

### General Instructions

- (i) The examination will be conducted in Computer-Based Test (CBT) mode.
- (ii) Each question carries +1 mark for a correct answer. There is no negative marking for incorrect answers.
- (iii) The total number of questions is 120.
- (iv) The duration of the exam is 1 hour and 30 minutes (90 minutes).

1.

If the domain and the range of the real valued function

$$f(x) = \frac{1}{\sqrt{|x| - [x]}}$$

are A and B, then  $A \cap B = (R^+ \text{ is set of positive real numbers and } Z^+ \text{ is set of positive integers})$

- (A)  $R^+ - Z^+$
- (B)  $R^+$
- (C)  $R - Z$
- (D)  $R - (Z^+ \cup \{0\})$

2.

A real valued function  $f$  defined by

$$f(x) = |x| - x$$

is

- (A) an injection but not surjection, if  $[0, \infty)$  is its domain and  $(-\infty, 0]$  is its codomain
- (B) a bijection, if  $(-\infty, 0]$  is its domain and also codomain

(C) a bijection, if  $[0, \infty)$  is its domain and also codomain

(D) a surjection but not injection, if  $R$  is its domain and  $[0, \infty)$  is its codomain

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3.

Consider the following Assertion and Reason

Assertion:

$$\frac{1}{5 \cdot 9} + \frac{1}{9 \cdot 13} + \frac{1}{13 \cdot 17} + \dots \text{ to 10 terms} = \frac{9}{41}$$

Reason:

$$\text{For all } n \in N, \quad \frac{1}{5 \cdot 9} + \frac{1}{9 \cdot 13} + \dots = \frac{n}{5(4n + 5)}$$

(A) Both true and R explains A

(B) Both true but R not explanation

(C) A true, R false

(D) A false, R true

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4.

If

$$A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$$

and

$$S = A + A^2 + A^3 + \dots + A^{12}$$

then sum of all elements of matrix S is

(A) 104

(B) 96

(C) 102

(D) 81

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5.

If

$$A = \begin{bmatrix} 0 & \alpha & \beta \\ \beta & \alpha & 0 \\ \alpha & 0 & \beta \end{bmatrix}$$

where  $\beta > \alpha > 0$  and

$$AA^T = \begin{bmatrix} 25 & a & b \\ a & 25 & 12 \\ b & a & 25 \end{bmatrix}$$

then

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

- (A)  $\sqrt{24}$
  - (B) 26
  - (C) 25
  - (D) 27
- 

6.

Let

$$A = \begin{bmatrix} x & 2 & -1 \\ -2 & 1 & 2x \\ 3x & 2 & 1 \end{bmatrix}$$

and

$$\det(A) = f(x)$$

If  $f(x)$  attains minimum value  $m$  at  $x = n$ , then

$$\left| \frac{m}{n} \right| =$$

- (A)  $\frac{15}{2}$
  - (B) 30
  - (C) 60
  - (D)  $\frac{15}{4}$
- 

7.

If the system of equations

$$ax + y - 2z = 3, \quad 2x - y + 3z = b, \quad x + 2y - z = 3$$

has infinitely many solutions, then  $3a - 2b =$

- (A) 0
  - (B) 1
  - (C) 5
  - (D) 3
- 

8.

If

$$z = i^i$$

then

$$z^i =$$

- (A)  $-i$
  - (B)  $i$
  - (C) 1
  - (D) -1
- 

9.

If

$$\sqrt{-4x + 2i\sqrt{x^4 + 2x^2 + 9}} = \pm(a + ib)$$

then

$$a^2 + b^2 - 6 =$$

- (A)  $x^4$
  - (B)  $2x^2$
  - (C)  $4x$
  - (D)  $x^4 + 2x^2$
- 

10.

Product of all the five values of

$$(1 - i)^{4/5}$$

is

- (A) 4
  - (B) -2
  - (C) -4
  - (D) 2
- 

11.

