

# **EAMCET-AP 2015 ENGINEERING**

**Question Paper  
with Solutions**

**CODE-C**

## MATHS

1. If the median of the data  $6, 7, x - 2, x, 18, 21$  written in ascending order is 16, then the variance of that data is

1)  $30\frac{1}{5}$

2)  $31\frac{1}{3}$

3)  $32\frac{1}{2}$

4)  $33\frac{1}{3}$

**Key:** 2

**Sol:**  $x = 17$

$$\bar{x} = 14$$

$$= \frac{1}{6} \sum xi^2 - (14)^2$$

$$= \frac{1364}{6} - 196$$

$$= \frac{1364 - 1176}{6}$$

$$= \frac{188}{6}$$

$$= \frac{94}{3}$$

$$= 31\frac{1}{3}$$

2. Two persons A and B are throwing an unbiased six faced die alternatively, with the condition that the person who throws 3 first wins the game. If A starts the game, the probabilities of A and B to win the same are respectively

1)  $\frac{6}{11}, \frac{5}{11}$

2)  $\frac{5}{11}, \frac{6}{11}$

3)  $\frac{8}{11}, \frac{3}{11}$

4)  $\frac{3}{11}, \frac{8}{11}$

**Key:** 1

**Sol:**  $P = \frac{1}{6}; q = \frac{5}{6}$

$$P + qp + \dots \dots \infty$$

$$P(A) = \frac{P}{1-q^2} = \frac{\left(\frac{1}{6}\right)}{1-25/36} = \frac{1}{6} \times \frac{36}{11} = \frac{6}{11}$$

$$P(A) = \frac{6}{11}, P(B) = \frac{5}{11}$$

3. The letters of the word “QUESTION” are arranged in a row at random. The probability that there are exactly two letters between Q and S is

1)  $\frac{1}{14}$

2)  $\frac{5}{7}$

3)  $\frac{1}{7}$

4)  $\frac{5}{28}$

**Key:** 4

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**Sol: QUESTION**

$Q \square \square S$

$$6p_2 2! 5!$$

$$P(A) = \frac{6 \times 5 \times 2! 5!}{8!}$$

$$= \frac{5}{28}$$

4. If  $\frac{1+3p}{3}, \frac{1-2p}{2}$  are probabilities of two mutually exclusive events, then p lies in the interval

1)  $\left[-\frac{1}{3}, \frac{1}{2}\right]$

2)  $\left(-\frac{1}{2}, \frac{1}{2}\right)$

3)  $\left[-\frac{1}{3}, \frac{2}{3}\right]$

4)  $\left(-\frac{1}{3}, \frac{2}{3}\right)$

**Key: 1**

**Sol:**  $0 \leq \frac{1+3p}{3} \leq 1$

$$0 \leq 1+3p \leq 3$$

$$-1 \leq 3p \leq 2$$

$$-\frac{1}{3} \leq p \leq \frac{2}{3} \longrightarrow (1)$$

$$0 \leq \frac{1-2p}{2} \leq 1$$

$$0 \leq 1-2p \leq 2$$

$$-2 \leq 2p - 1 \leq 0$$

$$-1 \leq 2p \leq 1$$

$$-\frac{1}{2} \leq p \leq \frac{1}{2} \longrightarrow (2)$$

$$0 \leq \frac{1+3p}{3} + \frac{1-2p}{2} \leq 1$$

$$0 \leq \frac{5}{6} \leq 1$$

From (1) & (2)

$$P \in \left[-\frac{1}{3}, \frac{1}{2}\right]$$

5. The probability that an event does not happen in one trial is 0.8. The probability that the event happen atmost once in three trials is

1) 0.896

2) 0.791

3) 0.642

4) 0.592

**Key: 1**

**Sol:**  $P(\bar{A}) = 0.8$

$$P(A) = 0.2$$

$$P(X=0) + P(X=1) = {}^3C_0 (0.8)^3 + {}^3C_1 (0.8)^2 (0.2)$$

$$= (0.8)^2 [0.8 + 0.6]$$

$$= (0.64)(1.4)$$

$$= 0.896$$

6. The probability distribution of a random variable is given below

$X = x$	0	1	2	3	4	5	6	7
$P(X = x)$	0	K	$2K$	$2K$	$3K$	$K^2$	$2K^2$	$7K^2 + K$

$$\text{Then } P(0 < X < 5) =$$

$$1) \frac{1}{10} \quad 2) \frac{3}{10}$$

$$3) \frac{8}{10}$$

$$4) \frac{7}{10}$$

**Key: 3**

$$\text{Sol: } \sum P(x = xi) = 1$$

$$10K^2 + 9K - 1 = 0$$

$$10K^2 + 10K - K - 1 = 0$$

$$10K + (K + 1) - 1(K + 1) = 0$$

$$K = -1, \frac{1}{10}, 1 \text{ But } K \neq -1$$

$$P(0 < X < 5) = P(X = 1) + P(X = 2) + P(X = 3) + P(X = 4)$$

$$= K + 2K + 2K + 3K$$

$$= 8K$$

$$= 0.8 = \frac{8}{10}$$

7. If the equation to the locus of points equidistant from the points  $(-2, 3), (6, -5)$  is  $ax + by + c = 0$  where  $a > 0$  then, the ascending order of  $a, b, c$  is

$$1) a, b, c \quad 2) c, b, a \quad 3) b, c, a \quad 4) a, c, b$$

**Key: 2**

**Sol:**

$$x - y = 2 - (-1)$$

$$x - y = 3$$

$$x - y - 3 = 0$$

$$a = 1, b = -1, c = -3$$

$$c < b < a$$

8. The points  $(2, 3)$  is first reflected in the straight line  $y = x$  and then translated through a distance of 2 units along the positive direction of x-axis. The coordinates of the transformed point are

$$1) (5, 4) \quad 2) (2, 3) \quad 3) (5, 2) \quad 4) (4, 5)$$

**Key: 3**

**Sol:** Reflection of  $(2, 3)$  w.r.t  $y = x$  is  $(3, 2)$

Translation along distance of 2 units in the positive direction of  $x$ -axis is  $(5, 2)$

9. If the straight lines  $2x + 3y - 1 = 0$ ,  $x + 2y - 1 = 0$  and  $ax + by - 1 = 0$  form a triangle with origin as ortho centre, then  $(a, b) =$

1)  $(6, 4)$

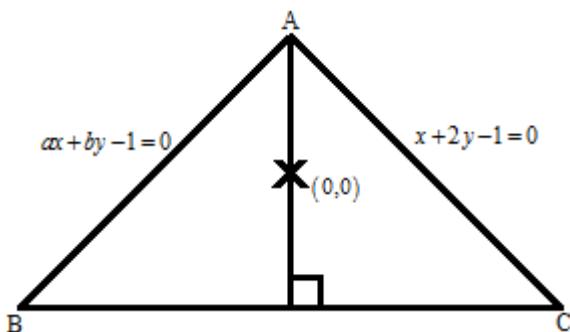
2)  $(-3, 3)$

3)  $(-8, 8)$

4)  $(0, 7)$

**Key:** 3

**Sol:**



$$(ax + by - 1) + \lambda(x + 2y - 1) = 0$$

$$-1 + \lambda(-1) = 0$$

$$\Rightarrow \lambda + 1 = 0, \lambda = -1$$

$$(ax + by - 1) - x - 2y + 1 = 0$$

$$(a-1)x + (b-2)y = 0$$

$$\frac{(a-1)}{(b-2)} \times \frac{2}{3} = -1$$

$$2a - 2 = -3(b-2)$$

$$= -3b + 6$$

$$2a + 3b = 8 \text{ and } a + b = 0$$

10. The point on the line  $4x - y - 2 = 0$  which is equidistant from the points  $(-5, 6)$  and  $(3, 2)$  is

1)  $(2, 6)$

2)  $(4, 14)$

3)  $(1, 2)$

4)  $(3, 10)$

**Key:** 2

**Sol:**  $y = 4x - 2$        $A = (-5, 6)$

$$P = (\alpha, 4\alpha - 2) \quad B = (3, 2)$$

$$PA^2 = PB^2$$

$$(\alpha + 5)^2 + (4\alpha - 2 - 6)^2 = (\alpha - 3)^2 + (4\alpha - 2 - 2)^2$$

$$-54\alpha + 89 = -38\alpha + 25$$

$$\alpha = 4$$

$$P(\alpha, 4\alpha - 2) = P(4, 14)$$

- 11. If the lines  $x + 2ay + a = 0$ ,  $x + 4cy + c = 0$  are concurrent, then  $a, b, c$  are in**

- |  |  |
|--|--|
| 1) Arithmetic progression<br>3) Harmonic progression | 2) Geometric Progression<br>4) Arithmetico-Geometric Progression |
|--|--|

**Key: 3**

**Sol:**  $\begin{vmatrix} 1 & 2a & a \\ 1 & 3b & b \\ 1 & 4c & c \end{vmatrix} = 0$

$$(3b - 2a)(c - a) - (4c - 2a)(b - a) = 0$$

$$3bc - 3ab - 2ac + 2a^2 = 4bc - 4ac - 2ab + 2a^2$$

$$0 = bc + ab - 2ac$$

$$b(a+c) = 2ac$$

$$\frac{b}{2} = \frac{ac}{a+c}; \quad b = \frac{2ac}{a+c}$$

$a, b, c \longrightarrow H.P$

- 12. The angle between the straight lines represented by  $(x^2 + y^2) \sin^2 \alpha = (x \cos \alpha - y \sin \alpha)^2$  is**

$$(x^2 + y^2) \sin^2 \alpha = (x \cos \alpha - y \sin \alpha)^2$$

$$1) \frac{\alpha}{2}$$

2) α

3) 2a

$$4) \frac{\pi}{2}$$

**Key: 3**

$$\text{Sol: } x^2 \sin^2 \alpha + y^2 \sin^2 \alpha - x^2 \cos^2 \alpha - y^2 \sin^2 \alpha + xy \sin 2\alpha = 0$$

$$\cos 2\alpha x^2 - \sin 2\alpha xy = 0$$

$$\tan \theta = \frac{2\sqrt{\frac{\sin^2 2\alpha - 0}{4}}}{\cos 2\alpha}$$

$$\tan \alpha = \tan 2\alpha$$

$$\theta = 2\alpha$$

13. If the slope of one lines represented by  $ax^2 - 6xy + y^2 = 0$  is the square of the other, then the value of  $a$  is

- 1) -27 or 8                  2) -3 or 2                  3) -64 or 27                  4) -4 or 3

**Key:** 1

$$\text{Sol: } m + m^2 = \frac{-2h}{b} = \frac{6}{1}$$

$$m \cdot m^2 = \frac{a}{b} = a$$

$$m^3 = a$$

$$m^2 + m - 6 = 0$$

$$(m+3)(m-2)=0$$

$$m = -3; m = 2$$

$$a = -27; a = 8$$

14. The sum of the minimum and maximum distance of the point  $(4, -3)$  to the circle

$$x^2 + y^2 + 4x - 10y - 7 = 0 \text{ is}$$

1) 10                    2) 12

3) 16

4) 20

**Key: 4**

**Sol:**  $S.D = CP - r$

$$L.D = CP + r$$

$$S.D + L.D = 2CP = 20$$

$$C = (-2, 5)$$

$$P = (4, -3) \quad 2CP = 20$$

$$CP = \sqrt{36 + 64} = 10$$

15. The locus of centres of the circles which cut the circles  $x^2 + y^2 + 4x - 6y + 9 = 0$  and  $x^2 + y^2 - 5x + 4y + 2 = 0$  orthogonally is

1)  $3x + 4y - 5 = 0$       2)  $9x - 10y + 7 = 0$       3)  $9x + 10y - 7 = 0$       4)  $9x - 10y + 11 = 0$

**Key: 2**

**Sol:**  $2g(2) + 2f(-3) = C + 9$

$$2g\left(\frac{-5}{2}\right) + 2f(2) = C + 2$$

$$9g - 10f = 7$$

$$-9x + 10y = 7$$

$$9x - 10y + 7 = 0$$

16. The equation of the circle passing through  $(2, 0)$  and  $(0, 4)$  and having the minimum radius is

1)  $x^2 + y^2 = 20$

2)  $x^2 + y^2 - 2x - 4y = 0$

3)  $x^2 + y^2 = 4$

4)  $x^2 + y^2 = 16$

**Key: 2**

**Sol:** Optional verification  $\sqrt{1+4} = \sqrt{5}$

17. If  $x^2 + y^2 - 4x - 2y + 5 = 0$  and  $x^2 + y^2 - 6x - 4y - 3 = 0$  are members of a coaxal system of circles then centre of a point circle in the system is

