency ν . The average kinetic energy during its motion from the position of equilibrium to the end is

$$\pi^2 m a^2 \nu^2$$

a.

$$\frac{1}{4} m a^2 \nu^2$$

b.

$$4\pi^2 m a^2 v^2$$

c.

$$2\pi^2 m a^2 v^2$$

d.

$$K_{av} = \frac{\int_0^{T/4} \frac{1}{2} m [a \omega \cos(ax + \phi)]^2 dt}{\int_0^{T/4} dt} = \frac{ma^2 \omega^2}{2 \cdot \frac{T}{4}} \int_0^{T/4} \cos^2(ax + \phi) dt$$

$$= \frac{2ma^2 \omega^2}{T} \cdot \frac{T}{8} = \frac{1}{4} ma^2 \omega^2 = \frac{1}{4} ma^2 (2\pi v)^2 = \pi^2 m a^2 v^2$$

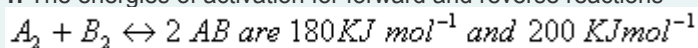
Sol:

Correct choice: (1)

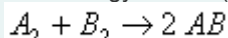
AIEEE 2007 Solved Paper

Chemistry

Q. 1. The energies of activation for forward and reverse reactions



for _____ respectively. The presence of a catalyst lowers the activation energy of both (forward and reverse) reactions by 100 kJ mol^{-1} . The enthalpy change of the



reaction _____ in the presence of catalyst will be (in kJ mol^{-1})

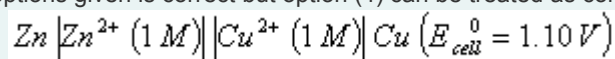
- a. 300
- b. 120
- c. 280
- d. 20

Sol: Enthalpy change of a reaction is not affected by the presence of a catalyst as it lowers the activation energy of

$$\Delta H = E_{a,f} - E_{a,r} = 180 - 200 = -20 \text{ KJ mol}^{-1}$$

the forward and reverse reaction by the same amount

None of the options given is correct but option (4) can be treated as correct in terms of magnitude. Correct choice: (4)



Q. 2. The cell, _____, was allowed to be completely discharged at

$$Zn^{2+} \text{ to } Cu^{2+} \left(\frac{[Zn^{2+}]}{[Cu^{2+}]} \right) \text{ is}$$

298 K. The relative concentration of Zn and Cu

- a. antilog (24.08)
- b. 37.3
- c. 10^{373}
- d. 9.65×10^4

$$\begin{aligned} -nFE_{cell}^0 &= -2.303 RT \log \frac{[Zn^{2+}]}{[Cu^{2+}]} \\ 2 \times 96500 \times 1.10 &= 2.303 \times 8.314 \times 298 \log \frac{[Zn^{2+}]}{[Cu^{2+}]} \\ \log \frac{[Zn^{2+}]}{[Cu^{2+}]} &= 37.3; \frac{[Zn^{2+}]}{[Cu^{2+}]} = 10^{373} \end{aligned}$$

Sol:

Correct choice: (3)

Q. 3. The pK_a of a weak acid (HA) is 4.5. The pOH of an aqueous buffered solution of HA in which 50% of the acid is ionized is

- a. 4.5
- b. 2.5
- c. 9.5

d. 7.0

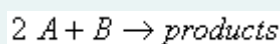
Sol: If the given weak acid is 50% ionized, then its conjugate base will have the concentration same as that of weak acid.

$$\therefore pH = pK_a + \log \frac{[Conjugate\ base]}{[Acid]} = 4.5 + \log \frac{0.5c}{0.5c}$$

$$pH = 4.5$$

$$\therefore pOH = 14 - pH = 14 - 4.5 = 9.5$$

Correct choice: (3)



Q. 4. Consider the reaction, When concentration of B alone was doubled, the half-life did not change. When the concentration of A alone was doubled, the rate increased by two times. The unit of rate constant for this reaction is

$$L\ mol^{-1}\ s^{-1}$$

a.

b. no unit

$$mol\ L^{-1}\ s^{-1}$$

c.

$$s^{-1}$$

d.