If

$$\sqrt[3]{i} = cis \alpha, \quad \alpha \text{ belongs to second quadrant}$$

and

$$\sqrt[3]{-i} = cis \beta, \quad \beta \text{ belongs to third quadrant}$$

then

$$cis \alpha + cis \beta =$$

- (A)  $\sqrt{3}$
  - (B)  $i$
  - (C)  $-i$
  - (D)  $-3$
- 

12.

If  $\alpha \in R$  and equation

$$(x - \alpha)(x - 3) + 1 = 0$$

has equal roots, then sum of squares of all values of  $\alpha$  is

- (A) 13
  - (B) 25
  - (C) 26
  - (D) 20
- 

13.

The set of all values of x satisfying

$$\sqrt{x^2 - 2x + 1} > x + 2$$

is

- (A)  $(-2, \infty)$
  - (B)  $(-\infty, 0)$
  - (C)  $(-\infty, -\frac{1}{2})$
  - (D)  $(-\frac{1}{2}, \infty)$
- 

14.

Two real roots of

$$3x^4 + ax^3 + 55x^2 - 52x + 12 = 0$$

are positive and equal. Product of other two roots is 1. If roots belong to natural numbers then

$$a\beta - a + \frac{\gamma}{\delta} =$$

- (A) 25
  - (B) 52
  - (C) 28
  - (D) 35
- 

15.

If all roots of

$$x^5 - 3x^4 + 2x^3 - 3x^2 + 5x - 2 = 0$$

are increased by real value h so that term containing  $x^3$  vanishes in transformed equation and h is integer, then h=

- (A) 1
  - (B) 2
  - (C) -2
  - (D) -1
-

16.

The rank of the word 'NEEDED', when all letters of this word are permuted in all possible ways to form different 6-letter words and arranged in dictionary order, is

- (A) 45
  - (B) 59
  - (C) 38
  - (D) 27
- 

17.

If number of circular permutations of 10 distinct things taken 5 at a time is  $m$  and number of linear permutations of 9 distinct things taken 4 at a time is  $n$ , then  $m : n =$

- (A) 1:2
  - (B) 2:1
  - (C) 2:3
  - (D) 3:2
- 

18.

A student found 6 Mathematics books, 5 Physics books and 4 Chemistry books. If he buys at least one book of each subject, total number of ways is

- (A) 29295
  - (B) 32768
  - (C) 4210
  - (D) 5120
- 

19. The term independent of  $x$  in expansion of

$$\left( \frac{\sqrt{x}}{2} - \frac{3}{x} \right)^{12}$$

is

- (A)  $55\left(\frac{3}{2}\right)^6$
  - (B)  $495\left(\frac{9}{16}\right)^2$
  - (C)  $55\left(\frac{9}{16}\right)^2$
  - (D)  $\frac{45}{4}$
-

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20. Coefficient of  $x^3$  in the expansion of

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

is

- (A)  $\frac{17\sqrt{2}}{384}$   
(B)  $\frac{17\sqrt{2}}{768}$   
(C)  $\frac{49\sqrt{2}}{768}$   
(D)  $\frac{49\sqrt{2}}{384}$
- 

21. If

$$\frac{2x^3 + x - 3}{x^4 - 5x^2 + 4}$$

then partial fraction form is

- (A)  $\frac{5(x-1)}{4(x^2-3x+2)} + \frac{3x+1}{4(x^2+3x+2)}$   
(B)  $\frac{5(x+1)}{4(x^2-3x+2)} + \frac{3x-1}{4(x^2+3x+2)}$   
(C)  $\frac{2}{x-1} + \frac{5}{4(x-2)} - \frac{1}{x+1} + \frac{7}{4(x+2)}$   
(D)  $\frac{5}{4(x-2)} - \frac{1}{x+1} + \frac{7}{4(x+2)}$
- 

22. Evaluate

$$4 \sin \frac{\pi}{6} \sin \frac{2\pi}{6} \sin \frac{3\pi}{6} \sin \frac{4\pi}{6} \sin \frac{5\pi}{6}$$