1)  $(-5, -6)$       2)  $(5, 6)$

3)  $(3, 5)$

4)  $(-8, -13)$

**Key: 1**

**Sol:**  $2x + 2y + 8 = 0$

$$x + y + 4 = 0$$

$$x^2 + y^2 - 4x - 2y + 5 + \lambda x + \lambda y + 4\lambda = 0$$

$$x^2 + y^2 + (\lambda - 4)x + (\lambda - 2)y + 5 + 4\lambda = 0$$

$$\frac{(\lambda-4)^2}{4} + \frac{(\lambda-2)^2}{4} - 5 - 4\lambda = 0$$

$$(\lambda-4)^2 + (\lambda-2)^2 - 20 - 16\lambda = 0$$

$$2\lambda^2 + 20 - 12\lambda - 20 - 16\lambda = 0$$

$$2\lambda^2 - 28\lambda = 0$$

$$2\lambda(\lambda - 14) = 0$$

$$\lambda = 0 \quad \lambda = 14$$

$$\left[ \frac{4-\lambda}{2}, \frac{2-\lambda}{2} \right] \quad \left( \frac{-10}{2}, \frac{-12}{2} \right)$$

$$(2,1) \quad = (-5, -6)$$

- 18. If  $x - y + 1 = 0$  meets the circle  $x^2 + y^2 + y - 1 = 0$  at A and B then the equation of the circle with AB as diameter is**

$$1) 2(x^2 + y^2) + 3x - y + 1 = 0$$

$$2) 2(x^2 + y^2) + 3x - y + 2 = 0$$

$$3) 2(x^2 + y^2) + 3x - y + 3 = 0$$

$$4) x^2 + y^2 + 3x - y + 1 = 0$$

**Key: 1**

$$\text{Sol: } x^2 + y^2 + y - 1 + \lambda(x - y + 1) = 0$$

$$x^2 + y^2 + \lambda x + (1 - \lambda)y + (\lambda - 1) = 0$$

$$= \left( \frac{-\lambda}{2}, \frac{\lambda - 1}{2} \right) \in x - y + 1 = 0$$

$$\frac{-\lambda}{2} - \frac{\lambda - 1}{2} + 1 = 0$$

$$\frac{-\lambda - \lambda + 1 + 2}{2} = 0$$

$$2\lambda = 3$$

$$\lambda = \frac{3}{2}$$

$$x^2 + y^2 + y - 1 + \frac{3}{2}x - \frac{3}{2}y + \frac{3}{2} = 0$$

$$2(x^2 + y^2) + 2y - 2 + 3x - 3y + 3 = 0$$

$$2(x^2 + y^2) + 3x - y + 1 = 0$$

- 19. An equilateral triangle is inscribed in the parabola  $y^2 = 8x$ , with one of its vertices is the vertex of the parabola. then the length of the side of that triangle is**

$$1) 24\sqrt{3}$$

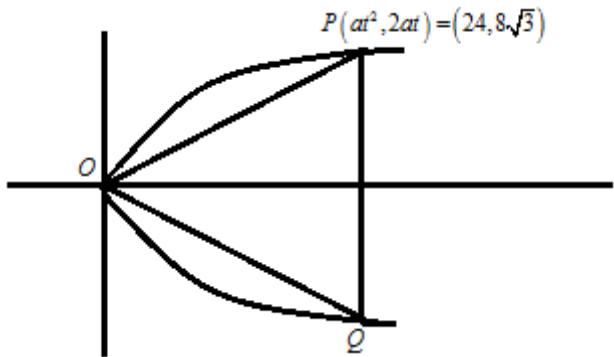
$$2) 16\sqrt{3}$$

$$3) 8\sqrt{3}$$

$$4) 4\sqrt{3}$$

**Key: 2**

**Sol:**



$$\tan 30^\circ = \frac{2at}{at^2} = \frac{2}{t}$$

$$\frac{1}{\sqrt{3}} = \frac{2}{t} \Rightarrow t = 2\sqrt{3}$$

$$\text{Side} = 4at = 8\sqrt{3}a = 16\sqrt{3}$$

20. The points  $(3, 4)$  is the focus and  $2x - 3y + 5 = 0$  is the directrix of a parabola. Its latus rectum is

1)  $\frac{2}{\sqrt{13}}$

2)  $\frac{4}{\sqrt{13}}$

3)  $\frac{1}{\sqrt{13}}$

4)  $\frac{3}{\sqrt{13}}$

**Key: 1**

**Sol:**  $2a = \frac{|6-12+5|}{\sqrt{13}} = \frac{1}{\sqrt{13}}$

$$4a = \frac{2}{\sqrt{13}}$$

21. The radius of the circle passing through te foci of the ellipse  $\frac{x^2}{16} + \frac{y^2}{9} = 1$  and having it centre at

$(0, 3)$  is

1) 6

2) 4

3) 3

4) 2

**Key: 2**

**Sol:**  $e = \sqrt{1 - \frac{9}{16}} = \frac{\sqrt{7}}{4}$

$$ae = \sqrt{7}$$

$$S = (\sqrt{7}, 0)$$

$$C = (0, 3)$$

$$r = CS = \sqrt{7+9} = 4$$

$$x^2 + (y-3)^2 = 16$$

22. The values that can take so that the straight line  $y = 4x + m$  touches the curve  $x^2 + 4y^2 = 4$  is

1)  $\pm\sqrt{45}$

2)  $\pm\sqrt{60}$

3)  $\pm\sqrt{65}$

4)  $\pm\sqrt{72}$

**Key: 3**

**Sol:**

$$\left. \begin{array}{l} y = 4x + m \\ \frac{x^2}{4} + \frac{y^2}{1} = 1 \end{array} \right\}$$

$$m^2 = 4(16) + 1$$

$$m = \pm\sqrt{65}$$

23. The foci of the ellipse  $\frac{x^2}{16} + \frac{y^2}{b^2} = 1$  and the hyperbola  $\frac{x^2}{144} - \frac{y^2}{81} = \frac{1}{25}$  coincide. Then, the value of  $b^2$  is

1) 5

2) 7

3) 9

4) 1

**Key: 2**

**Sol:**  $\frac{x^2}{\left(\frac{144}{25}\right)} - \frac{y^2}{\left(\frac{81}{25}\right)} = 1$

$$a = \frac{12}{5}, b = \frac{9}{5}$$

$$e = \sqrt{1 + \frac{81}{144}} = \frac{15}{12} = \frac{5}{4}$$

$$ae = \frac{12}{5} \times \frac{5}{4} = 3$$

$$S(ae, 0) = (3, 0)$$

$$\frac{x^2}{16} + \frac{y^2}{b^2} = 1$$

$$S(ae, 0) = (4e, 0) = (3, 0)$$

$$e = \frac{3}{4}$$

$$\sqrt{1 - \frac{b^2}{16}} = \frac{3}{4}$$

$$1 - \frac{9}{16} = \frac{b^2}{16}$$

$$\Rightarrow b^2 = 7$$

24. If  $(2, -1, 2)$  and  $(K, 3, 5)$  are the triads of direction ratios of two lines and the angle between them is  $45^\circ$ , then a value of  $K$  is

1) 2

2) 3

3) 4

4) 6

**Key: 3**

Sol:  $\cos 45^\circ = \frac{2K - 3 + 10}{3\sqrt{K^2 + 9 + 25}}$

$$\frac{1}{\sqrt{2}} = \frac{2K + 7}{3\sqrt{K^2 + 34}}$$

$$2(2K + 7)^2 = 9(K^2 + 34)$$

$$K^2 - 56K + 208 = 0$$

$$(K - 4)(K - 52) = 0$$

$$K = 4, 52$$

25. The length of perpendicular from the origin to the plane which makes intercepts  $\frac{1}{3}, \frac{1}{4}, \frac{1}{5}$  respectively on the coordinates axes is

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

2)  $\frac{1}{10}$

3)  $5\sqrt{2}$

4) 5

**Key: 1**

Sol:  $3x + 4y + 5z = 1$

$$\frac{1}{\sqrt{9+16+25}} = \frac{1}{\sqrt{50}} = \frac{1}{5\sqrt{2}}$$

26. Match the following :

I. The centroid of the triangle formed by

a)  $(2, 2, 2)$

$(2, 3, -1), (5, 6, 3), (2, -3, 1)$  is

II. The circumcentre of the triangle formed by

b)  $(3, 1, 4)$

$(1, 2, 3), (2, 3, 1), (3, 1, 2)$

III. The orthocentre of the triangle formed by

c)  $(1, 1, 0)$

$(2, 1, 5), (3, 2, 3), (4, 0, 4)$  is

IV. The incentre of the triangle formed by

d)  $(3, 2, 1)$

$(0, 0, 0), (3, 0, 0), (0, 4, 0)$  is

	I	II	III	IV
(1)	d	a	b	c
(2)	a	b	c	d
(3)	d	e	b	c
(4)	d	a	e	c

**Key: 1**

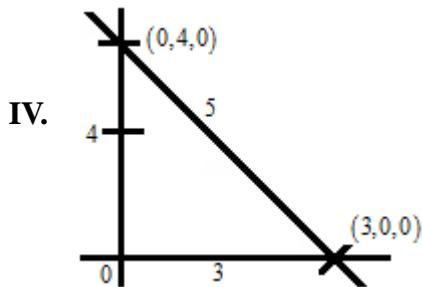
**Sol: I.**  $G = [3, 2, 1] \rightarrow d$

$$\text{II. } \left. \begin{array}{l} AB = \sqrt{1+1+4} = \sqrt{6} \\ BC = \sqrt{1+4+1} = \sqrt{6} \\ CA = \sqrt{4+1+1} = \sqrt{6} \end{array} \right\}$$

Circumcentre  $= [2, 2, 2] \rightarrow a$

$$\text{III. } \left. \begin{array}{l} AB = \sqrt{1+1+4} = \sqrt{6} \\ BC = \sqrt{1+4+1} = \sqrt{6} \\ CA = \sqrt{4+1+1} = \sqrt{6} \end{array} \right\}$$

Orthocentre  $= (3, 1, 4) \rightarrow b$



$$r = \frac{A}{S} \rightarrow c$$

27. If  $g(x) = \frac{x}{[x]}$  for  $x > 2$  then  $\lim_{x \rightarrow 2^+} \frac{g(x) - g(2)}{x - 2} =$

1) -1

2) 0

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

4) 1

**Key: 1**

$$\text{Sol: } g(x) = \frac{x}{[x]} \quad x > 2$$

$$\lim_{x \rightarrow 2^+} \frac{g(x) - g(2)}{x - 2} = g'(2^+) = \frac{d}{dx} \left( \frac{x}{2} \right) = \frac{1}{2}$$

$$28. \lim_{x \rightarrow \frac{\pi}{2}} \left( \frac{2x - \pi}{\cos x} \right) =$$

1) 0

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

3) -2

4) 5

**Key: 3**

$$\text{Sol: } \lim_{x \rightarrow \frac{\pi}{2}} \frac{2x - \pi}{\cos x}$$

$$= \lim_{x \rightarrow \frac{\pi}{2}} \frac{2}{-\sin x} = -2$$

**29.** If  $f(x) = \begin{cases} x, & \text{for } 0 \leq x < 1 \\ 2-x, & \text{for } x \geq 1 \end{cases}$ , then at  $x=1$ ,  $f$  is

- 1) Continous differentiable  
2) Continuous but not differentiable  
3) Discontinous but differentiable  
4) Neither continuous nor differentiable

**Key: 2**

$$\text{Sol: } f(x) = \begin{cases} x, & 0 \leq x < 1 \\ 2-x, & x \geq 1 \end{cases}$$

$$f'(x) = \begin{cases} 1, & 0 \leq x < 1 \\ -1, & x \geq 1 \end{cases}$$

$$f'(1-) \neq f'(1+) \rightarrow \text{not differentiable } f(1)=1$$

$$\lim_{x \rightarrow 1^-} f(x) = \lim_{x \rightarrow 1^-} 1 = 1 = f(1)$$

$$\lim_{x \rightarrow 1^+} f(x) = \lim_{x \rightarrow 1^+} 2-x = 1 = f(1)$$

$f(x)$  continuous but not differentiable

**30.** If  $x^2 + y^2 = t + \frac{1}{t}$  and  $x^4 + y^4 = t^2 + \frac{1}{t^2}$  then  $\frac{dy}{dx} =$

1)  $\frac{-x}{y}$

2)  $\frac{-y}{x}$

3)  $\frac{x^2}{y^2}$

4)  $\frac{y^2}{x^2}$

**Key: 2**

$$\text{Sol: } x^2 + y^2 = t + \frac{1}{t}; \quad x^4 + y^4 = t^2 + \frac{1}{t^2}$$

$$x^4 + y^4 + 2x^2y^2 = t^2 + \frac{1}{t^2} + 2$$

$$t^2 + \frac{1}{t^2} + 2x^2y^2 = t^2 + \frac{1}{t^2} + 2$$

$$x^2y^2 = 1$$

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

**31.** Let D be the domain of a twice differentiable function f. For all  $x \in D$ ,  $f''(x) + f(x) = 0$  and

$$f(x) = \int g(x) dx + \text{constant}. \text{ If } h(x) = f(x)^2 + (g(x))^2 \text{ and } h(0) = 5 \text{ then } h(2015) - h(2014) =$$

1) 5

2) 3

3) 0

4) 1

**Key: 3**

**Sol:**  $h(x)$  is constant function

**32.** If  $x = at^2$  and  $y = 2at$ , then  $\frac{d^2y}{dx^2}$  at  $t = \frac{1}{2}$  is

(1)  $\frac{-2}{a}$

(2)  $\frac{4}{a}$

(3)  $\frac{8}{a}$

(4)  $\frac{-4}{a}$

**Key: 4**

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**Sol:**  $x = t^2$

$$\frac{dx}{dt} = 2at$$

$$y = 2at$$

$$\frac{dy}{dt} = 2a$$

$$\frac{dy}{dx} = \frac{1}{t}$$

$$\frac{d^2y}{dx^2} = \frac{-1}{t^2} \cdot \frac{dt}{dx} = \frac{-1}{t^2} \cdot \frac{1}{2at} = \frac{-1}{2at^3} = \frac{-1}{2a\left(\frac{1}{8}\right)} = \frac{-4}{a}$$

33. The volume of a sphere is increasing at the rate of 1200 c.cm/sec. The rate of increase in its surface area when the radius is 10 cm is

(1) 120 sq.cm/sec      (2) 240 sq.cm/sec      (3) 200 sq.cm/sec      (4) 100 sq.cm.sec

**Key: 2**

**Sol:**  $\frac{dv}{dt} = 1200 \text{ cc/sec}; \quad r = 10$

$$V = \frac{4}{3}\pi r^3; \quad S = 4\pi r^2; \quad r = \frac{\sqrt{S}}{2\sqrt{\pi}}; \quad V = \frac{1}{6\sqrt{\pi}} S^{3/2}$$

$$\sqrt{S} = 2\sqrt{\pi}r \Rightarrow 20\sqrt{\pi}$$

$$V = \frac{1}{6\sqrt{\pi}} S^{3/2}$$

$$\frac{dv}{dt} = \frac{1}{6\sqrt{\pi}} \frac{3}{2} S^{\frac{1}{2}} \frac{ds}{dt}$$

$$= \frac{\sqrt{S}}{4\sqrt{\pi}} \frac{ds}{dt}$$

$$= \frac{20\sqrt{\pi}}{4\sqrt{\pi}} \frac{ds}{dt}; \quad \frac{ds}{dt} = \frac{1200}{5} = 240$$

34. The slope of the tangent to the curve  $y = \int_0^x \frac{dt}{1+t^3}$  at the point where  $x=1$  is

(1)  $\frac{1}{4}$

(2)  $\frac{1}{3}$

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

(4) 1

**Key: 3**

**Sol:**  $y = \int_0^x \frac{dt}{1+t^3}$

$$\frac{dy}{dx} = \frac{1}{1+x^3}(1) - 0$$

$$\text{slope} = \frac{1}{1+1} = \frac{1}{2}$$



$$\text{Sol: } (x, y) = (5 \cos \theta, 5 \sin \theta)$$

$$\text{Maximum } (15 \cos \theta + 20 \sin \theta) = 25$$

$$\log^{25} \equiv 2$$

36. If  $f$  is defined in  $[1,3]$  by  $f(x) = x^3 + bx^2 + ax$ , such that  $f(1) - f(3) = 0$  and  $f'(c) = 0$  where

$$c = 2 + \frac{1}{\sqrt{3}}, \text{ then } (a, b) =$$

- (1)  $(-6, 11)$       (2)  $\left(2 - \frac{1}{\sqrt{3}}, 2 + \frac{1}{\sqrt{3}}\right)$       (3)  $(11, -6)$       (4)  $(6, 11)$