Sol: The reaction would be first order with respect to A and first order with respect to B. The overall order of the reaction is 2.

$$Rate = K[A][B]$$

$$\frac{mole}{litre\ s} = K \left[\frac{mole}{litre} \right]^2; K = = mole^{-1}\ litre\ s^{-1}$$

Correct choice: (1)

Q. 5. Identify the incorrect statement among the following:

a. d-Block elements show irregular and erratic chemical properties among themselves .

b. La and Lu have partially filled d orbitals and no other partially filled orbitals.

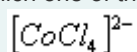
c. The chemistry of various lanthanoids is very similar.

d. 4f and 5f orbitals are equally shielded.

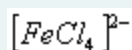
Sol: 4f orbital electrons are shielded more than 5f orbital electrons.

Correct choice: (4)

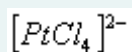
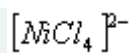
Q. 6. Which one of the following has a square planar geometry?



a.



b.

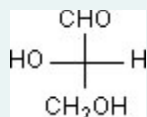


(Atomic numbers: Co = 27, Ni = 28, Fe = 26, Pt = 78)

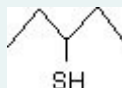
Sol: Platinum(+II) only forms square planar complex. Correct choice: (4)

Q. 7. Which of the following molecules is expected to rotate the plane of plane – polarised light?

a.



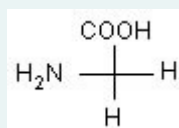
b.



c.



d.



Sol: Compound (1) does not have any plane of symmetry as well as centre of symmetry so it rotates the plane of plane-polarised light. Compound (2), (3) and (4) have a plane of symmetry, so they all are optically inactive.

Correct choice: (1)

Q. 8. The secondary structure of protein refers to:



a. helical backbone.

b. hydrophobic interactions.



c. sequence of amino acids.

d. fixed configuration of the polypeptide backbone.



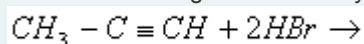
Sol: Secondary structure of a protein refers to the fixed configuration of the polypeptide skeleton. helix



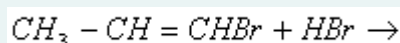
structure results only when intramolecular H-bonds are formed between of one amino acid residue and N-H

of fourth amino acid residue in polypeptide chain. β -pleated structure is formed when intermolecular H-bond is formed between $C=O$ of one polypeptide chain with N-H of the other chain. Correct choice: (4)

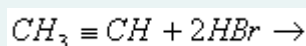
Q. 9. Which of the following reactions will yield 2,2-dibromopropane?



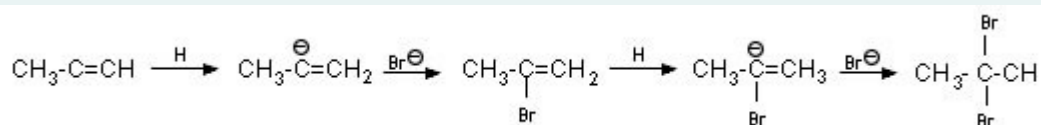
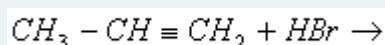
b.



c.

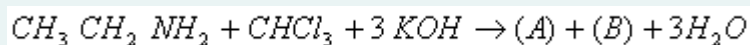


d.



Sol:

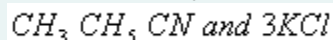
Correct choice: (1)



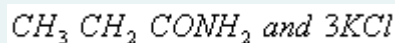
Q. 10. In the chemical reaction,

the compounds

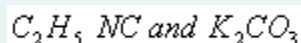
(A) and (B) are respectively:



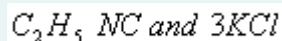
b.



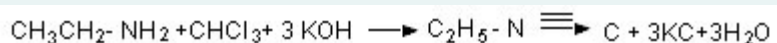
c.



d.



d.



Sol:

This is carbylamine reaction. Correct

choice: (4)

Q. 11. The reaction of toluene with Cl_2 in presence of $FeCl_3$ gives predominantly:

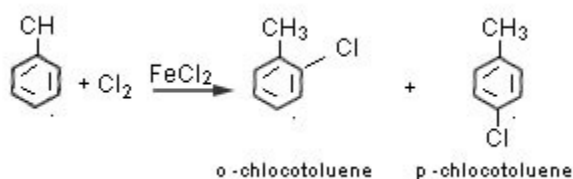
a. benzoyl chloride

b. benzyl chloride

c. o- and p-chlorotoluene

d. m-chlorotoluene

Sol:



The reaction proceeds by electrophilic substitution mechanism.