- (A)  $\cos \frac{\pi}{3} \cos \frac{2\pi}{3}$   
(B)  $\sin \frac{\pi}{3} \sin \frac{2\pi}{3}$   
(C)  $\sin \frac{\pi}{3} \cos \frac{2\pi}{3}$   
(D)  $\cos \frac{\pi}{3} \sin \frac{2\pi}{3}$
- 

23. If

$$x = \sin 18^\circ$$

and

$$y = \tan 22\frac{1}{2}^\circ$$

then

$$4x(4x + 2) =$$

- (A)  $(y + 1)^2$
  - (B)  $3y(y + 1)$
  - (C)  $y^2 + y$
  - (D)  $y^2 + 2y + 3$
- 

24. If  $\alpha, \beta \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ ,

$$\cos^4 \alpha = \frac{1}{16}, \quad \sin^4 \beta = \frac{1}{16}$$

then

$$\cos \alpha + \cos \beta =$$

- (A)  $\sqrt{2} \cos 15^\circ$
  - (B)  $\sqrt{2} \sin 15^\circ$
  - (C)  $-\sqrt{2} \cos 15^\circ$
  - (D)  $-\sqrt{2} \sin 15^\circ$
- 

25. Number of solutions of equation

$$3^{2 \sin^2 x} + 3^{2 \cos^2 x} = 6$$

lying in interval

$$[-\pi, \pi]$$

is

- (A) 2
  - (B) 4
  - (C) 3
  - (D) 1
- 

26. If

$$(2 \sin^{-1} x)^3 = \pi^3 - (2 \cos^{-1} x)^3$$

then one value of

$$\cos(2 \sin^{-1} x - 3 \cos^{-1} x)$$

is

- (A) -1
  - (B)  $\frac{\pi}{2}$
  - (C) 1
  - (D)  $\frac{1}{\sqrt{2}}$
- 

27. Evaluate

$$e^{\text{Sinh}^{-1}(2\sqrt{2})} + e^{\text{Cosh}^{-1}(3)}$$

- (A)  $2e^{\text{Tanh}^{-1}(\frac{1}{2\sqrt{2}})}$
  - (B)  $\frac{2}{3}e^{\text{Cosech}^{-1}(3)}$
  - (C)  $2e^{\text{Sech}^{-1}(\frac{1}{3})}$
  - (D)  $\frac{1}{3}e^{\text{Coth}^{-1}(2\sqrt{2})}$
- 

28. In triangle ABC, if

$$\frac{a}{b+c} + \frac{c}{a+b} = 1$$

and

$$s = r + a$$

then

$$\sin A + \sin B + \sin C =$$

- (A)  $\frac{3\sqrt{3}}{2}$
  - (B)  $1 + \sqrt{2}$
  - (C)  $\frac{3+\sqrt{3}}{2}$
  - (D)  $\frac{\sqrt{3}+2}{3}$
- 

29. In a triangle ABC, if

$$r - r_1 + r_2 + r_3 = 2\sqrt{2}R, \quad r + r_1 - r_2 + r_3 = 0$$

and

$$b = 2\sqrt{2}$$

then

$$a + c =$$

- (A) 5
  - (B) 6
  - (C)  $2 + \sqrt{2}$
  - (D) 4
- 

30. Let

$$\vec{a} = \vec{i} + 2\vec{j} + \vec{k}$$

and

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

be two vectors. If vector

$$\vec{r} = x\vec{i} + y\vec{j} + 2\vec{k}$$

is along the bisector of angle between  $\vec{a}$  and  $\vec{b}$ , then

$$|\vec{r}| =$$

- (A)  $\sqrt{14}$
  - (B)  $\sqrt{6}$
  - (C) 3
  - (D) 7
- 

31. If the points with position vectors

$$x\vec{i} + 2\vec{j} + y\vec{k}$$

$$\vec{i} - 2\vec{j} + 2x\vec{k}$$

and

$$2\vec{i} + 3\vec{j} - \vec{k}$$

are collinear, then

$$10x - 25y =$$

- (A) -7
  - (B) 20
  - (C) 0
  - (D) 1
- 

32. Let

$$\vec{a} = 2\vec{i} - \vec{j} - 3\vec{k}, \quad \vec{b} = \vec{i} + 3\vec{j} - 2\vec{k}, \quad \vec{c} = 3\vec{i} - 2\vec{j} + \vec{k}$$