**Key:** 3

$$\text{Sol: } f(x) = x^3 + bx^2 + ax$$

$$f(1) = 1 + b + a$$

$$f(3) = 27 + 9b + 3a$$

$$f(1) - f(3) = 0$$

$$-8b - 2a - 26 = 0$$

$$a+4b+13=0$$

$$3\left(2 + \frac{1}{\sqrt{2}}\right)^2 + 2b\left(2 + \frac{1}{\sqrt{2}}\right) + a = 0$$

$$3\left[\frac{13}{3} + \frac{4}{\sqrt{3}}\right] + 2b\left(2 + \frac{1}{\sqrt{3}}\right) - 13 - 4b = 0$$

$$4\sqrt{3} + \frac{2b}{\sqrt{3}} = 0$$

$$b = -6, a = 11$$

37.  $\int \frac{dx}{(x-1)\sqrt{x^2-1}} =$

(1)  $-\sqrt{\frac{x-1}{x+1}} + C$       (2)  $\sqrt{\frac{x-1}{x^2+1}} + C$       (3)  $-\sqrt{\frac{x+1}{x-1}} + C$       (4)  $\sqrt{\frac{x^2+1}{x-1}} + C$

**Key:** 3

**Sol:**  $\int \frac{dx}{(x-1)\sqrt{x^2-1}}$

$$= \int \frac{dx}{\left(\frac{x-1}{x+1}\right)^{\frac{3}{2}} (x+1)^2}$$

$$= \frac{1}{2} \int \left(\frac{x-1}{x+1}\right)^{-\frac{3}{2}} \times \frac{2}{(x+1)^2}$$

$$= \frac{1}{2} \frac{\left(\frac{x-1}{x+1}\right)^{-\frac{1}{2}}}{\frac{-1}{2}} = -\sqrt{\frac{x+1}{x-1}} + C$$

38.  $\int e^x \frac{x^2+1}{(x+1)^2} dx =$

(1)  $\frac{e^x}{x+1} + C$

(2)  $\frac{-e^x}{x-1} + C$

(3)  $e^x \left(\frac{x-1}{x+1}\right) + C$

(4)  $e^x \frac{(x+1)}{x-1} + C$

**Key: 3**

**Sol:**  $\int e^x \left(\frac{x^2+1}{(x+1)^2}\right) dx = \int e^x \left(\frac{x-1}{x+1} + \frac{2}{(x+1)^2}\right) dx$

$$= e^x \left(\frac{x-1}{x+1}\right) + C$$

39.  $\int \frac{x+1}{x(1+xe^x)} dx =$

(1)  $\log \left| \frac{1+xe^x}{xe^x} \right| + C$

(2)  $\log \left| \frac{xe^x}{1+xe^x} \right| + C$

(3)  $e^x \left(\frac{x-1}{x+1}\right) + C$

(4)  $e^x \left(\frac{x+1}{x-1}\right) + C$

**Key: 2**

**Sol:**  $\int \frac{x+1}{x(1+xe^x)} dx = \int \frac{e^x(x+1)}{xe^x(1+xe^x)} dx$

$xe^x = t$

$$= \int \frac{dt}{t(1+t)} = \int \left(\frac{1}{t} - \frac{1}{1+t}\right) dt$$

$$= \log \left(\frac{t}{1+t}\right) + C = \log \left(\frac{xe^x}{1+xe^x}\right) + C$$

40.  $\int \frac{f(x)g'(x) - f'(x)g(x)}{f(x)g(x)} [ \log(g(x)) - \log(f(x)) ] dx =$

(1)  $\log\left(\frac{g(x)}{f(x)}\right) + C$

(2)  $\frac{1}{2} \left[ \log\left(\frac{g(x)}{f(x)}\right) \right]^2 + C$

(3)  $\frac{g(x)}{f(x)} \log\left(\frac{g(x)}{f(x)}\right) + C$

(4)  $\log\left(\frac{g(x)}{f(x)}\right) - \frac{g(x)}{f(x)} + C$

(C is a constant)

**Key: 2**

**Sol:**  $\int \frac{f(x)g'(x) - f'(x)g(x)}{f(x)g(x)} \log\left(\frac{g(x)}{f(x)}\right) dx$

$$= \int \left( \frac{g'(x)}{g(x)} - \frac{f'(x)}{f(x)} \right) (\log g(x) - \log f(x)) dx$$

$$= \left( \frac{\log g(x) - \log f(x)}{2} \right)^2 + C$$

$$= \frac{1}{2} \left( \log\left(\frac{g(x)}{f(x)}\right) \right)^2 + C$$

41.  $\int_0^{\pi/4} \frac{\sin x + \cos x}{3 + \sin 2x} dx =$

(1)  $\frac{1}{2} \log 3$

(2)  $\log 2$

(3)  $\log 3$

(4)  $\frac{1}{4} \log 3$

**Key: 4**

**Sol:**  $\int_0^{\pi/4} \frac{\sin x + \cos x}{3 + \sin 2x} dx$

$$\sin x - \cos x = t$$

$$= \int_{-1}^0 \frac{dt}{2^2 - t^2}$$

$$= \left[ \frac{1}{2(2)} \log \left| \frac{2+t}{2-t} \right| \right]_{-1}^0$$

$$= \frac{1}{4} \log 3$$

42.  $\int_{-1}^1 \frac{\sqrt{1+x+x^2} - \sqrt{1-x+x^2}}{\sqrt{1+x+x^2} + \sqrt{1-x+x^2}} dx =$

(1)  $\frac{3\pi}{2}$

(2)  $\frac{\pi}{2}$

(3) 0

(4) -1

**Key:** 3

**Sol:**  $= \int_{-1}^{+1} \frac{\sqrt{1+x+x^2} - \sqrt{1-x+x^2}}{\sqrt{1+x+x^2} + \sqrt{1-x+x^2}} dx$

$= \int_{-1}^{+1} f(x) dx; f(x)$  is odd function

$= 0$

43. The area of the region described by  $\{(x, y) / x^2 + y^2 \leq 1 \text{ and } y^2 \leq 1-x\}$  is

1)  $\frac{\pi}{2} - \frac{2}{3}$

2)  $\frac{\pi}{2} + \frac{2}{3}$

3)  $\frac{\pi}{2} + \frac{4}{3}$

4)  $\frac{\pi}{2} - \frac{4}{3}$

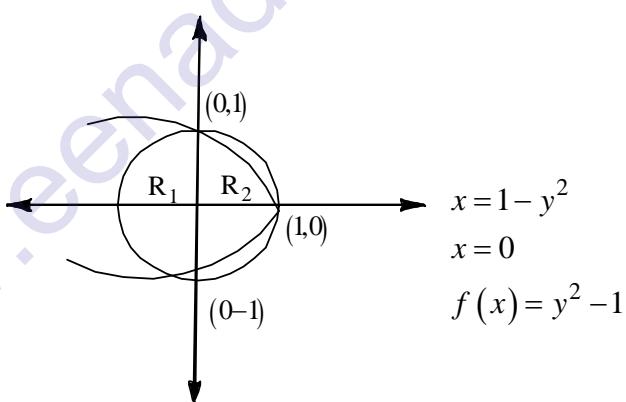
**Key:** 3

**Sol:**  $x^2 + y^2 \leq 1 \quad y^2 \leq 1-x$

$x^2 + 1-x = 1$

$x^2 - x = 0 \quad y^2 = -(x-1)$

$x = 0, x = 1$



$$R_1 = \frac{\pi r^2}{2} = \frac{\pi}{2}$$

$$R_2 = \frac{\Delta^{3/2}}{6a^2} = \frac{(4)^{3/2}}{6(1)^2}$$

$$= \frac{8}{6}$$

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

---


$$\text{Area} = \frac{\pi}{2} + \frac{4}{3}$$

44. The solution of  $\frac{dy}{dx} + \frac{1}{x} = \frac{e^y}{x^2}$  is

1)  $2x = (1 + Cx^2)e^y$     2)  $x = (1 + Cx^2)e^y$     3)  $2x^2 = (1 + Cx^2)e^{-y}$     4)  $x^2 = (1 + Cx^2)e^{-y}$

**Key: 1**

**Sol:**  $\frac{dy}{dx} + \frac{1}{x} = \frac{e^y}{x^2}$

$$e^{-y} \frac{dy}{dx} + \frac{e^{-y}}{x} = \frac{1}{x^2}$$

Put  $e^{-y} = t$

$$-\frac{dt}{dx} + \frac{t}{x} = \frac{1}{x^2}$$

$$\frac{dt}{dx} + t\left(\frac{-1}{x}\right) = -\frac{1}{x^2}$$

$$\text{I.F} = e^{\int \frac{1}{x} dx} = \frac{1}{x}$$

$$t\left(\frac{1}{x}\right) = \int \frac{-1}{x^2} \times \frac{1}{x} dx$$

$$\frac{e^{-y}}{x} = \int \frac{-1}{x^3} dx$$

$$\frac{e^{-y}}{x} = \frac{-1}{2x^2} + c$$

$$2xe^{-y} = 1 + 2x^2 \quad \frac{1}{2x^2}$$

$$2x = e^y (1 + c_1 x^2)$$

45. The differential equation  $\frac{dy}{dx} = \frac{1}{ax + by + c}$  where a,b,c are all non zero real numbers, is

1) Linear in y

2) linear in x

3) Linear in both x and y

4) Homogeneous equation

**Key: 2**

**Sol:**  $\frac{dy}{dx} = \frac{1}{ax + by + c}$

$$\frac{dx}{dy} = ax + by - c$$

$$\frac{dx}{dy} - ax = (by + c)$$

46. If  $f : R \rightarrow R, g : R \rightarrow R$  are defined by  $f(x) = 5x - 3$ ,  $g(x) = x^2 + 3$ , then  $(gof^{-1})(3) =$

- 1)  $\frac{25}{9}$       2)  $\frac{111}{25}$       3)  $\frac{9}{25}$       4)  $\frac{25}{111}$

**Key:** 2

**Sol:**  $f(x) = 5x - 3$

$$g(x) = x^2 + 3$$

$$f^{-1}(x) = \frac{x+3}{5}$$

$$(gof^{-1})(3) = g\left[\frac{6}{5}\right]$$

$$= \frac{36}{25} + 3$$

$$= \frac{111}{25}$$

47. If  $A = \left\{ x \in R \mid \frac{\pi}{4} \leq x \leq \frac{\pi}{3} \right\}$  and  $f(x) = \sin x - x$ , then  $f(A) =$

- 1)  $\left[ \frac{\sqrt{3}}{2} - \frac{\pi}{3}, \frac{1}{\sqrt{2}} - \frac{\pi}{4} \right]$    2)  $\left[ -\frac{1}{\sqrt{2}} - \frac{\pi}{4}, \frac{\sqrt{3}}{2} - \frac{\pi}{3} \right]$    3)  $\left[ -\frac{\pi}{3}, \frac{-\pi}{4} \right]$    4)  $\left[ \frac{\pi}{4}, \frac{\pi}{3} \right]$

**Key:** 1

**Sol:**  $f(x) = \sin x - x$

$$f'(x) = \cos x - 1 < 0$$

$$f\left(\frac{\pi}{4}\right) = \frac{1}{\sqrt{2}} - \frac{\pi}{4}$$

$$f\left(\frac{\pi}{3}\right) = \frac{\sqrt{3}}{2} - \frac{\pi}{3}$$

$$f(A) = \left[ \frac{\sqrt{3}}{2} - \frac{\pi}{3}, \frac{1}{\sqrt{2}} - \frac{\pi}{4} \right]$$

48. The value of the sum  $1.2.3 + 2.3.4 + 3.4.5 + \dots$  upto n terms =

- 1)  $\frac{1}{6}n^2(2n^2 + 1)$       2)  $\frac{1}{6}(n^2 - 1)(2n - 1)(2n + 3)$   
 3)  $\frac{1}{8}(n^2 + 1)(n^2 + 5)$       4)  $\frac{1}{4}n(n+1)(n+2)(n+3)$

**Key:** 4

---

**Sol:**  $S_n = 1.2.3 + 2.3.4 + 3.4.5 + \dots + n^{\text{th}} \text{ term}$

$$t_n = n(n+1)(n+2)$$

$$S_n = \sum t_n$$

$$= \sum_{n=1}^n (n^3 + 3n^2 + 2n)$$

$$= \frac{n^2(n+1)^2}{4} + 3n \frac{(n+1)(2n+1)}{6} + 2 \frac{n(n+1)}{2}$$

$$= \frac{n(n-1)}{4} [n^2 + n + 4n + 2 + 4]$$

$$= \frac{n(n+1)}{4} (n^2 + 5n) + 6$$

$$= \frac{n(n+1)(n+2)(n+3)}{4}$$

**49. The value of the determinant**

$$\begin{vmatrix} b^2 - ab & b - c & bc - ac \\ ab - a^2 & a - b & b^2 - ac \\ bc - ac & c - a & ab - a^2 \end{vmatrix}$$

1) abc

2) a+b+c

3) 0

4) ab+bc+ca

**Key: 3**

**Sol:**

$$\begin{vmatrix} b^2 - ab & b - c & bc - ac \\ ab - a^2 & a - b & b^2 - ab \\ bc - ac & c - a & ab - a^2 \end{vmatrix}$$

$$= \begin{vmatrix} b(b-a) & b - c & c(b-a) \\ a(b-a) & a - b & b(b-a) \\ c(b-a) & c - a & a(b-a) \end{vmatrix}$$

$$= (b-a)^2 \begin{vmatrix} b & b - c & c \\ a & a - b & b \\ c & c - a & a \end{vmatrix}$$

$$C_2 \rightarrow C_2 + C_3$$

$$= (b-a)^2 \begin{vmatrix} b & b & c \\ a & a & b \\ c & c & a \end{vmatrix}$$

$$= 0$$

---

50. If  $A$  is the square matrix of order 3, then  $|Adj(Adj A^2)| =$

- 1)  $|A|^2$       2)  $|A|^4$       3)  $|A|^8$       4)  $|A|^{16}$

**Key:** 3

**Sol:**  $|Adj(Adj)(A^2)|$

$$= |A^2|^{(n-1)^2}$$

$$= |A|^{2(n-1)^2}$$

$$n=3$$

$$= |A|^8$$

51. The system  $2x+3y+z=5$ ,  $3x+y+5z=7$ ,  $x+4y-2z=3$  has

- 1) unique solution      2) finite number of solutions  
3) Infinite solutions      4) No solutions