Correct choice: (3)

Q. 12. Presence of a nitro group in a benzene ring

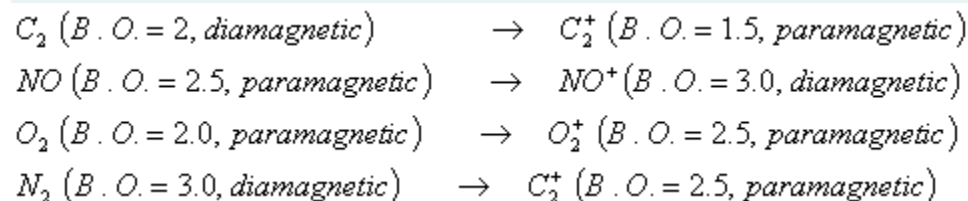
- activates the ring towards electrophilic substitution.
- renders the ring basic.
- deactivates the ring towards nucleophilic substitution.
- deactivates the ring towards electrophilic substitution.

Sol: $-\text{NO}_2$ group in benzene ring shows $-I$ and $-R$ effect, which deactivates the ring towards electrophilic substitution but activates it towards nucleophilic substitution. Correct choice: (4)

Q. 13. In which of the following ionization processes, the bond order has increased and the magnetic behaviour has changed?

- $\text{C}_2 \rightarrow \text{C}_2^+$
- $\text{NO} \rightarrow \text{NO}^+$
- $\text{O}_2 \rightarrow \text{O}_2^+$
- $\text{N}_2 \rightarrow \text{N}_2^+$

Sol:



Correct choice: (2)

Q. 14. The actinoids exhibit more number of oxidation states in general than the lanthanoids. This is because

- the 5f orbitals are more buried than the 4f orbitals.
- there is a similarity between 4f and 5f orbitals in their angular part of the wave function.
- the actinoids are more reactive than the lanthanoids.
- the 5f orbitals extend further from the nucleus than the 4f orbitals.

Sol: The actinoids exhibit more number of oxidation states than lanthanoids because they can lose more number of electrons as the 5f orbital electrons are held less strongly than the 4f orbital electrons. Correct choice: (4)

25°C

Q. 15. Equal masses of methane and oxygen are mixed in an empty container at . The fraction of the total pressure exerted by oxygen is

- a. $\frac{2}{3}$
- b. $\frac{1}{3} \times \frac{273}{298}$
- c. $\frac{1}{3}$
- d. $\frac{1}{2}$

Sol: Let the mass of methane and oxygen be x g each.

$$\therefore \text{Total moles of gaseous mixture} = \text{Moles of } CH_4 + \text{Moles of } O_2 = \frac{x}{4} + \frac{x}{32} = \frac{3x}{32}$$

$$P_{O_2} = P_T \times X_{O_2}; \quad \frac{P_{O_2}}{P_T} = X_{O_2} = \frac{x / 32}{3x / 32} = \frac{1}{3}$$

Correct choice: (3)

Q. 16. A 5.25% solution of a substance is isotonic with a 1.5% solution of urea (molar mass = 60 g mol⁻¹) in the same solvent. If the densities of both the solutions are assumed to be equal to 1.0 g cm⁻³, molar mass of the substance will be

- a. 90.0 g mol⁻¹
- b. 115.0 g mol⁻¹
- c. 105.0 g mol⁻¹
- d. 210.0 g mol⁻¹

Sol: Since the two solutions are isotonic, their concentrations will be

$$\therefore C_1 = C_2; \quad \frac{5.25}{M} = \frac{1.5}{60}; \quad M = 210 \text{ mol}^{-1}$$

same.