If magnitude of projection of

$$\vec{a} + \lambda\vec{b}$$

on  $\vec{c}$  is

$$\frac{10}{\sqrt{14}}$$

then sum of squares of magnitudes of all such vectors is

- (A) 188
  - (B) 225
  - (C) 121
  - (D) 181
- 

33. Let

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

and

$$\vec{b} = 2\vec{i} + 3\vec{j} - 6\vec{k}$$

If

$$\alpha\vec{i} + \beta\vec{j} + \gamma\vec{k}$$

is perpendicular to plane of

$$2\vec{a} + \vec{b}$$

and

$$\vec{b} - \vec{a}$$

such that

$$\alpha + \beta + \gamma = 46$$

then

$$\alpha - 2\beta + 3\gamma =$$

- (A) 12
  - (B) 14
  - (C) 0
  - (D) 1
- 

34. Let

$$\vec{a} = 3\vec{i} - 2\vec{j} + 5\vec{k}, \quad \vec{b} = \vec{i} + 3\vec{j} - 2\vec{k}$$

If  $\vec{c}$  is a vector such that

$$\vec{b} \times \vec{c} = \vec{a}$$

and

$$\vec{b} \cdot \vec{c} = 5$$

then

$$14\vec{c} \times \vec{a} =$$

- (A)  $-11(2\vec{i} - 5\vec{j} + 7\vec{k})$
  - (B)  $11(12\vec{i} + 3\vec{j} - 6\vec{k})$
  - (C)  $-11(2\vec{i} + 13\vec{j} + 4\vec{k})$
  - (D)  $11(4\vec{i} + \vec{j} + 3\vec{k})$
- 

35. The standard deviation of the data

$$2, 3, 4, 5, 6, 7, 10, 11, 13, 19$$

is

- (A)  $\sqrt{13}$
- (B)  $\sqrt{8}$
- (C) 5
- (D) 8

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36. If a 4-digit number is chosen from all possible 4-digit numbers, probability of getting exactly three odd digits and one even digit is

- (A)  $\frac{2}{9}$
  - (B)  $\frac{19}{72}$
  - (C)  $\frac{19}{36}$
  - (D)  $\frac{2}{19}$
- 

37. Let

$$S = \{2, 3, 5, 7, 11, 13\}$$

Consider all onto functions from  $S$  to  $S$ . If function  $f$  is chosen randomly, probability that

$$f(3) > 3f(2)$$

is

- (A)  $\frac{2}{3}$
  - (B)  $\frac{2}{15}$
  - (C)  $\frac{1}{6}$
  - (D)  $\frac{1}{10}$
- 

38. A bag A contains 3 red, 2 white and 2 black balls and another bag B contains 1 red, 2 white and 4 black balls. A die is thrown to select a bag. If an odd prime number appears on the die, a ball is drawn from bag A; otherwise from bag B. If the ball drawn is black, then the probability that it is drawn from bag B is

- (A)  $\frac{6}{7}$
  - (B)  $\frac{3}{7}$
  - (C)  $\frac{1}{5}$
  - (D)  $\frac{4}{5}$
- 

39. If a random variable  $X$  has the following probability distribution, then the mean of  $X$  is

$X = x_i$	1	3	5	7	9
$P(X = x_i)$	$3k$	$5k$	$k^2$	$3k^2 + k$	$6k^2$

- (A) 9.6  
 (B) 8.4  
 (C) 10.2  
 (D) 3.3
- 

40. In a Poisson distribution with parameter  $\lambda$ , if

$$5P(X = 3) = P(X = 5)$$

then

$$P(X = 2) =$$

- (A)  $\frac{25}{e^5}$   
 (B)  $\frac{50}{e^{10}}$   
 (C)  $\frac{30}{e^6}$   
 (D)  $\frac{40}{e^8}$
- 