**Key:** 4

**Sol:** Augmented  $[AB] = \begin{vmatrix} 1 & 4 & -2 & 3 \\ 2 & 3 & 1 & 5 \\ 3 & 1 & 5 & 7 \end{vmatrix}$

$$R_2 \rightarrow R_2 - 2R_1$$

$$R_3 \rightarrow R_3 - 3R_1$$

$$\square \begin{bmatrix} 1 & 4 & -2 & 3 \\ 0 & -5 & 5 & -1 \\ 0 & -11 & 11 & -2 \end{bmatrix}$$

$$R_3 \rightarrow 5R_3 - 11R_2$$

$$\square \begin{bmatrix} 1 & 4 & -2 & 3 \\ 0 & -5 & 5 & -1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

52.  $\sum_{k=1}^6 \left[ \sin \frac{2k\pi}{7} - i \cos \frac{2k\pi}{7} \right]$

- 1) -1      2) 0      3) -i      4) i

**Key:** 4

**Sol:**  $= -i \sum_{i=1}^6 \operatorname{cis} \frac{2k\pi}{7}$

$$= -i(-1)$$

$$= i$$

53. If ' $\omega$ ' is a complex cube root of unity, then

- 1) 1      2) -1      3)  $\omega$       4) i

**Key:** 2

$$\text{Sol: } w^{\frac{1}{1-\frac{2}{3}}} + w^{\frac{1}{1-\frac{3}{4}}} = w^1 + w^2$$

$$= -1$$

**54. The common root of the equations  $z^3 + 2z^2 + 2z + 1 = 0$ ,  $z^{2014} + z^{2015} + 1 = 0$  are**

- 1)  $\omega, \omega^2$       2)  $1, \omega, \omega^2$       3)  $-1, \omega, \omega^2$       4)  $-\omega, -\omega^2$

**Key:** 1

$$\text{Sol: } z^3 + 2z^2 + 2z + 1 = 0$$

$$(z^3 + 1) + 2z(z + 1) = 0$$

$$(z + 1)(z^2 - z + 1 + 2z) = 0$$

$$(z + 1)(z^2 + z + 1) = 0$$

$$z = -1, w, w^2$$

$$z^{2014} + z^{2015} + 1 = 0$$

$\omega, \omega^2$  satisfies

$$55. \left( \frac{1 + \cos \frac{\pi}{8} - i \sin \frac{\pi}{8}}{1 + \cos \frac{\pi}{8} + i \sin \frac{\pi}{8}} \right)^8 =$$

- 1) 1      2) -1      3) 2      4)  $\frac{1}{2}$

**Key:** 2

$$\text{Sol: } \left( \frac{1 + \cos \frac{\pi}{8} - i \sin \frac{\pi}{8}}{1 + \cos \frac{\pi}{8} + i \sin \frac{\pi}{8}} \right)^8 = \left( \frac{2 \cos^2 \frac{\pi}{16} - i 2 \sin \frac{\pi}{16} \cos \frac{\pi}{16}}{2 \cos^2 \frac{\pi}{16} + i 2 \sin \frac{\pi}{16} \cos \frac{\pi}{16}} \right)$$

$$= \left( \frac{cis\left(-\frac{\pi}{16}\right)}{cis\left(\frac{\pi}{16}\right)} \right)^8$$

$$= \left( cis\left(\frac{-\pi}{8}\right) \right)^8$$

$$= cis(-\pi)$$

$$= -1$$

56. If  $a, b, c$  are distinct and the roots of  $(b-c)x^2 + (c-a)x + (a-b) = 0$  are equal, then  $a, b, c$  are in

1) A.P                    2) G.P                    3) H.P                    4) AGP

**Key:** 1

$$\text{Sol: } 1 = \frac{a-b}{b-c}$$

$$b-c = a-b$$

$$2b = a+c$$

$$a, b, c \text{ A.P}$$

57. If the roots of  $x^3 - kx^2 + 14x + 8 = 0$  are in geometric progression, then  $k =$

1) -3                    2) 7                    3) 4                    4) 0

**Key:** 2

$$\text{Sol: } \frac{a}{r}, a, ar \text{ are roots}$$

$$a \left[ 1+r+\frac{1}{r} \right] = k$$

$$a^3 = 8. \quad a = 2$$

$$\frac{a^2}{r} + a^2 r + a^2 = 14$$

$$2 \left[ 1+r+\frac{1}{r} \right] = 7$$

$$2 \left[ r+r^2+1 \right] = 7r$$

$$r^2 - 5r + 2 = 0$$

$$2r^2 - 4r - r + 2 = 0$$

$$2r(r-2) + 1(r-2) = 0 \quad r = 2, \frac{1}{2}$$

58. If the harmonic mean of the roots of  $\sqrt{2}x^2 - bx + (8-2\sqrt{5}) = 0$  is 4, then the value of  $b =$

1) 2                    2) 3                    3)  $4-\sqrt{5}$                     4)  $4+\sqrt{5}$

**Key:** 3

$$\text{Sol: } \frac{2\alpha\beta}{\alpha+\beta} = 4$$

$$2 \frac{\frac{(8-2\sqrt{5})}{\sqrt{2}}}{\frac{b}{\sqrt{2}}} = 4$$

$$b = 4 - \sqrt{5}$$

- 59.** For real values of  $x$ , the range of  $\frac{x^2 + 2x + 1}{x^2 + 2x - 1}$  is

- 1)  $(-\infty, 0) \cup (1, \infty)$     2)  $\left[\frac{1}{2}, 2\right]$     3)  $\left(-\infty, \frac{-2}{9}\right) \cup (1, \infty)$     4)  $(-\infty, -6) \cup (-2, \infty)$

**Key:** 1

**Sol:** .  $y = \frac{x^2 + 2x + 1}{x^2 + 2x - 1}$

$$x^2(y-1) + 2x(y-1) - (y+1) = 0$$

$$\Delta \geq 0$$

$$4(y-1)^2 + 4(y^2 - 1) \geq 0$$

$$(y-1)(y-1+y+1) \geq 0$$

$$2y(y-1) \geq 0$$

$$y \leq 0 \text{ or } y \geq 1$$

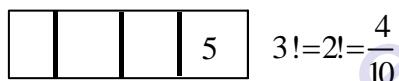
$$(-\infty, 0] \cup [1, \infty)$$

- 60.** The number of four digit numbers formed by using the digits 0, 2, 4, 5 and which are not divisible by 5 is

- 1) 10    2) 8    3) 6    4) 4

**Key:** 2

**Sol:** 0, 2, 4, 5



$$\text{Required} = (4! - 3!) - 10$$

$$= 18 - 10$$

$$= 8$$

- 61.**  $T_m$  denotes the number of triangles that can be formed with the vertices of a regular polygon of  $m$  sides. If  $T_{m-1} - T_m = 15$ , then  $m =$

- 1) 3    2) 6    3) 9    4) 12

**Key:** 2

**Sol:**  $T_{m+1} - T_m = 15$

$${}^{m+1}C_3 - {}^mC_3 = 15$$

$$\frac{(m+1)m(m-1)}{6} - \frac{m(m-1)(m-2)}{6} = 15$$

$$m(m-1)(3) = 15 \times 6$$

$$m(m-1) = 6 \times 5$$

$$m = 6$$

62. If  $|x|<1$  then the coefficient of  $x^5$  in the expansion of  $\frac{3x}{(x-2)(x+1)}$  is
- 1)  $\frac{33}{32}$       2)  $-\frac{33}{32}$       3)  $\frac{31}{32}$       4)  $-\frac{31}{32}$

**Key:** 2

$$\begin{aligned}
 \text{Sol: } \frac{3x}{(x-2)(x+1)} &= \frac{6}{3(x-2)} + \frac{-3}{(-3)(x+1)} \\
 &= \frac{2}{x-2} + \frac{1}{(x+1)} \\
 &= \frac{-2}{(2-x)} (1+x)^{-1} \\
 &= -2 \times 2^{-1} \left(1 - \frac{x}{2}\right)^{-1} + (1+x)^{-1} \\
 &= -\left[1 + \left(\frac{x}{2}\right) + \left(\frac{x}{2}\right)^2 + \left(\frac{x}{2}\right)^4 + \left(\frac{x}{2}\right)^5 + \dots\right] + (1-x+x^2-x^3+x^4-x^5+\dots)
 \end{aligned}$$

$$\text{coefficients of } x^5 = -\frac{1}{32} - 1$$

$$= \frac{-1-32}{32} = -\frac{33}{32}$$

63. If the coefficients of  $x^9, x^{10}, x^{11}$  in the expansion of  $(1+x)^n$  are in arithmetic progression then  $n^2-41n$  =

- 1) 398      2) 298      3) -398      4) 198

**Key:** 3

**Sol:** Coefficients of  $x^{r-1}, x^r, x^{r+1}$  of  $(1+x)^n$  are in A.P

$$\Rightarrow (n-2r)^2 = n+2$$

$$\text{put } r=10$$

$$\Rightarrow (n-20)^2 = x+2$$

$$\Rightarrow n^2 - 40x + 400 - x - 2 = 0$$

$$\Rightarrow n^2 - 41n + 398 = 0$$

$$\Rightarrow n^2 - 41n = -398$$

64. If  $x = \frac{1}{5} + \frac{1.3}{5.10} + \frac{1.3.5}{5.10.15} + \dots \infty$  then  $3x^2 + 6x =$

- 1) 1      2) 2      3) 3      4) 4

**Key:** 2

**Sol:**  $x = \frac{1}{5} + \frac{1.3}{1.2} \left(\frac{1}{5}\right)^2 + \frac{1.3.5}{1.2.3} \left(\frac{1}{5}\right)^3 + \dots \infty$

$$x+1 = 1 + \frac{1}{1} \left(\frac{1}{5}\right) + \frac{1.3}{2} \left(\frac{1}{5}\right)^2 + \dots$$

$$= 1 + \frac{p}{1} \left(\frac{x}{q}\right) + \frac{p(p+q)}{2} \left(\frac{x}{q}\right)^2 + \dots$$

$$p=1, \quad \frac{x}{q}=\frac{1}{5}, \quad p+q=3$$

$$\frac{x}{2}=\frac{1}{5} \quad q=2$$

$$x=\frac{2}{5}$$

$$x+1 = (1-x)^{\frac{-p}{q}} = \left(1 - \frac{2}{5}\right)^{\frac{-1}{2}} = \left(\frac{3}{5}\right)^{-1/2}$$

$$(x+1)^2 = \frac{5}{3}$$

$$x^2 + 2x + 1 = \frac{5}{3} \Rightarrow 3x^2 + 6x = 2$$

65. If  $\sin \theta + \cos \theta = p$  and  $\tan \theta + \cot \theta = q$  then  $q(p^2 - 1) =$

1) 1/2                          2) 2                                  3) 1

4) 3

**Key:** 2

**Sol:**  $\sin \theta + \cos \theta = p, \frac{\sin \theta}{\cos \theta} + \frac{\cos \theta}{\sin \theta} = q$

$$\frac{1}{\sin \theta \cos \theta} = q$$

$$\sin \theta \cos \theta = \frac{1}{q}$$

$$(\sin \theta + \cos \theta)^2 = p^2$$

$$\Rightarrow 1 + \frac{2}{q} = p^2$$

$$\Rightarrow q + 2 = qp^2$$

$$\Rightarrow 2 = qp^2 - q$$

$$\Rightarrow q(p^2 - 1) = 2$$

66.  $\tan \frac{\pi}{5} + 2 \tan \frac{2\pi}{5} + 4 \cot \frac{4\pi}{5} =$

1)  $\cot \frac{\pi}{5}$

2)  $\cot \frac{2\pi}{5}$

3)  $\cot \frac{3\pi}{5}$

4)  $\cot \frac{4\pi}{5}$

**Key:** 1

**Sol:**  $\tan A + 2\tan(2A) + 4\tan(4A) + \dots + 2^{n-1}\tan(2^{n-1}A) + 2^n \cdot \cot(2^n A) = \cot A$

$$\tan\left(\frac{\pi}{5}\right) + 2\tan\left(2\frac{\pi}{5}\right) + 4\tan\left(4\frac{\pi}{5}\right) = \cot\left(\frac{\pi}{5}\right)$$

67. If  $\sin A + \sin B + \sin C = 0$  and  $\cos A + \cos B + \cos C = 0$ , then

$$\cos(A+B) + \cos(B+C) + \cos(C+A) =$$

1)  $\cos(A+B+C)$       2) 2

3) 1

4) 0

**Key:** 4

**Sol:**  $\sin A = \sin b + \sin c = 0 = \cos A + \cos B + \cos C$

$$x = cis A$$

$$y = cis B$$

$$z = cis C$$

$$xy + yz + zx = \sin 3\left[\frac{1}{x} + \frac{1}{y} + \frac{1}{z}\right] = xyz(0)$$

$$cis(A+B) + cis(B+C) + cis(C+A) = 0$$

$$\sum \cos(A+B) = 0$$

68. If  $\tan \theta \cdot \tan(120^\circ - \theta) = \frac{1}{\sqrt{3}}$ ,  $\tan \theta =$

1)  $\frac{n\pi}{3} + \frac{\pi}{18}, n \in Z$

2)  $\frac{n\pi}{3} + \frac{\pi}{12}, n \in Z$

3)  $\frac{n\pi}{12} + \frac{\pi}{12}, n \in Z$

4)  $\frac{n\pi}{3} + \frac{\pi}{6}, n \in Z$

**Key:** 1

**Sol:**  $\tan 3\theta = \frac{1}{\sqrt{3}} = \tan(30^\circ)$

$$3\theta = n\pi + \frac{\pi}{6}$$

$$\theta = n\frac{\pi}{3} + \frac{\pi}{18}, n \in Z$$

69. If  $\sin^{-1}\left(x - \frac{x^2}{2} + \frac{x^3}{4} - \dots - \infty\right) + \cos^{-1}\left(x^2 - \frac{x^4}{2} + \frac{x^6}{4} - \dots - \infty\right) = \frac{\pi}{2}$  and  $0 < x < \sqrt{2}$  then  $x =$