Correct choice: (4)

ΔU

Q. 17. Assuming that water vapour is an ideal gas, the internal energy change when 1 mol of water is vapourised at 1 bar pressure and 100°C, (Given: Molar enthalpy of vapourisation of water at 1 bar and 373 K = 41 kJ mol⁻¹ and R = 8.3 J mol⁻¹K⁻¹) will be:

- a. 4.100 kJ mol⁻¹

- b. 3.7904 kJ mol⁻¹
- c. 37.904 kJ mol⁻¹
- d. 41.00 kJ mol⁻¹

Sol:

Given that, $H_2O(l) \rightarrow H_2O(g)$; $\Delta H = 41 \text{ KJ mol}^{-1}$

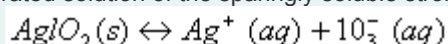
The change in internal energy (ΔU) for the above process is given by

$$\Delta U = \Delta H - \Delta n_g RT = \Delta H - RT \left[\Delta n_g = 1 \right]$$

$$= 41 - \frac{8.3 \times 373}{1000} = 37.904 \text{ KJ mol}^{-1}$$

Correct choice: (3)

Q. 18. In a saturated solution of the sparingly soluble strong electrolyte $AgIO_3$ (Molecular mass = 283) the equilibrium



which sets in is

If the solubility product constant K_{sp} of $AgIO_3$ at a given

temperature is, what is the mass of $AgIO_3$ contained in 100 ml of its saturated solution?

- a. $28.3 \times 10^{-2} \text{ g}$
- b. $2.83 \times 10^{-3} \text{ g}$
- c. $1.0 \times 10^{-7} \text{ g}$
- d. $1.0 \times 10^{-4} \text{ g}$

Sol:

Given that, $AgIO_3(s) \leftrightarrow Ag^+(aq) + IO_3^-(aq)$

If 's' is the solubility of $AgIO_3$ in a saturated solution, then

$$K_{sp} = [Ag^+][IO_3^-] = s^2; s = \sqrt{K_{sp}} = \sqrt{1.0 \times 10^{-8}}$$

$$= 10^{-4} \text{ mol L}^{-1} = 10^{-4} \times 283 \text{ g L}^{-1} = \frac{10^{-4} \times 283}{10}$$

$$\text{g per } 100 \text{ mL} = 2.83 \times 10^{-3} \text{ g per } 100 \text{ mL}$$

Correct choice: (2)

Q. 19. A radioactive element gets spilled over the floor of a room. Its half-life period is 30 days. If the initial activity is ten times the permissible value, after how many days will it be safe to enter the room?

- a. 1000 days
- b. 300 days
- c. 10 days
- d. 100 days

Sol: Let the permissible activity limit of the radioactive element be x, then the initial activity would be 10 x.

$$t = \frac{2.303}{\lambda} \log \frac{[A]}{[A]_t} = \frac{2.303 \times 30}{0.693} \log \frac{10x}{x} \approx 100 \text{ days}$$

Correct choice: (4)

Q. 20. Which one of the following conformations of cyclohexane is chiral?

- Twist boat
- Rigid
- Chair
- Boat

Sol: Twist boat conformation of cyclohexane is chiral because it has neither plane of symmetry nor centre of symmetry. Correct choice: (1)

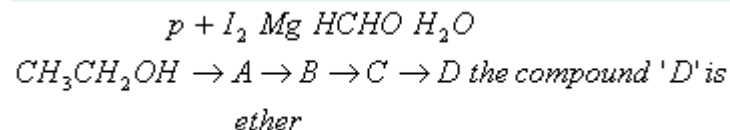
Q. 21. Which of the following is the correct order of decreasing S_N2 reactivity?

- $RCH_2X > R_3CX > R_2CHX$
- $RCH_2X > R_2CHX > R_3CX$
- $R_3CX > R_2CHX > RCH_2X$
- $R_2CHX > R_3CX > RCH_2X$

(X = a halogen)

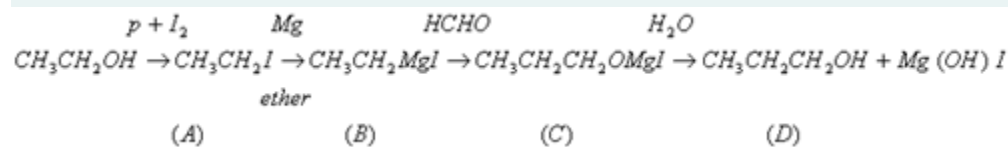
Sol: The reactivity of a compound towards S_N2 reaction decreases as the crowding at the C-atom containing leaving group increases. Correct choice: (2)

Q. 22. In a following sequence of reactions,



- butanal
- n-butyl alcohol
- n-propyl alcohol
- propanal

Sol:



Correct choice: (3)

Q. 23. Which of the following sets of quantum numbers represents the highest energy of an atom?

$$n = 3, l = 1, m = 1, s = +\frac{1}{2}$$

a.

$$n = 3, l = 2, m = 1, s = +\frac{1}{2}$$

b.

$$n = 4, l = 0, m = 0, s = +\frac{1}{2}$$

c.

$$n = 3, l = 0, m = 0, s = +\frac{1}{2}$$

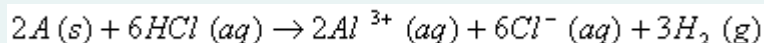
d.