41. If a straight line passing through the point  $(2, 3)$  intersects X-axis at A and Y-axis at B, then the locus of a point dividing AB in the ratio 2 : 3 is

- (A)  $x^2 - 5xy + 6y^2 = 0$   
 (B)  $x^2 + y^2 - 4x - 6y + 4 = 0$   
 (C)  $x + y = 5$   
 (D)  $6x - 5xy + 6y = 0$
- 

42. When origin is shifted to point

$$\left(-\frac{4}{7}, \frac{6}{7}\right)$$

and transformed equation of

$$2x^2 + 5xy + 4y^2 - 2x - 4y + 2 = 0$$

is

$$ax^2 + 35xy + by^2 + 2gx + 2fy + c = 0$$

then

- (A)  $a + b + c = 48$
  - (B)  $2g + 2f + c = 28$
  - (C)  $a + b = 2f + c$
  - (D)  $a + c = 2g + b$
- 

43. If the inclination of a straight line

$$x - y + 1 = 0$$

with another straight line  $L$  is  $30^\circ$  and  $m$  is the slope of line  $L$ , then

$$m^2 + 1 =$$

- (A)  $4m$
  - (B)  $2m$
  - (C)  $-2m$
  - (D)  $-4m$
- 

44. If  $A(2, 1)$ ,  $B(4, k)$ ,  $C(3, 4)$  are vertices of triangle right angled at  $B$  and  $k$  is not an odd number, then equation of line joining orthocentre and circumcentre is

- (A)  $x + y = 6$
  - (B)  $x - y = 0$
  - (C)  $3x + y = 14$
  - (D)  $x + 3y = 10$
- 

45. Let  $ABC$  be a triangle and  $A = (-2, 3)$ . If

$$7x - y + 2 = 0$$

and

$$4x - 7y + 44 = 0$$

are medians drawn through vertices B and C respectively, then  $AB =$

- (A)  $5\sqrt{2}$
  - (B)  $3\sqrt{5}$
  - (C)  $\sqrt{5}$
  - (D)  $\frac{\sqrt{57}}{2}$
- 

**46. Orthocentre of triangle formed by pair of lines**

$$2x^2 - xy - 3y^2 = 0$$

and line

$$x - y + 4 = 0$$

is

- (A)  $(-3, 1)$
  - (B)  $(-2, 2)$
  - (C)  $(4, 0)$
  - (D)  $(1, 5)$
- 

**47. If circle**

$$x^2 + y^2 + 2x + 4y + k = 0$$

lies totally inside third quadrant and point

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

lies outside circle, then set of all real values of  $k$  is

- (A)  $(4, 5]$
  - (B)  $(\frac{1}{2}, 4]$
  - (C)  $(\frac{5}{2}, 5)$
  - (D)  $(5, 6]$
- 

48. Let  $L_1 \equiv 3x + 4y - 1 = 0$ ,  $L_2 \equiv 8x - 6y + 1 = 0$ ,  $L_3 \equiv 12x + 9y - 1 = 0$  be three tangents drawn to the circle

$$x^2 + y^2 + 2gx + 2fy + c = 0$$

and  $L_1 > 0$ ,  $L_2 > 0$ ,  $L_3 > 0$  at the centre  $(-g, -f)$ . Then  $g + 2f =$

- (A) 0
  - (B)  $\frac{1}{4}$
  - (C) 1
  - (D)  $\frac{1}{2}$
- 

49. If

$$l_1x + m_1y + n_1 = 0$$

and

$$l_2x + m_2y + n_2 = 0$$

are tangents drawn from point  $(2, -1)$  to circle

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

then  $n_1 + n_2 =$

- (A)  $l_1 + l_2 + m_1 + m_2$
  - (B)  $l_1 + l_2 + m_1$
  - (C)  $l_1l_2m_2$
  - (D)  $l_1l_2m_1$
- 