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

2) 1

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

4) -1

**Key:** 2

**Sol:**  $x - \frac{x^2}{2} + \frac{x^3}{4} - \dots = x^2 - \frac{x^4}{2} + \frac{x^6}{4} - \dots$   $x = 1$

70. If  $2\sinh^{-1}\left(\frac{a}{\sqrt{1-a^2}}\right) = \log\left(\frac{1+a}{1-a}\right)$  then  $x =$

1) a

2)  $\frac{1}{a}$

3)  $\sqrt{1-a^2}$

4)  $\frac{1}{\sqrt{1-a^2}}$

**Key: 1**

**Sol:**  $\sinh^{-1} x = \log\left(x + \sqrt{x^2 + 1}\right)$

$$\sinh^{-1}\left(\frac{a}{\sqrt{1-a^2}}\right) = \log\left(\frac{a}{\sqrt{1-a^2}} + \sqrt{\frac{a^2}{1-a^2} + 1}\right)$$

$$= \log\left(\frac{a}{\sqrt{1-a^2}} + \sqrt{\frac{a^2 + 1 - a^2}{1-a^2}}\right)$$

$$= \log\left(\frac{a}{\sqrt{1-a^2}} + \frac{1}{\sqrt{1-a^2}}\right)$$

$$= \log\left(\frac{a+1}{\sqrt{1-a^2}}\right)$$

$$= \log\left(\frac{\sqrt{a+1}\sqrt{a+1}}{\sqrt{1-a}\sqrt{1+a}}\right)$$

$$= \log\left(\frac{1+a}{1-a}\right)^{1/2}$$

$$= \frac{1}{2} \log\left(\frac{1+a}{1-a}\right)$$

$$2\sinh^{-1}\left(\frac{a}{\sqrt{1-a^2}}\right) = \log\left(\frac{1+a}{1-a}\right)$$

$$x = a$$

71. In a  $\Delta ABC, (a+b+c)(b+c-a) = \lambda bc$ , then

1)  $\lambda < -6$

2)  $\lambda > 6$

3)  $0 < \lambda < 4$

4)  $\lambda > 4$

**Key: 3**

**Sol:**  $(a+b+c)(b+c-a) = \lambda bc$

$$2s \times 2(s-a) = \lambda(bc)$$

$$\Rightarrow 4 \frac{s(s-a)}{bc} = \lambda$$

$$\Rightarrow \frac{s(s-a)}{bc} = \frac{\lambda}{4}$$

$$\Rightarrow \cos^2\left(\frac{A}{2}\right) = \frac{\lambda}{4} \Rightarrow 0 < \frac{\lambda}{4} < 1$$

$$\Rightarrow 0 < \lambda < 4$$

72. If in a  $\Delta ABC$ ,  $r_1 = 2r_2 = 3r_3$ , then the perimeter of the triangle is equal to

1)  $3a$

2)  $3b$

3)  $3c$

4)  $3(a+b+c)$

**Key: 2**

**Sol:** . if  $xr_1 = yr_2 = zr_3$

$$\text{then } a:b:c = y+z:z+x : x+y$$

$$a:b:c = 5:4:3$$

$$a+b+c = 12 = 3(b)$$

73. In a  $\Delta ABC$ ,  $\frac{a}{\tan A} + \frac{b}{\tan B} + \frac{c}{\tan C} =$

1)  $2r$

2)  $r+2R$

3)  $2r+R$

4)  $2(r+R)$

**Key: 4**

**Sol:** .  $\frac{a}{\tan A} + \frac{b}{\tan B} + \frac{c}{\tan C}$

$$\frac{2R \sin A \cos A}{\sin A} + \frac{2R \sin B \cos B}{\sin B} + \frac{2R \sin C \cos C}{\sin C}$$

$$= 2R [\cos A + \cos B + \cos C]$$

$$= 2R \left[ 1 + 4 \sin \frac{A}{2} \sin \frac{B}{2} \sin \frac{C}{2} \right]$$

$$= 2R + 2 \left[ 4R \sin \frac{A}{2} \sin \frac{B}{2} \sin \frac{C}{2} \right]$$

$$= 2R + 2r$$

$$= 2(R+r)$$

74. If  $m_1, m_2, m_3, m_4$  are respectively the magnitudes of the vectors

$\overline{a_1} = 2\overline{i} - \overline{j} + \overline{k}$ ,  $\overline{a_2} = 3\overline{i} - 4\overline{j} - 4\overline{k}$ ,  $\overline{a_3} = -\overline{i} + \overline{j} - \overline{k}$ ,  $\overline{a_4} = -\overline{i} + 3\overline{j} + \overline{k}$ , then the correct order of  $m_1, m_2, m_3, m_4$  is

1)  $m_3 < m_1 < m_4 < m_2$    2)  $m_3 < m_1 < m_2 < m_4$    3)  $m_3 < m_4 < m_1 < m_2$    4)  $m_3 < m_4 < m_2 < m_1$

**Key: 1**

**Sol:** .  $m_1 = |\overline{a_1}| = \sqrt{4+1+1} = \sqrt{6}$

$m_2 = |\overline{a_2}| = \sqrt{9+16+16} = \sqrt{41}$

$$m_3 = \sqrt{a_3} = \sqrt{1+1+1} = \sqrt{3}$$

$$m_4 = \sqrt{a_4} = \sqrt{1+9+1} = \sqrt{11}$$

$$m_3 < m_1 < m_4 < m_2$$

75. If  $\bar{a}, \bar{b}, \bar{c}$  are unit vectors such that  $\bar{a} + \bar{b} + \bar{c} = \bar{0}$ , then the  $\bar{a}.\bar{b} + \bar{b}.\bar{c} + \bar{c}.\bar{a} =$

$$1) \frac{3}{2} \quad 2) -\frac{3}{2}$$

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

$$4) -\frac{1}{2}$$

**Key:** 2

**Sol:**  $|a| = 1, |b| = 1, |c| = 1$

$$\left(\bar{a} + \bar{b} + \bar{c}\right)^2 = 0$$

$$\Rightarrow 1+1+1+2(\bar{a}.\bar{b} + \bar{b}.\bar{c} + \bar{c}.\bar{a}) = 0$$

$$\bar{a} \cdot \bar{b} + \bar{b} \cdot \bar{c} + \bar{c} \cdot \bar{a} = -\frac{3}{2}$$

76. If  $\bar{a} = 2\bar{i} + \bar{k}$ ,  $\bar{b} = \bar{i} + \bar{j} + \bar{k}$ ,  $\bar{c} = 4\bar{j} - 3\bar{j} + 7\bar{k}$  then the vector  $\bar{r}$  satisfying  $\bar{r} \times \bar{b} = \bar{c} \times \bar{b}$  and  $\bar{r} \cdot \bar{a} = 0$  is.

$$1) \overline{i} + 8\overline{j} + 2\overline{k}$$

$$+2\bar{k} \quad \quad \quad 3) \bar{i}-8\bar{j}-2\bar{k}$$

$$4) -\bar{i} - 8\bar{j} + 2\bar{k}$$

**Key:** 4

$$\text{Sol: } \bar{r} \times \bar{b} - \bar{c} \times \bar{b} = 0$$

$$(\bar{r} - \bar{c}) \times \bar{b} = 0$$

$$\Rightarrow \bar{r} - \bar{c} = \lambda \bar{b}$$

$$\Rightarrow \overline{r.a} = \overline{c.a} + \lambda(\overline{b.a})$$

$$\Rightarrow 0 = \overline{c} \cdot \overline{a} + \lambda (\overline{b} \cdot \overline{a})$$

$$\Rightarrow \lambda = -\frac{(\bar{c} \cdot \bar{a})}{(\bar{b} \cdot \bar{a})}$$

$$= - \frac{[8+7]}{(2+1)}$$

$$= -5$$

$$\therefore \bar{r} = \bar{c} - 5\bar{b}$$

$$= \left( 4\bar{i} - 3\bar{j} + 7\bar{k} \right) - 5\bar{i} - 5\bar{j} - 5\bar{k}$$

$$= -\vec{i} - 8\vec{j} + 2\vec{k}$$

77. If  $\vec{a}, \vec{b}, \vec{c}$  are three vectors such that  $|\vec{a}| = 1, |\vec{b}| = 2, |\vec{c}| = 3$ , and  $\vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c} = \vec{b} \cdot \vec{c} = 0$ , then  $[\vec{a} \vec{b} \vec{c}] =$
- 1) 0      2) 2      3) 3      4) 6

**Key:** 4

$$\text{Sol: } |\vec{a}| = 1, |\vec{b}| = 2, |\vec{c}| = 3$$

$$[\vec{a} \vec{b} \vec{c}]^2$$

$$= |\vec{a} (\vec{b} \times \vec{c})|^2$$

$$= |\vec{a}|^2 |\vec{b} \times \vec{c}|^2 \cos^2(\vec{a}, \vec{b} \times \vec{c})$$

$$= |\vec{a}|^2 |\vec{b}|^2 |\vec{c}|^2 \sin^2 90^\circ \cdot \cos^2 0$$

$$= 1 \times 4 \times 9$$

$$= 36$$

$$[\vec{a} \vec{b} \vec{c}] = 6$$

78. If  $[\vec{a} \times \vec{b} \vec{b} \times \vec{c} \vec{c} \times \vec{a}] = \lambda [\vec{a} \vec{b} \vec{c}]^2$ , then  $\lambda =$

1) 0      2) 1      3) 2      4) 3

**Key:** 2

$$\text{Sol: } [\vec{a} \times \vec{b} \quad \vec{b} \times \vec{c} \quad \vec{c} \times \vec{a}] = [\vec{a} \vec{b} \vec{c}]^2$$

$$\text{So } \lambda = 1$$

79. The Cartesian equation of the plane passing through the point (3,-2,-1) and parallel to the vectors

$$\vec{b} = \vec{i} - 2\vec{j} + 4\vec{k} \text{ and } \vec{c} = 3\vec{i} + 2\vec{j} - 5\vec{k} \text{ is}$$

1)  $2x - 17y - 8z + 63 = 0$

2)  $3x + 17y + 8z - 36 = 0$

3)  $2x + 17y + 8z + 36 = 0$

4)  $3x - 16y + 8z - 63 = 0$

**Key:** 3

$$\text{Sol: } \begin{vmatrix} x-3 & y+2 & z+1 \\ 1 & -2 & 4 \\ 3 & 2 & -5 \end{vmatrix} = 0$$

$$\Rightarrow 2x + 17y + 8z + 36 = 0$$

80. The arithmetic mean of the observations 10,8,5,a,b is 6 and their variance is 6.8. then  $ab =$

1) 6      2) 4      3) 3      4) 12

**Key:** 4

$$\text{Sol: } \frac{10+8+5+a+b}{5} = 6$$

$$a+b = 7$$

$$\sigma^2 = \frac{1}{5} \sum x^2 - \bar{x}^2 = 6.8$$

$$\frac{1}{5} [100 + 64 + 25 + a^2 + b^2] = 6.8 + 36$$

$$189 + a^2 + b^2 = 5[42.8]$$

$$a^2 + b^2 = 214 - 189 = 25$$

$$\frac{(a+b)^2 - (a^2 + b^2)}{2} = ab$$

$$ab = 12$$

## PHYSICS

- 81.** An image is formed at a distance of 100 cm from the glass surface when light from point source in air falls on a spherical glass surface with refractive index 1.5. The distance of the light source from the glass surface is 100 cm. The radius of curvature is.

1) 20 cm      2) 40 cm      3) 30 cm      4) 50 cm

Key : 1

$$\text{Sol: } \frac{\mu_2}{V} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$

$$\mu_2 = \frac{3}{2}$$

$$\mu_1 = 1$$

$$V = 100 \text{ cm}$$

$$u = -100 \text{ cm}$$

$$\therefore R = 20 \text{ cm}$$

- 82.** Two coherent sources of intensity ratio 9 : 4 produce interference. The intensity ratio of maxima and minima of the interference pattern is

1) 13 : 5      2) 5 : 1      3) 25 : 1      4) 3 : 2

Key : 3

$$\text{Sol: } \frac{I_{\max}}{I_{\min}} = \left( \frac{\sqrt{I_1} + \sqrt{I_2}}{\sqrt{I_1} - \sqrt{I_2}} \right)^2 = \left( \frac{3+2}{3-2} \right)^2 = \frac{25}{1}$$

- 83.** The energy of a parallel plate capacitor when connected to a battery is E. With the battery still in connection, if the plates of the capacitor are separated so that the distance between them is twice the original distance, then the electrostatic energy becomes

1) 2E      2)  $\frac{E}{4}$       3)  $\frac{E}{2}$       4) 4E

Key : 3

$$\text{Sol: } E = \frac{1}{2} CV^2 = \frac{1}{2} \frac{A\epsilon_0}{d} V^2 \rightarrow (1)$$

$$E' = \frac{1}{2} \frac{A\epsilon_0}{2d} V^2 = \frac{E}{2}$$

- 84.** Two point charges  $+8\mu\text{C}$  and  $+12\mu\text{C}$  repel each other with a force of 48 N. When an additional charge of  $-10\mu\text{C}$  is given to each of these charges (the distance between the charges is unaltered) then the new force is

1) Repulsive force of 24 N      2) Attractive force of 24 N

3) Repulsive force of 2 N      4) Attractive force of 2 N

Key : 4

Sol:  $F = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{r^2} = K \times \frac{8 \times 12}{r^2} = 48N \rightarrow (1) \text{ repulsion } \frac{K}{r^2} = \frac{48}{96} = \frac{1}{2}$

$$F' = K \times \frac{\dot{q}_1 \dot{q}_2}{r^2} = K \times \frac{-2 \times 2}{r^2}$$

$$= \frac{-4K}{r^2}$$

$$= -4 \times \frac{1}{2} = -2N$$

$F' = 2N$  attraction

85. If the dielectric constant of a substance is  $K = \frac{4}{3}$ , then the electric susceptibility  $\psi_e$  is

1)  $\frac{\epsilon_0}{3}$

2)  $3\epsilon_0$

3)  $\frac{4}{3}\epsilon_0$

4)  $\frac{3}{4}\epsilon_0$

Key : 1

Sol:  $\psi_e = \epsilon_0(k-1)$

$$= \left( \frac{4}{3} - 1 \right) \epsilon_0 = \frac{\epsilon_0}{3}$$

86. In a region of uniform electric field of intensity  $E$ , an electron of mass  $m_e$  is released from rest. The distance travelled by the electron in a time ' $t$ ' is

1)  $\frac{2me_e t^2}{e}$

2)  $\frac{eEt^2}{2m_e}$

3)  $\frac{m_e g t^2}{eE}$

4)  $\frac{2Et^2}{em_e}$

Key : 2

Sol:  $S = \frac{1}{2}at^2 = \frac{1}{2} \frac{Ee}{m_e} \cdot t^2$

87. A constant potential difference is applied between the ends of the wire. If the length of the wire is elongated 4 times, then the drift velocity of electrons will be

- 1) increases 4 times    2) decreases 4 times    3) increases 2 times    4) decreases 2 times