Sol: An orbital having higher value of $(n + l)$ has higher energy. Out of the four options given, the value of $(n + l)$ is highest if $n = 3$ and $l = 2$. Correct choice: (2)

Q. 24. Which of the following hydrogen bonds is the strongest?

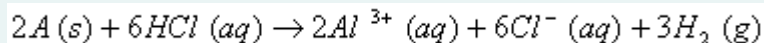
- O—H...N
- F—H...F
- O—H...O
- O—H...F

Sol: Greater the difference in electronegativity of H-atom and the other electronegative atom with which H is covalently bonded, stronger is the hydrogen bond. Highest electronegativity difference exists in HF molecule. Correct choice: (2)



Q. 25. In the reaction,

- 6 L HCl(aq) is consumed for every 3 L H₂(g) produced.
- 33.6 L H₂(g) is produced regardless of temperature and pressure for every mole Al that reacts.
- 67.2 L H₂(g) at STP is produced for every mole Al that reacts.
- 11.2 L H₂(g) at STP is produced for every mole HCl(aq) consumed.



Sol: Given that,

For each mole of Al reacted, 1.5 mol of H₂ is formed; and for each mole of HCl(aq) consumed, 0.5 mol or 11.2 L of H₂ at STP is formed. Correct choice: (4)

Q. 26. Regular use of which of the following fertilizers increases the acidity of soil?

- Potassium nitrate
- Urea
- Superphosphate of lime
- Ammonium sulphate

Sol: Ammonium sulphate is a salt of weak base and strong acid. Its aqueous solution is acidic due to hydrolysis of ammonium ion. It will increase the acidity of soil. Correct choice: (4)

Q. 27. Identify the correct statement regarding a spontaneous process:

- For a spontaneous process in an isolated system, the change in entropy is positive.
- Endothermic processes are never spontaneous.
- Exothermic processes are always spontaneous.
- Lowering of energy in the reaction process is the only criterion for spontaneity.

Sol: For a process to be spontaneous in an isolated system, the change in entropy is positive. Correct choice: (1)

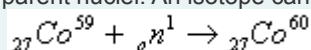
Q. 28. Which of the following nuclear reactions will generate an isotope?

- neutron particle emission
- positron emission
- α - particle emission
- β - particle emission

α -

β -

Sol: In a nuclear reaction, an isotope cannot be generated by the emission of positron β^+ particle or α particle because it will change the atomic number of the parent nuclei. An isotope can be generated when the nuclei of an



element are bombarded with slow neutrons e.g., ${}_{27}^{59}\text{Co} + {}_0^1\text{n} \rightarrow {}_{27}^{60}\text{Co}$. Formation of isotope by neutron

particle emission is a hypothetical process. Correct choice: (1)

Q. 29. The equivalent conductances of two strong electrolytes at infinite dilution in H_2O (where ions move freely through a solution) at 25°C are given

$$\Lambda^0 \text{CH}_3\text{COONa} = 91.0 \text{ S cm}^2 / \text{equiv}; \Lambda^0 \text{CH}_3\text{COOH} = 426.2 \text{ S cm}^2 / \text{equiv}$$

below:

What additional information/quantity one needs to calculate of an aqueous solution of acetic acid?

$$\Lambda^0 \text{ of NaCl}$$

a.

$$\Lambda^0 \text{ of CH}_3\text{COOK}$$

b.

$$H^+ (\lambda_{H^+}^0)$$

c. (C) The limiting equivalent conducted of

$$\Lambda^0 \text{ of chloracetic acid (ClCH}_2\text{COOH)}$$

d.