50. The external centre of similitude for circles

$$x^2 + y^2 + 10x - 16y - 11 = 0$$

and

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

is

- (A)  $(\frac{5}{7}, -\frac{4}{7})$
  - (B)  $(-2, 3)$
  - (C)  $(\frac{25}{7}, -\frac{44}{7})$
  - (D)  $(-3, 5)$
- 

**51. A circle  $S$  passing through origin cuts another circle**

$$x^2 + y^2 - 6x + 8y + 16 = 0$$

**orthogonally and makes a chord of maximum length on line**

$$x - y - 2 = 0$$

**then one diameter of circle  $S$  is**

- (A)  $x + y = 2$
  - (B)  $2x + 3y = 4$
  - (C)  $4x - 5y + 10 = 0$
  - (D)  $5x + 6y + 12 = 0$
- 

**52.  $T_1, T_2$  are points of contact of a transverse common tangent drawn to circles**

$$x^2 + y^2 + 4x - 10y + 4 = 0$$

and

$$x^2 + y^2 - 6x + 8y + 9 = 0$$

**If  $T_1T_2$  is horizontal line, midpoint of segment  $T_1T_2$  is**

- (A)  $(\frac{23}{10}, 0)$
  - (B)  $(\frac{13}{10}, 0)$
-

(C)  $(\frac{1}{2}, 0)$

(D)  $(\frac{2}{5}, 0)$

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53. If  $P(t_1)$  and  $Q(t_2)$  are two points on the parabola

$$y^2 = 7x$$

If  $t_1 = 2$  and  $t_2 = -4$ , then the length of chord  $PQ$  is

(A)  $21\sqrt{2}$

(B)  $\frac{21\sqrt{5}}{4}$

(C)  $\frac{21\sqrt{5}}{2}$

(D)  $\frac{21\sqrt{2}}{2}$

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54. If a straight line

$$y = mx + c$$

touches the circle

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

and parabola

$$y^2 = 4x$$

then  $2m^2 =$

(A)  $\sqrt{2} + 1$

(B) 2

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

(D)  $\sqrt{2} - 1$

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55. Let  $S, S'$  be foci and  $B$  one end of minor axis of an ellipse. If

$$\angle SBS' = 120^\circ$$

and area of triangle  $SBS'$  is  $\sqrt{3}$ , then length of latus rectum is

- (A)  $\frac{1}{2}$
  - (B)  $\frac{2}{\sqrt{3}}$
  - (C) 1
  - (D)  $\sqrt{3}$
- 

56. If  $\theta$  is acute angle between tangents drawn from point  $(3, 4)$  to ellipse

$$\frac{x^2}{25} + \frac{y^2}{9} = 1$$

then  $\theta =$

- (A)  $\text{Tan}^{-1}\left(\frac{16}{9}\right)$
  - (B)  $\text{Tan}^{-1}\left(\frac{32}{9}\right)$
  - (C)  $\text{Tan}^{-1}\left(\frac{9}{25}\right)$
  - (D)  $\text{Tan}^{-1}\left(\frac{16}{25}\right)$
- 

57. If both foci of a hyperbola having eccentricity  $\sqrt{3}$  lie on x-axis and x coordinates of foci are roots of equation

$$x^2 - 4x + 1 = 0$$

then length of chord passing through focus and perpendicular to transverse axis is

- (A) 2
  - (B)  $2\sqrt{3}$
  - (C)  $\sqrt{2}$
  - (D) 4
- 

58. Let D be harmonic conjugate of point C with respect to points

$$A(1, -3, 5), \quad B(5, -3, 1)$$

If C divides AB in ratio 3 : 5, then point dividing CD in ratio 1 : 2 is

- (A)  $(-5, -3, 11)$

- (B)  $\left(\frac{5}{2}, -3, \frac{7}{2}\right)$   
(C)  $(3, -3, 3)$   
(D)  $(0, -3, 6)$
- 

59. If  $(1, -2, 2)$  and  $(2, 6, -3)$  are the direction ratios of two straight lines, then the direction cosines of the line bisecting an angle between these two lines are