Key : 2

Sol:  $V = iR$

$$V = (nAeV_d) \left( \frac{\rho l}{A} \right)$$

$V = ne v_d \rho l$

$n, e, \rho$  are constants

$$\therefore V_d \propto \frac{1}{l}$$

88. In a metre bridge, the gaps are enclosed by resistances of  $2\Omega$  and  $3\Omega$ . The value of shunt to be added to  $3\Omega$  resistor to shift the balancing point by 22.5 cm is

1)  $1\Omega$

2)  $2\Omega$

3)  $2.5\Omega$

4)  $5\Omega$

Key : 2

Sol: 1st case  $\frac{x}{R} = \frac{l}{100-l}$

$$\frac{2}{3} = \frac{l}{100-l}$$

$$200 - 2l = 3l$$

$$5l = 200$$

$$l = 40\text{cm} \rightarrow (1)$$

$$\frac{x}{R'} = \frac{l'}{100-l'}$$

$$\begin{aligned} l' &= l + 22.5 \\ &= 62.5\text{cm} \end{aligned}$$

$$\frac{x}{\left(\frac{3y}{3+y}\right)} = \frac{62.5}{100-62.5} = \frac{62.5}{37.5}$$

$$\frac{x}{1} \times \frac{3+y}{3y} = \frac{625}{375} = \frac{5}{3}$$

$$2\left(\frac{3+y}{3y}\right) = \frac{5}{3}$$

$$3+y = \frac{5 \times 3y}{6}$$

$$18 + 6y = 15y$$

$$9y = 18$$

$$y = 2\Omega$$

99. Two long straight parallel conductors 10 cm apart, carry equal currents of magnitude 3A in the same direction. Then the magnetic induction at a point midway between them is

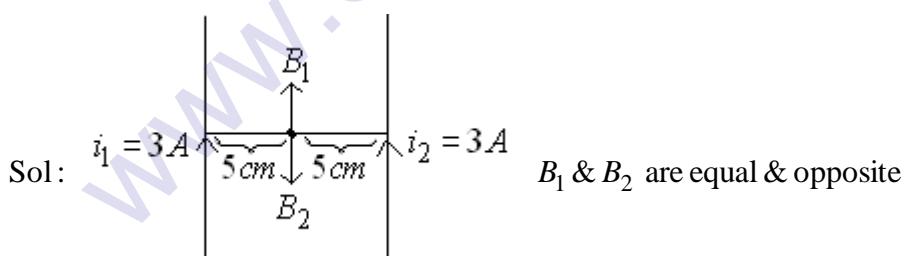
1)  $2 \times 10^{-5}\text{T}$

2)  $3 \times 10^{-5}\text{T}$

3) Zero

4)  $4 \times 10^{-5}\text{T}$

Key : 3



$\therefore B = 0$  at the centre

90. In a crossed field, the magnetic field induction is  $2.0\text{T}$  and electric field intensity is  $20 \times 10^3 \text{V/m}$ . At which velocity the electron will travel in a straight line without the effect of electric and magnetic fields?

1)  $\frac{20}{1.6} \times 10^3 \text{ms}^{-1}$

2)  $10 \times 10^3 \text{ms}^{-1}$

3)  $20 \times 10^3 \text{ms}^{-1}$

4)  $40 \times 10^3 \text{ms}^{-1}$

Key : 2

$$\text{Sol: } V = \frac{E}{B} = \frac{20 \times 10^3}{2} = 10^4 = 10 \times 10^3 \text{ m/s}$$

- 91.** A material of  $0.25 \text{ cm}^2$  cross sectional area is placed in a magnetic field of strength (H)  $1000 \text{ Am}^{-1}$ . Then the magnetic flux produced is (Susceptibility of material is 313) (Permeability of free space,  $\mu_0 = 4\pi \times 10^{-7} \text{ HMm}^{-1}$ )

1)  $8.33 \times 10^{-8} \text{ weber}$     2)  $8.34 \times 10^{-6} \text{ weber}$     3)  $9.87 \times 10^{-6} \text{ weber}$     4)  $3.16 \times 10^{-6} \text{ weber}$

Key : 3

$$\text{Sol: } B = \mu H \quad \mu_r = 1 + \chi$$

$$\frac{\phi}{A} = \mu_r \cdot \mu_0 H \quad 1 + 313 = 314 = 100\pi$$

$$\phi = A \cdot \mu_r \cdot \mu_0 H \quad \mu = \mu_r \cdot \mu_0, \pi^2 = 10 \approx 9.87$$

$$= 0.25 \times 10^{-4} \times 314 \times 4\pi \times 10^{-7} \times 1000$$

$$= 25 \times 10^{-6} \times 100\pi \times 4\pi \times 10^{-4}$$

$$= 25 \times 4 \times 10^{-6+2} + \pi^2 \times 10^{-4}$$

$$= 100 \times 10 \times 10^{-8} = 10^{-5}$$

$$\approx 10 \times 10^{-6} \text{ wb}$$

- 92.** The magnitude of the induced emf in a coil of inductance  $30 \text{ mH}$  in which the current changes from  $6\text{A}$  to  $2\text{A}$  in  $2 \text{ sec.}$  is

1)  $0.06 \text{ V}$     2)  $0.6 \text{ V}$     3)  $1.06 \text{ V}$     4)  $6 \text{ V}$

Key : 1

$$\text{Sol: } e = -L \frac{di}{dt} = -30 \times 10^{-3} \times \left( \frac{2-6}{2} \right)$$

$$= 30 \times 10^{-3} \times 2 = 6 \times 10^{-2} = 0.06 \text{ V}$$

- 93.** In an AC circuit  $V$  and  $I$  are given below, then find the power dissipated in the circuit

$$V = 50 \sin(50t) \text{ V}$$

$$I = 50 \sin\left(50t + \frac{\pi}{3}\right) \text{ mA}$$

1)  $0.625 \text{ W}$     2)  $1.25 \text{ W}$     3)  $2.50 \text{ W}$     4)  $5.0 \text{ W}$

Key : 1

$$\text{Sol: Power} = V_{rms} i_{rms} \cos \phi$$

$$= \frac{V_0 i_0}{2} \times \cos \phi$$

$$= \frac{50 \times 50}{2} \times \cos\left(\frac{\pi}{3}\right) \text{ mW}$$

$$= \frac{2500}{2} \times \frac{1}{2} \times 10^{-3} \text{ W}$$

$$= \frac{2.5}{4} \text{ W}$$

$$P = 0.625 \text{ W}$$

- 94. Light with an energy flux of  $9\text{Wcm}^{-2}$  falls on a non-reflecting surface at normal incidence. If the surface has an area of  $20\text{cm}^2$ . The total momentum delivered for complete absorption in one hour is**

1)  $2.16 \times 10^{-4}\text{kgms}^{-1}$     2)  $1.16 \times 10^{-3}\text{kgms}^{-1}$     3)  $2.16 \times 10^{-3}\text{kgms}^{-1}$     4)  $3.16 \times 10^{-4}\text{kgms}^{-1}$

Key : 3

Sol:  $I = 9\text{Wcm}^{-2}; A = 20\text{cm}^2$

time =  $t = 1\text{hour} = 60 \times 60\text{seconds}$

$$I = \frac{\text{Energy}}{\text{Area} \times \text{Time}} \Rightarrow I = \frac{Q}{At}$$

$$I = \frac{N \left( \frac{hc}{\lambda} \right)}{At} \Rightarrow I = \frac{Nh c}{\lambda At} \rightarrow (1)$$

But change in momentum is  $\Delta P$

$$\begin{aligned} \Delta P &= P_{Final} - P_{initial} \\ &= -P_{Initial} \end{aligned}$$

Total momentum delivered =  $\frac{h}{\lambda}$

for  $N$  photons

Total momentum delivered =  $\frac{Nh}{\lambda} \rightarrow (2)$

From Equation (1)

$$\frac{Nh}{\lambda} = \frac{IAt}{C}$$

$$\therefore \text{Total momentum} = \frac{IAt}{C}$$

$$= \frac{9 \times 20 \times 60 \times 60}{3 \times 10^8}$$

$$= 2.16 \times 10^{-3}\text{kgms}^{-1}$$

- 95. The ratio of the deBroglie wave lengths for the electron and proton moving with the same velocity is ( $m_p$  – mass of proton,  $m_e$  – mass of electron)**

1)  $m_p:m_e$     2)  $m_p^2:m_e^2$     3)  $m_e:m_p$     4)  $m_e^2:m_p^2$

Key : 1

Sol: DeBroglie wavelength ( $\lambda$ ) =  $\frac{h}{P}$

$$\lambda = \frac{h}{mv}$$

$$\lambda \propto \frac{1}{m}$$

$$\frac{\lambda_1}{\lambda_2} = \frac{m_2}{m_1} \Rightarrow \frac{\lambda_{electron}}{\lambda_{proton}} = \frac{m_{proton}}{m_{electron}}$$

$$\frac{\lambda_e}{\lambda_p} = \frac{m_p}{m_e}$$

**96. The ratio of longest wavelength lines in the Balmer and Paschen series of hydrogen spectrum is**

- 1)  $\frac{5}{36}$       2)  $\frac{7}{20}$       3)  $\frac{7}{144}$       4)  $\frac{5}{27}$

Key : 2

Sol : For largest wavelength of Balmer series electron jumps from 3rd to 2nd orbit

$$\frac{1}{\lambda_B} = R \left[ \frac{1}{2^2} - \frac{1}{3^2} \right]$$

$$\frac{1}{\lambda_B} = R \times \frac{5}{36} \rightarrow (1)$$

For largest wavelength of Paschen series electron jumps from 4th to 3rd orbit

$$\frac{1}{\lambda_P} = R \left[ \frac{1}{3^2} - \frac{1}{4^2} \right]$$

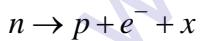
$$\frac{1}{\lambda_P} = R \left[ \frac{7}{9 \times 16} \right] \rightarrow (2)$$

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

$$\frac{\left( \frac{1}{\lambda_P} \right)}{\left( \frac{1}{\lambda_B} \right)} = \frac{R \left( \frac{7}{9 \times 16} \right)}{R \left( \frac{5}{36} \right)}$$

$$\frac{\lambda_B}{\lambda_P} = \frac{7}{9 \times 10} \times \frac{36}{5} = \frac{\lambda_B}{\lambda_P} = \frac{7}{20}$$

**97. In the following nuclear reaction ' $x$ ' stands for**

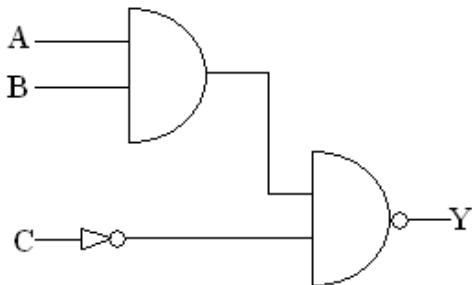


- 1)  $\alpha$  – particle      2) positron      3) neutrino      4) Antineutrino

Key : 4

Sol : With electron always Antineutrino is emitted

**98. In the following circuit the output Y becomes zero for the input combinations.**



- 1) A=1,B=0,C=0      2) A=0,B=1,C=1      3) A=0,B=0,C=0      4) A=1,B=1,C=0

Key : 4

Sol : Conceptual

**99. The maximum amplitude of an amplitude modulated wave is 16V, while the minimum amplitude is 4V. The modulation index is**

- 1) 0.4      2) 0.5      3) 0.6

- 4) 4

Key : 3

$$\text{Sol: } \frac{A_c + A_m}{A_c - A_m} = \frac{16}{4} = 4$$

$$\Rightarrow \mu = \frac{A_m}{A_c} = \frac{3}{5} = 0.6$$

**100. The pressure on a circular plate is measured by measuring the force on the plate and the radius of the plate. If the errors in measurement of the force and the radius are 5% and 3% respectively, the percentage of error in the measurement of pressure is**

- 1) 8      2) 14      3) 11      4) 12

Key : 3

$$\text{Sol: } P = \frac{F}{\pi r^2}$$

$$\frac{\Delta P}{P} = \frac{\Delta F}{F} + 2\left(\frac{\Delta r}{r}\right) = \frac{5}{100} + 2\left(\frac{3}{100}\right) = \frac{11}{100}$$

**101. A body is projected vertically from the surface of the earth of radius 'R' with the velocity equal to half of the escape velocity. The maximum height reached by the body is**

- 1)  $\frac{R}{2}$       2)  $\frac{R}{3}$       3)  $\frac{R}{4}$       4)  $\frac{R}{5}$

Key : 2

$$\text{Sol: } \frac{-GMm}{R} + \frac{1}{2}m\left(\frac{V_e}{2}\right)^2 = \frac{-GMm}{R+h}$$

$$V_e = \sqrt{\frac{2GM}{R}}$$

$$\therefore h = \frac{R}{3}$$

- 102. A particle aimed at a target, projected with an angle  $15^\circ$  with horizontal is short of the target by 10m. If projected with an angle of  $45^\circ$  is away from the target by 15m, then the angle of projection to hit the target is**

1)  $\frac{1}{2} \sin^{-1} \frac{1}{10}$       2)  $\frac{1}{2} \sin^{-1} \frac{3}{10}$       3)  $\frac{1}{2} \sin^{-1} \frac{9}{10}$       4)  $\frac{1}{2} \sin^{-1} \frac{7}{10}$

Key : 4

$$\text{Sol: } R - 10 = \frac{u^2 \sin^2(15^\circ)}{g}$$

$$R + 15 = \frac{u^2 \sin^2(45^\circ)}{g}$$

Solving  $R = 35\text{m}$

$$\therefore 35 = \frac{u^2 \sin 2\theta}{g}$$

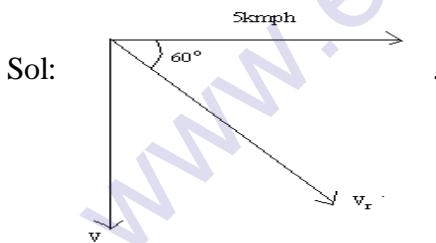
$$\frac{u^2}{g} = 50 \Rightarrow \sin 2\theta = \frac{35}{50} = \frac{7}{10}$$

$$\theta = \frac{1}{2} \sin^{-1} \left( \frac{7}{10} \right)$$

- 103. A man running at a speed of 5kmph finds that the rain is falls vertically. When he stops running, he finds that the rain is falling at an angle of  $60^\circ$  with the horizontal. The velocity of rain with respect to running man is**

1)  $\frac{5}{\sqrt{3}}\text{ kmph}$       2)  $\frac{5\sqrt{3}}{2}\text{ kmph}$       3)  $\frac{4\sqrt{3}}{5}\text{ kmph}$       4)  $5\sqrt{3}\text{ kmph}$