Sol:

$$\Lambda^0 \text{CH}_3\text{CO}_2\text{M} = \Lambda^0 \text{CH}_3\text{CO}_2^- + \Lambda^0 \text{M}^+ \quad \dots\dots\dots (i)$$

$$\Lambda^0 \text{HCl} = \Lambda^0 \text{H}^+ + \Lambda^0 \text{Cl}^- \quad \dots\dots\dots (ii)$$

$$\Lambda^0 \text{MCl} = \Lambda^0 \text{M}^+ + \Lambda^0 \text{Cl}^- \quad \dots\dots\dots (iii)$$

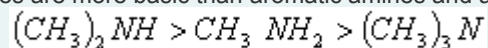
$$\Lambda^0 \text{CH}_3\text{CO}_2\text{H} = \Lambda^0 \text{CH}_3\text{CO}_2^- + \Lambda^0 \text{H}^+ \quad \dots\dots\dots (iv)$$

Correct choice: (1)

Q. 30. Which one of the following is the strongest base in aqueous solution?

- Trimethylamine
- Aniline
- Dimethylamine
- Methylamine

Sol: Aliphatic amines are more basic than aromatic amines and among aliphatic amines, the order of basicity in



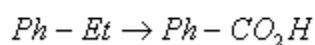
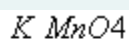
aqueous solution is

Correct choice: (3)

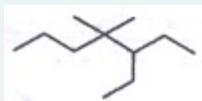
Q. 31. The compound formed as a result of oxidation of ethyl benzene by $KMnO_4$ is

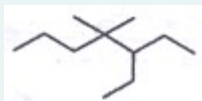
- benzophenone
- acetophenone
- benzoic acid
- benzyl alcohol

Sol:

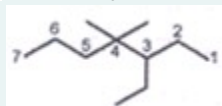


Correct choice: (3)



Q. 32. The IUPAC name of  is

- 1,1-diethyl-2,2-dimethylpentane
- 4,4-dimethyl-5,5-diethylpentane
- 5,5-diethyl-4,4-dimethylpentane
- 3-ethyl-4,4-dimethylheptane



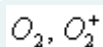
Sol:

IUPAC name of the given compound is: 3-ethyl-4,4-dimethyl heptane.

Correct choice: (4)

Q. 33. Which of the following species exhibits the diamagnetic behaviour?

- O_2^{2-}
- O_2^+
- O_2
- NO



Sol: O_2 , O_2^+ and NO are paramagnetic due to the presence of 2, 1 and 1 unpaired electrons respectively. O_2^{2-} will have no unpaired electron and is diamagnetic in nature. Correct choice: (1)

Q. 34. The stability of dihalides of Si, Ge, Sn and Pb increases steadily in the sequence

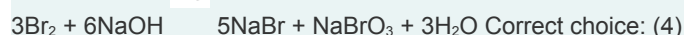
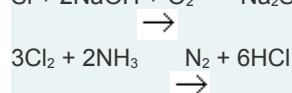
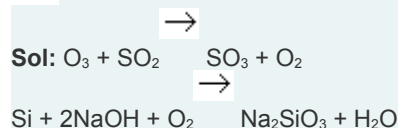
- $GeX_2 \ll SiX_2 \ll SnX_2 \ll PbX_2$
- $SiX_2 \ll GeX_2 \ll PbX_2 \ll SnX_2$
- $SiX_2 \ll GeX_2 \ll SnX_2 \ll PbX_2$

d. $\text{PbX}_2 \ll \text{SnX}_2 \ll \text{GeX}_2 \ll \text{SiX}_2$

Sol: The stability of the lower oxidation state increases down the group in group 14. $\text{SiX}_2 \ll \text{GeX}_2 \ll \text{SnX}_2 \ll \text{PbX}_2$ Correct choice: (3)

Q. 35. Identify the incorrect statement among the following:

- Ozone reacts with SO_2 to give SO_3 .
- Silicon reacts with NaOH(aq) in the presence of air to give Na_2SiO_3 and H_2O .
- Cl_2 reacts with excess of NH_3 to give N_2 and HCl .
- Br_2 reacts with hot and strong NaOH solution to give NaBr , NaBrO_4 and H_2O .



Q. 36. The charge/size ratio of a cation determines its polarizing power. Which one of the following sequences represents the increasing order of the polarizing power of the cationic species, K^+ , Ca^{2+} , Mg^{2+} , Be^{2+} ?