- (A)  $\left(\frac{1}{\sqrt{41}}, \frac{4}{\sqrt{41}}, \frac{5}{\sqrt{41}}\right)$   
(B)  $\left(\frac{13}{\sqrt{1218}}, \frac{32}{\sqrt{1218}}, \frac{5}{\sqrt{1218}}\right)$   
(C)  $\left(\frac{13}{\sqrt{210}}, \frac{4}{\sqrt{210}}, \frac{5}{\sqrt{210}}\right)$   
(D)  $\left(\frac{13}{\sqrt{714}}, \frac{4}{\sqrt{714}}, \frac{23}{\sqrt{714}}\right)$
- 

60. If the image of point  $(1, -1, 1)$  in the plane

$$x - 2y + 3z = 4$$

is  $(x_1, y_1, z_1)$ , then  $x_1 - y_1 - z_1 =$

- (A) 0  
(B) 1  
(C) 4  
(D) 3
- 

61. Let

$$f(x) = \frac{([x] + |x| - x)x}{\sin|x|}$$

be a real valued function. If

$$\alpha = \lim_{x \rightarrow 0^-} f(x), \quad \beta = \lim_{x \rightarrow 0^+} f(x)$$

then

- (A)  $\alpha = \beta$   
(B)  $\alpha - \beta = 1$   
(C)  $\alpha + \beta = 3$
-

(D)  $\alpha\beta = 1$

---

62. If the function

$$f(x) = \begin{cases} \frac{p(1 + \sin 3x)}{(\pi + 6x)^2}, & -\frac{\pi}{2} < x < -\frac{\pi}{6} \\ z, & x = -\frac{\pi}{6} \\ \frac{q(\sin 12x + 2 \sin 6x)}{\cos^3\left(\frac{\pi+12x}{2}\right)}, & -\frac{\pi}{6} < x < 0 \end{cases}$$

is continuous at

$$x = -\frac{\pi}{6}$$

then  $p + 2q =$

- (A) 3
  - (B) 2
  - (C) 1
  - (D) 0
- 

63. The domain of derivative of real valued function

$$f(x) = (x^2 - x - 2)|x^2 + x - 6|$$

is

- (A)  $\mathbb{R}$
  - (B)  $\mathbb{R} - \{-3\}$
  - (C)  $\mathbb{R} - \{-3, 2\}$
  - (D)  $\mathbb{R} - \{-3, -1, 2\}$
- 

64. If

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

then  $f'(1) =$

- (A)  $\frac{4}{5}$
  - (B) 2
  - (C)  $\frac{1}{5}$
  - (D) -2
- 

65. If

$$x = \sin 2\theta + \sin 3\theta, \quad y = \cos 2\theta - \cos 3\theta$$

then

$$\frac{d^2y}{dx^2} =$$

- (A)  $\frac{35+6\cos\theta}{(2\cos 2\theta+3\cos 3\theta)^3}$
  - (B)  $\frac{19+6\cos\theta}{(2\cos 2\theta+3\cos 3\theta)^3}$
  - (C)  $\frac{35+6\cos 5\theta}{(2\cos 2\theta+3\cos 3\theta)^3}$
  - (D)  $\frac{19+6\cos 5\theta}{(2\cos 2\theta+3\cos 3\theta)^3}$
- 

66. If

$$f(x) = (1 + x^3)(1 + x^6)(1 + x^{12})(1 + x^{24})$$

then  $f'(-1) =$

- (A) 24
  - (B) 12
  - (C) 48
  - (D) 60
- 

67. By application of derivatives, approximate value of

$$\sqrt[5]{242}$$

is

- (A) 2.9085
  - (B) 2.9975
  - (C) 2.9527
  - (D) 2.8529
- 

68. If displacement of particle moving in straight line is

$$S = t^3 - 3t^2 + 3t - 4$$

then time interval in which  $S$  is increasing is

- (A) only  $(1, \infty)$
  - (B) only  $[0, 1)$
  - (C)  $[0, \infty)$  only
  - (D)  $[3, \infty)$
- 