Key : 4



Then horizontal velocity of rain = velocity of running man = 5kmph  
vertical velocity of rain =  $v$  kmph

$$\tan 60^\circ = \frac{V}{5} \Rightarrow v = 5\sqrt{3}\text{ kmph} = \text{relative velocity of rain w.r.t. running man}$$

- 104. A horizontal force just sufficient to move a body of mass 4 kg lying on a rough horizontal surface, is applied on it. Coefficient of static and kinetic frictions are 0.8 and 0.6 respectively. If the force continues to act even after the body has started moving, the acceleration of the body is**

$$(g = 10\text{ms}^{-2})$$

1)  $6\text{ms}^{-2}$       2)  $8\text{ms}^{-2}$       3)  $2\text{ms}^{-2}$       4)  $4\text{ms}^{-2}$

Key : 3

---

$$\text{Sol: } a = g(\mu_s - \mu_k)$$

$$= 10(0.8 - 0.6)$$

$$= 10 \times 0.2$$

$$a = 2 \text{ ms}^{-2}$$

**105.** A force  $(2\hat{i} + \hat{j} - \hat{k}) \text{ N}$  acts on a body which is initially at rest. At 20sec the velocity of the body is

$$(4\hat{i} + \hat{j} - 2\hat{k}) \text{ ms}^{-1}$$
, then the mass of the body is

1) 8 kg

2) 10 kg

3) 5 kg

4) 4.5 kg

Key : 2

$$\text{Sol: } F^{-1} = m\alpha^{-1}$$

$$\vec{F} = m\vec{a}$$

$$\vec{F} = m\left(\frac{\vec{v} - \vec{u}}{t}\right) \quad \vec{u} = 0$$

$$\Rightarrow \vec{F} = \frac{m\vec{v}}{t}$$

$$2\hat{i} + \hat{j} - \hat{k} = m\left(\frac{4\hat{i} + 2\hat{j} - 2\hat{k}}{20}\right)$$

$$2\hat{i} + \hat{j} - \hat{k} = \frac{m}{5}\hat{i} + \frac{m}{10}\hat{j} - \frac{m}{10}\hat{k}$$

$$\frac{m}{5} = 2 \Rightarrow m = 10$$

∴ mass = 10kg

**106.** A man of weight 50 kg carries an object to a height of 20m in a time of 10 sec. The power used by the man in this process is 2000W, then find the weight of the object carried by the man

assume  $g = 10 \text{ ms}^{-2}$

1) 100kg

2) 25kg

3) 50kg

4) 10kg

Key : 3

$$\text{Sol: Power} = \frac{\text{Work done}}{\text{time}}$$

$$\text{Power} = \frac{mgh}{t}$$

$$2000 = \frac{(50 + m_0)10 \times 20}{10}$$

$$50 + m_0 = 100$$

$$m_0 = 50 \text{ kg}$$

- 107. A ball 'P' moving with a speed of  $n \text{ ms}^{-1}$  collides directly with another identical ball 'Q' moving with a speed  $10\text{ms}^{-1}$  in the opposite direction. P comes to rest after the collision. If the coefficient of restitution is 0.6, the value of  $n$  is**

- 1)  $30\text{ms}^{-1}$       2)  $40\text{ms}^{-1}$       3)  $50\text{ms}^{-1}$       4)  $60\text{ms}^{-1}$

Key : 2

Sol: In inelastic collision of 2 bodies velocity of first body after collision is  $v_1$

$$v_1 = v_1 \left( \frac{m_1 - em_2}{m_1 + m_2} \right) + u_2 \left( \frac{(1+e)m_2}{m_1 + m_2} \right)$$

$$u_1 = u_1; m_1 = m_2 = m; u_2 = -10\text{ms}^{-1} e = 0.6$$

$$v_1 = 0$$

$$0 = v \left( \frac{m - 0.6m}{m + m} \right) - 10 \frac{(1+0.6)m}{(m+m)}$$

$$0 = \frac{0.4}{2} v$$

$$\frac{0.4v}{2} = 8 \Rightarrow v = \frac{16}{0.4}$$

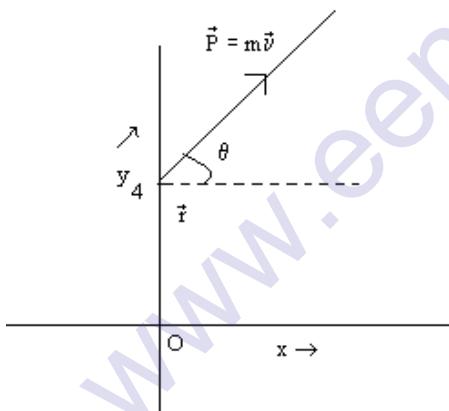
$$v = 40\text{ms}^{-1}$$

- 108. A particle of mass  $m=5$  units is moving with uniform speed  $V=3\sqrt{2}$  units in the XY plane along with the line  $Y=X+4$ . The magnitude of the angle momentum about origin is**

- 1) Zero      2) 60 units      3) 7.5 units      4) 40 units

Key : 2

Sol:



$$v = 3\sqrt{2} \text{ units}$$

$$m=5 \text{ units}; \vec{P} = 5 \times 3\sqrt{2} \cos 45\hat{i} + 5 \times 3\sqrt{2} \sin 45\hat{j}$$

$$\vec{P} = 15\hat{i} + 15\hat{j}$$

$$\vec{r} = 4\hat{j}$$

$$\text{angular momentum} = \vec{L} = \vec{r} \times \vec{P}$$

$$\vec{L} = (4\hat{j}) \times (15\hat{i} + 15\hat{j})$$

$$\vec{L} = 60\hat{k}$$

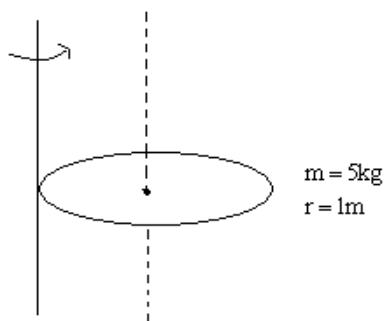
$$L = 60 \text{ units}$$

109. The kinetic energy of a circular disc rotating with a speed of 60 r.p.m. about an axis passing through a point on its circumference and perpendicular to its plane is ( mass of circular disc = 5kg, radius of disc = 1m) approximately.

1) 170J                    2) 160J                    3) 150J                    4) 140J

Key: 3

Sol:  $n = 60 \text{ rpm} = 1 \text{ rps}$



$$\text{Rotational KE} = \frac{1}{2} I w^2$$

$$I = \frac{MR^2}{2} + Mx^2$$

$$= \frac{MR^2}{2} + MR^2$$

$$= \frac{3}{2} MR^2$$

$$w = 2\pi n$$

$$= 2\pi \times 1 = 2\pi \text{ rad sec}^{-1}$$

$$\begin{aligned} RKE &= \frac{1}{2} I \omega^2 \\ &= \frac{1}{2} \times \left( \frac{3}{2} MR^2 \right) \times \omega^2 \\ &= \frac{1}{2} \times \frac{3}{2} \times 5 \times 1^2 \times (2\pi)^2 \\ &= \frac{15 \times 4\pi^2}{4} = 15 \times 10 = 150 \text{ J} \end{aligned}$$

110. The amplitude of a simple pendulum is 10cm. When the pendulum is at a displacement of 4 cm from the mean position, the ratio of kinetic and potential energies at that point is

1) 5.25                    2) 2.5                    3) 4.5                    5) 7.5

Key : 1

$$\text{Sol: } \frac{K.E.}{P.E.} = \frac{\frac{1}{2} m \omega^2 (A^2 - y^2)}{\frac{1}{2} m \omega^2 y^2} = \frac{100 - 16}{16} = 5.25$$

- 111. A satellite revolving around a planet has orbit velocity 10km/s. The additional velocity required for the satellite to escape from the gravitational field of the planet is**

1) 14.14km/s      2) 11.2km/s      3) 4.14km/s      4) 41.4km/s

Key : 3

$$\text{Sol: } V_e = \sqrt{2}V_0$$

$$= 1.414 \times 10 = 14.14 \text{ km/s} \text{ Additional velocity } \Delta V = V_e - V_0 = 4.14 \text{ km/s}$$

- 112. The length of a metal wire is  $l_1$  when the tension in it is  $F_1$  and  $l_2$  when the tension is  $F_2$ . Then original length of wire is**

$$1) \frac{l_1 F_1 + l_2 F_2}{F_1 + F_2} \quad 2) \frac{l_2 - l_1}{F_2 - F_1} \quad 3) \frac{l_1 F_2 - l_2 F_1}{F_2 - F_1} \quad 4) \frac{l_1 F_1 - l_2 F_2}{F_2 - F_1}$$

Key : 3

Sol: Force  $\propto$  elongation .

$$F_1 \alpha(l_1 - l) - (1)$$

$$F_2 \alpha(l_2 - l) - (2)$$

$$\frac{F_1}{F_2} = \frac{l_1 - l}{l_2 - l}$$

$$F_1 l_2 - F_1 l = F_2 l_1 - F_2 l$$

$$(F_1 - F_2)l = F_1 l_2 - F_2 l_1$$

$$l = \frac{F_1 l_2 - F_2 l_1}{F_1 - F_2} = \frac{l_1 F_2 - l_2 F_1}{F_2 - F_1}$$

- 113. The average depth of Indian ocean is about 3000m. The value of fractional compression of water at the bottom of the ocean is (given that the bulk modulus of water is  $2.2 \times 10^9 \text{ Nm}^{-2}$ ,  $g = 9.8 \text{ ms}^{-2}$ ,  $P_{H_2O} = 1000 \text{ kg.m}^{-3}$ )**

1)  $3.4 \times 10^{-2}$       2)  $1.34 \times 10^{-2}$       3)  $4.13 \times 10^{-2}$       4)  $13.4 \times 10^{-2}$

Key : 2

$$\text{Sol: } K = \left( \frac{-P}{\frac{\Delta V}{V}} \right) \Rightarrow \frac{\Delta V}{V} = \frac{-P}{K} = \frac{-hpg}{K}$$

$$\frac{\Delta V}{V} = \frac{-3000 \times 10^3 \times 9.8}{2.2 \times 10^9} = \frac{-29.4 \times 10^{-9}}{2.2} \\ = 13.4 \times 10^{-3} = 1.34 \times 10^{-2}$$

- 114. The ratio of energies of emitted radiation by a black body at 600k and 900k when the surrounding temperature is 300k**

1)  $\frac{5}{16}$       2)  $\frac{7}{16}$       3)  $\frac{3}{16}$       4)  $\frac{9}{16}$

Key : 3

$$\text{Sol: } E = \sigma A (T^4 - T_0^4)$$

$$\frac{E_1}{E_2} = \frac{T_1^4 - T_0^4}{T_2^4 - T_0^4} = \frac{600^4 - 300^4}{900^4 - 300^4}$$

$$= \frac{6^4 - 3^4}{9^4 - 3^4} = \frac{1296 - 81}{6561 - 81} \\ = \frac{1215}{6470} \approx \frac{3}{16}$$

- 115.** The specific heat of helium at constant volume is  $12.6 \text{ J mol}^{-1}\text{K}^{-1}$ . The specific heat of helium at constant pressure in  $\text{J mol}^{-1}\text{K}^{-1}$  is about

(Assume the temperature of the gas is moderate, universal gas constant,  $R=8.314 \text{ J mol}^{-1}\text{K}^{-1}$ )

- 1) 12.6      2) 16.8      3) 18.9      4) 21

Key : 4

$$\text{Sol: } C_P' - C_V' = R$$

$$C_P' = C_V' + R = 12.6 + 8.314$$

$$= 20.914 \text{ J / mol - K} \square 21 \text{ J / mol - K}$$

- 116.** A gas does 4.5 J of external work during adiabatic expansion. If its temperature falls by 2K, then its internal energy will be

- 1) Increased by 4.5J      2) Decreased by 4.5J  
3) Decreased by 2.25J      4) Increased by 9.0J

Key : 2

$$\text{Sol: } dQ = dU + dw$$

$$O = dU + dw$$

$$dU = -dw$$

$$= -dw$$

$$= -4.5 \text{ J}$$

(dU) decrease by 4.5J

- 117.** The relation between efficiency ' $\eta$ ' of a heat engine and the co-efficient of performance ' $\alpha$ ' of a refrigerator is

- 1)  $\eta = \frac{1}{1-\alpha}$       2)  $\eta = \frac{1}{1+\alpha}$       3)  $\eta = 1+\alpha$       4)  $\eta = 1-\alpha$

Key: 2

$$\text{Sol: } \eta = \frac{dw}{dQ} \text{ but } \alpha = \frac{dQ_2}{dw} = \frac{Q_2}{Q_1 - Q_2} \Rightarrow \frac{1}{\alpha} = \frac{Q_1 - Q_2}{Q_2} \Rightarrow \frac{1}{\alpha} - 1 = \frac{1}{Q_2} \Rightarrow \frac{\alpha - 1}{\alpha} = \frac{1}{Q_2} \Rightarrow \frac{\alpha + 1}{\alpha} = \frac{Q_1}{Q_2} \Rightarrow \frac{Q_2}{Q_1} = \frac{\alpha}{\alpha + 1}$$

$$\eta = \frac{Q_1 - Q_2}{Q_1} = 1 - \frac{Q_2}{Q_1} = 1 - \frac{\alpha}{1+\alpha} = \frac{1+\alpha-\alpha}{1+\alpha} \quad \eta = \frac{1}{1+\alpha}$$

- 118.** A flask contains argon and chlorine in the ratio of 2:1 by mass. The temperature of the mixture is  $27^\circ\text{C}$ . The ratio of average kinetic energies of two gases per molecule is

- 1) 1:1      2) 2:1      3) 3:1      4) 6:1

Key : 1

$$\text{Sol: } KE_{average} = \frac{3}{2} KT$$

as temperature is same for both the gases in a mixture

$$\frac{KE_1}{KE_2} = \frac{1}{1}$$

- 119. A transverse wave is represented by the equation  $y=2\sin(30t-40x)$  and the measurements of distances are in meters, then the velocity of propagation is**

- 1)  $15\text{ms}^{-1}$       2)  $0.75\text{ms}^{-1}$       3)  $3.75\text{ms}^{-1}$       4)  $30\text{ms}^{-1}$

**Key : 2**

$$\text{Sol: } V = \frac{\omega}{K} = \frac{30}{40} = 0.75 \text{ m/s}$$

- 120. Two closed pipes have the same fundamental frequency. One is filled with oxygen and the other with hydrogen at the same temperature. Ratio of their lengths respectively is**