- $\text{Mg}^{2+} < \text{Be}^{2+} < \text{K}^+ < \text{Ca}^{2+}$
- $\text{Mg}^{2+} < \text{Be}^{2+} < \text{K}^+ < \text{Ca}^{2+}$
- $\text{Be}^{2+} < \text{K}^+ < \text{Ca}^{2+} < \text{Mg}^{2+}$
- $\text{K}^+ < \text{Ca}^{2+} < \text{Mg}^{2+} < \text{Be}^{2+}$
- $\text{K}^+ < \text{Ca}^{2+} < \text{Mg}^{2+} < \text{Be}^{2+}$

Sol: Greater the charge/size ratio of a cation, size but charge of all those ions is same. Thus, polarising power of

these ions is in the order: $\text{K}^+ < \text{Ca}^{2+} < \text{Mg}^{2+} < \text{Be}^{2+}$ K^+ has a 1 unit charge less than that of Ca^{2+} and its size is larger than that of Ca^{2+} , thus polarising power of K^+ is less than that of Ca^{2+} . So, the correct order

is $\text{K}^+ < \text{Ca}^{2+} < \text{Mg}^{2+} < \text{Be}^{2+}$

Correct choice: (3)

Q. 37. The density (in g mL^{-1}) of a 3.60 M sulphuric acid solution that is 29% H_2SO_4 (Molar mass = 98 g mol^{-1}) by mass will be

- .64
- 1.88
- 1.22
- 1.45

Sol: Let the mass of solution be x g.

$$3.6 \times 98 = x \times \frac{29}{100}; x = 1216.5g$$

$$\text{Density of solution} = \frac{\text{mass of solution}}{\text{Volume of solution}} = \frac{1216.5g}{1000 \text{ ml}} = 1.216 \text{ g ml}^{-1}$$

Correct choice: (3)

Q. 38. The first and second dissociation constants of an acid H_2A are 1.0×10^{-5} and 5.0×10^{-10} respectively. The overall dissociation constant of the acid will be

- a. 5.0×10^{-5}
- b. 5.0×10^{15}
- c. 5.0×10^{-15}
- d. 0.2×10^5

$$K_{\text{overall}} = K_{a1} \times K_{a2} = 1 \times 10^{-5} \times 5 \times 10^{-10} = 5 \times 10^{-15}$$

Sol:

Correct choice: (3)

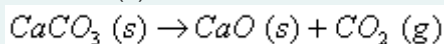
Q. 39. A mixture of ethyl alcohol and propyl alcohol has vapour pressure of 290 mm at 300 K. The vapour pressure of propyl alcohol is 200 mm. If the mole fraction of ethyl alcohol is 0.6, its vapour pressure (in mm) at the same temperature will be

- a. 350
- b. 300
- c. 700
- d. 360

Sol:

$$\begin{aligned} P_T &= P_E^0 X_E + P_P^0 X_P \\ 290 &= (P_E^0 \times 0.6) + (200 \times 0.4) \\ \therefore (P_E^0 \times 0.6) &= 290 - 80 = 210 \\ P_E^0 &= \frac{210}{0.6} = 350 \text{ mm Hg} \end{aligned}$$

Correct choice: (1)



Q. 40. In conversion of lime-stone to lime,

$$\Delta H^0 \quad \Delta S^0$$

The values of ΔH^0 and ΔS^0 are $+179.1 \text{ kJ mol}^{-1}$ and 160.2 J/K respectively at 298 K and 1 bar. Assuming

$$\Delta H^0 \quad \Delta S^0$$

that ΔH^0 and ΔS^0 do not change with temperature, temperature above which conversion of limestone to lime will be spontaneous is

- a. 1008 K
- b. 1200 K

c. 845 K

d. 1118 K

$$\Delta G^0 = \Delta H^0 - T\Delta S^0$$

Sol: The decomposition of CaCO_3 to CaO and CO_2 would become spontaneous

$$\Delta G^0$$

$$\Delta G^0$$

when ΔG^0 would be -ve. But limiting condition can be arrived at when ΔG^0 would become

$$\therefore \Delta G^0 = 0 = \Delta H^0 - T\Delta S^0; \Delta H^0 = T\Delta S^0$$

$$T = \frac{\Delta H^0}{\Delta S^0} = \frac{179.1 \text{ KJ}}{160.2 \text{ J / K}}$$

$$T = \frac{179.1 \times 10^3 \text{ J}}{160.2 \text{ J / K}} \cong 1118 \text{ K}$$

zero.

Correct choice: (4)