- 1) 1:4      2) 4:1      3) 1:2      4) 2:1

**Key 1**

$$\text{Sol: } n = \frac{V}{4l_C} \quad \text{but } V = \sqrt{\frac{\gamma RT}{M}}$$

$$l_C \propto V$$

$$\frac{l_1}{l_2} = \frac{V_1}{V_2} = \frac{1}{4} \quad \frac{V_1}{V_2} = \sqrt{\frac{M_2}{M_1}} = \sqrt{\frac{2}{32}} = \frac{1}{4}$$

### CHEMISTRY

- 121. A gas 'X' is dissolved in water at '2' bar pressures. its mole fraction is 0.02 in solution. The mole fraction of water when the pressure of gas is doubled at the same temperature is**

- 1) 0.04      2) 0.98      3) 0.96      4) 0.02

**Key: 3**

**Sol:**

$$P \propto X$$

$$\frac{P_1}{P_2} = \frac{X_1}{X_2}$$

$$\frac{2}{4} = \frac{0.02}{X_2}$$

$$X_2 = 0.04$$

$$X_{\text{solvent}} = 1 - 0.04 = 0.96$$

- 122. Calculate  $\Delta G^0$  for the following cell reaction**



$$E^0_{\text{Ag}^+/\text{Ag}} = +0.80\text{V} \text{ and } E^0_{\text{Zn}^{2+}/\text{Zn}} = -0.76\text{V}$$

- 1) -305 kJ/mol      2) -301 kJ/mol      3) 305 kJ/mol      4) 301 kJ/mol

**Key: 2**

$$\text{Sol: } \Delta G^0 = -nFE_{\text{cell}}^0$$

$$= \frac{-2 \times 96500 \times 1.56}{1000}$$

$$= -301 \text{ kJ/mol}$$

- 123. The time required for a first order reaction to complete 90% is 't'. What is the time required to complete 99% of the same reaction?**

- 1)  $2t$       2)  $3t$       3)  $t$       4)  $4t$

**Key: 1**

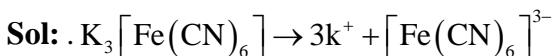
**Sol:**  $3.3 \times t_{1/2} = t$

$$2 \times 3.3 \times t_{1/2} = 2t$$

**124. Which of the following is the most effective in causing coagulation of ferric hydroxide sol?**

- 1) KCl      2)  $\text{KNO}_3$       3)  $\text{K}_2\text{SO}_4$       4)  $\text{K}_3[\text{Fe}(\text{CN})_6]$

**Key: 4**



**125. Which of the following process does not involve heating?**

- 1) Calcination      2) Smelting      3) Roasting      4) Levigation

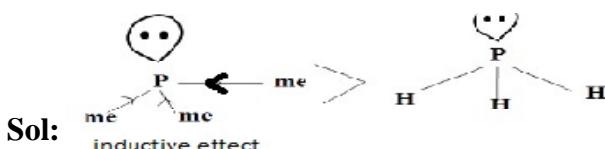
**Key: 4**

**Sol: Conceptual**

**126. Which one of the following is correct with respect to basic character?**

- 1)  $\text{P}(\text{CH}_3)_3 > \text{PH}_3$       2)  $\text{PH}_3 > \text{P}(\text{CH}_3)_3$       3)  $\text{PH}_3 > \text{NH}_3$       4)  $\text{PH}_3 = \text{NH}_3$

**Key: 1**

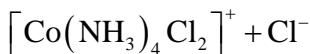


**127. When  $\text{AgNO}_3$  solution is added in excess to 1M solution  $\text{CoCl}_3 \times \text{NH}_3$ , one mole  $\text{AgCl}$  is formed?**

**What is the value of 'X'?**

- 1) 1      2) 4      3) 3      4) 2

**Key: 2**



**128. In which of the following coordination compounds, the central metal ion is in zero oxidation state?**

- 1)  $[\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_3$       2)  $\text{K}_4[\text{Fe}(\text{CN})_6]$       3)  $\text{Fe}(\text{CO})_5$       4)  $[\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_2$

**Key: 3**

**Sol: Conceptual**

**129. The percentage of lanthanides and iron, respectively, in Misch metal are.**

- 1) 50, 50      2) 75, 25      3) 90, 10      4) 95, 5

**Key: 2**

**Sol: 50% cerium 25% lanthanum**

**130. Sea divers use a mixture of**

- 1)  $\text{O}_2, \text{N}_2$       2)  $\text{O}_2, \text{H}_2$       3)  $\text{O}_2, \text{He}$       4)  $\text{N}_2, \text{H}_2$

**Key: 3**

**Sol: conceptual .**

**131. The polymer obtained with methylene bridges by cindensation polymer**

- 1) PVC      2) Buna-S      3) Poly acrylo nitrile      4) Bakelite

**Key: 4**

**Sol: conceptual**

**132. The amino acid containing Indole part is**

- 1) Tryptophan      2) Tryosine      3) Proline      4) Methionine

**Key: 1**

**Sol: conceptual .**

**133. The drug as post operative analgesic in medicine is**

- 1) L-Dopa      2) Amoxycillin      3) Sulphapyridine      4) Morphine

**Key: 4**

**Sol: conceptual.**

**134.  $C_2H_5OH + 4I_2 + 3Na_2CO_3 \rightarrow X + HCOONa + 5NaI + 3CO_2 + 2H_2O$  In the above reaction 'X' is**

- 1) Di iodo methane      2) Tri iodo methane      3) Iodo methane      4) Tera iodo methane

**Key: 2**

**Sol: conceptual.**

**135. Phenol on oxidation in air gives**

- 1) Quinone      2) Cathechol      3) Resorsinol      4) O-Cresol

**Key: 1**

**Sol: conceptual.**

**136. Identify the reagents A and B respectively in the following reactions**

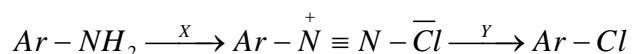


- 1)  $SOCl_2$ ,  $H_2$ / pd-BaSO<sub>4</sub>      2)  $H_2$ / pd-BaSO<sub>4</sub>,  $SOCl_2$   
3)  $SOCl_2$ ,  $H_2O_2$       4)  $SOCl_2$ , OsO<sub>4</sub>

**Key: 1**

**Sol: conceptual.**

**137. Predict respectively 'X' and 'Y' in the following reactions**



- 1)  $NaNO_3$  &  $Cl_2$       2)  $NaNO_3$  - HCl & HCl  
3)  $NaNO_2$  - HCl & Cu/HCl      4)  $NaNO_2$  - HCl &  $NaNH_2$

**Key: 3**

**Sol: conceptual.**

**138. Which of the following sets of quantum numbers is correct for an electron in 3d orbital.**

- 1)  $n = 3, l = 2, m = -3, s = +\frac{1}{2}$       2)  $n = 3, l = 3, m = +3, s = -\frac{1}{2}$   
3)  $n = 3, l = 2, m = -2, s = +\frac{1}{2}$       4)  $n = 3, l = 2, m = -3, s = -\frac{1}{2}$

**Key: 3**

**Sol: conceptual.**

**139. If the kinetic energy of a particle is reduced to half, Debroglie wave length becomes**

- 1) 2 times      2)  $\frac{1}{\sqrt{2}}$  times      3) 4 times      4)  $\sqrt{2}$  times

**Key: 4**

**Sol: .**

$$\lambda = \frac{h}{\sqrt{2mKE}}$$

$$\lambda' = \frac{h}{\sqrt{2m}\frac{KE}{2}} = \sqrt{2}\lambda$$

**140. Identify the most acidic oxide among the following oxides based on their reaction with water**

- 1)  $SO_3$       2)  $P_4O_{10}$       3)  $Cl_2O_7$       4)  $N_2O_5$

**Key: 3**

**Sol: conceptual.**

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**141. Match the following****List I**

- (A) Rubidium  
(B) Platinum  
(C) Ekasilicon  
(D) Polonium  
1) A-I, B-III, C-II, D-I  
3) A-II, B-I, C-IV, D-I II

**List II**

- (I) Germanium  
(II) Radio active chalcogen  
(III) S-Block element  
(IV) Atomic number 78  
2) A-III, B-IV, C-I, D-II  
4) A-IV, B-III, C-I, D-II

**Key:** 2**Sol:** conceptual.**142. Which of the following does not have triple bond between the atoms?**

- 1) N<sub>2</sub>                    2) CO                    3) NO                    4) C<sub>2</sub><sup>2-</sup>

**Key:** 3**Sol:** conceptual.**143. In which one of the following pairs the two species have identical shape but differ in hybridization**

- 1) I<sub>3</sub><sup>-</sup>, Be Cl<sub>2</sub>            2) NH<sub>3</sub>, BF<sub>3</sub>            3) XeF<sub>2</sub>, I<sub>3</sub><sup>-</sup>            4) NH<sub>4</sub><sup>+</sup>, SF<sub>4</sub>

**Key:** 1**Sol:** conceptual.**144. On the top of a mountain water boils at**

- 1) High temperature    2) Same temperature    3) High pressure    4) Low temperature

**Key:** 4**Sol:** conceptual.**145. Which one of the following is the wrong statement about the liquid?**

- 1) It has intermolecular force of attraction  
2) Evaporation of liquids increases with the decrease of surface area  
3) It resembles a gas near the critical temperature  
4) It is in an intermediate state between gaseous and solid state

**Key:** 2**Sol:** conceptual.**146. A carbon compound contains 12.8% of carbon, 2.1% of hydrogen and 85.1% of bromine. The molecular weight of the compound is 187.9. Calculate the molecular formula of the compound.  
(Atomic wts: H = 1.008, C = 12.0, Br = 79.9)**

- 1) CH<sub>3</sub>Br                    2) CH<sub>2</sub>Br<sub>2</sub>                    3) C<sub>2</sub>H<sub>4</sub>Br<sub>2</sub>                    4) C<sub>2</sub>H<sub>3</sub>Br<sub>3</sub>

**Key:** 3

**Sol:**  $\frac{12.8}{12}; \frac{2.1}{0.008}; \frac{85.1}{79.9}$

$$\frac{1.06}{1.06}; \frac{2.08}{1.06}; \frac{1.06}{1.06}$$

$$1 \quad 2 \quad 1$$

$$\Rightarrow \text{CH}_2\text{Br} = 12 + 2 + 80 = \frac{187.9}{94} = 2$$

**147.  $3.011 \times 10^{22}$  atoms of an element weights 1.15gm. The atomic mass of the element is**

- 1) 23                    2) 10                    3) 16                    4) 35.5

**Key:** 1

**Sol:**  $3.011 \times 10^{22}$  atoms  $\rightarrow 1.15\text{gm}$

$6.023 \times 10^{23}$  atoms  $\rightarrow ?$

**148. Which one of the following is applicable for an adiabatic expansion of an ideal gas**

- 1)  $\Delta E = 0$       2)  $\Delta W = \Delta E$       3)  $\Delta W = -\Delta E$       4)  $\Delta W = 0$

**Key:** 3

**Sol:** conceptual.

**149. On increasing temperature, the equilibrium constant of exothermic and endothermic reactions, respectively**

- 1) Increases and decreases      2) Decreases and increases  
3) Increases and Increases      4) Decreases and decreases

**Key:** 2

**Sol:** conceptual.

**150. What is the pH of the NaOH solution when 0.04 gm of it dissolved in water and made to 100ml of solution**

- 1) 2      2) 1      3) 13      4) 12

**Key:** 4

$$\text{Sol: } .m = \frac{0.04}{40} \times \frac{1000}{100} = \frac{0.4}{400}$$

$$[\text{OH}^-] = \frac{1}{100} = 10^{-2}$$

$$\text{gp}^H = 14 - 2 = 12$$

**151. Which of the following methods is used for the removal of temporary hardness of water?**

- 1) Treatment with washing soda      2) Calgon method  
3) Ion-exchange method      4) Clark's method

**Key:** 4

**Sol:** conceptual.

**152. Assertion (A): Alkali metals are soft and have low melting and boiling points**

**Reason (R): This is because interatomic bonds are weak**

- 1) Both A and R are not true  
2) A is true but R is not correct explanation of A  
3) A is not true but R is true  
4) Both A and R are true and R is correct explanation of A

**Key:** 4

**Sol:** conceptual.

**153. Identify the correct statement**

- 1) lead forms compounds in +2 oxidation state due to inert pair effect  
2) All halogens form only negative oxidation  
3) Catenation property increases from boron to oxygen  
4) Oxygen oxidation state is -1 in ozonides

**Key:** 1

**Sol:** conceptual.

**154. Assertion(A): Noble gases have very low boiling points**

**Reason(R): All Noble gases have general electronic configuration of  $ns^2 np^6$  (except HE)**

- 1) Both A and R are true R is correct explanation of A  
2) A is false but R is true  
3) A is true but R is true  
4) Both A and R are true but R is not the correct explanation of A

**Key:** 4

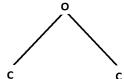
**Sol: conceptual.**

**155. Which of the following statements are correct?**

- 1) Ocean is sing for  $\text{CO}_2$ .
- 2) Green house effect causes lowering of temperature of earth's surface.
- 3) To control CO emission by automobiles usually catalytic convertor are fitted into exhaust pipes
- 4)  $\text{H}_2\text{SO}_4$  herbicides and insecticides from mist.

**Key: 4**

**Sol: conceptual.**



**156. The bond angle of bond in methoxy methane is**

- 1)  $111.7^\circ$
- 2)  $109^\circ$
- 3)  $108.9^\circ$
- 4)  $180^\circ$

**Key: 1**

**Sol: conceptual.**

**157. Which of the following compounds has zero dipolemoment?**

- 1) 1,4 - Dichlorobenzene
- 2) 1,2-Dichlorobenzene
- 3) 1,3 - Dichlorobenzene
- 4) 1-chloro-2-methyl benzene

**Key: 1**

**Sol: conceptual.**

**158. Which of the following reagent is used to find out carbon-carbon multiple bonds?**

- 1) Grignard reagent
- 2) Bayer's reagent
- 3) Sandmayer's reagent
- 4) Gatterman reagent

**Key: 2**

**Sol: conceptual.**

**159. Pure silicon doped with phosphorous is:**

- 1) Amorphous
- 2) p-type semiconductor
- 3) n-type semiconductor
- 4) Insulator

**Key: 3**

**Sol: conceptual.**

**160. 18gms of glucose is dissolved in 90 gm of water. The relative lowering of vapor pressure of the solution is equal to**

**Key: 4**

**Sol: conceptual.**

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