69. If  $\theta$  is angle between parabolas

$$y^2 = 108x$$

and

$$x^2 = 32y$$

then

$$\cos 2\theta =$$

- (A)  $\frac{13}{5\sqrt{10}}$
  - (B)  $\frac{9}{5\sqrt{10}}$
  - (C)  $\frac{81}{125}$
  - (D)  $\frac{44}{125}$
- 

70. If the real valued function

$$f(x) = \log(2x - 3) - 2x^2 + 6x - 4$$

then the interval in which  $f(x)$  is increasing is

- (A)  $(-\infty, 2)$
  - (B)  $(\frac{3}{2}, 2)$
  - (C)  $(2, \infty)$
  - (D)  $(\frac{3}{2}, \infty)$
- 

71. If  $m$  and  $M$  are respectively the absolute minimum and absolute maximum values of the function

$$f(x) = |2x^2 - x - 6| + 2x - 3$$

in the interval  $[-2, 4]$ , then  $2M + 8m =$

- (A) 154
  - (B) 6
  - (C) 8
  - (D) 150
- 

72. Evaluate

$$\int \frac{\cos x + \sin 2x}{1 - \sin x - 2 \sin^2 x} dx$$

- (A)  $\frac{1}{3} \log \left( \frac{(1-2 \sin x)^2}{|1+\sin x|} \right) + c$
  - (B)  $\frac{1}{3} \log \left( \frac{|1+\sin x|^{-1}}{(1-2 \sin x)^2} \right) + c$
  - (C)  $\frac{1}{3} \log \left( \frac{(1+2 \sin x)^2}{|1-\sin x|} \right) + c$
  - (D)  $\frac{1}{3} \log \left( \frac{|1-\sin x|}{(1+2 \sin x)^2} \right) + c$
- 

73. Evaluate

$$\int \frac{\cos x}{\sqrt{16 \cos^2 x + 9}} dx$$

- (A)  $\frac{1}{4} \sinh^{-1} \left( \frac{4 \sin x}{5} \right) + c$   
 (B)  $\frac{1}{4} \sin^{-1} \left( \frac{4 \sin x}{5} \right) + c$   
 (C)  $\frac{1}{4} \cosh^{-1} \left( \frac{4 \sin x}{3} \right) + c$   
 (D)  $\frac{1}{4} \cos^{-1} \left( \frac{4 \cos x}{3} \right) + c$
- 

74. If

$$\int (e^{2x} + 2e^x) \sqrt{e^{2x} - 4e^x + 5} dx = \frac{1}{3} [f(x)]^{3/2} + 4 \left[ \frac{e^x - 2}{2} \sqrt{f(x)} + \frac{1}{2} g(x) \right] + c$$

then  $f(0) =$

- (A) 2  
 (B) 0  
 (C) 1  
 (D) 3
- 

75. Evaluate

$$\int \frac{1}{2 \cot x - 3 \tan x} dx$$

- (A)  $\frac{1}{5} \log |2 \cos^2 x - 3 \sin^2 x| + c$   
 (B)  $-\frac{1}{10} \log |2 - 5 \sin^2 x| + c$   
 (C)  $-\frac{1}{5} \log |2 - 5 \sin^2 x| + c$   
 (D)  $\frac{1}{10} \log |2 \cos^2 x - 3 \sin^2 x| + c$
- 

76. Evaluate

$$\int_{\frac{\pi}{4}}^{\frac{3\pi}{4}} \frac{x \sin x}{1 + \cos 2x} dx$$

- (A)  $\frac{\pi}{\sqrt{2}}$   
 (B)  $-\frac{\pi}{\sqrt{2}}$   
 (C)  $\sqrt{2}\pi$   
 (D)  $-\sqrt{2}\pi$
-

77. The area of the region bounded by the curves

$$y = x^2 - 3x + 3$$

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

is

- (A)  $\frac{403}{6}$
  - (B) 27
  - (C) 19
  - (D)  $\frac{125}{6}$
- 

78. Evaluate

$$\int_{\pi/6}^{\pi/3} \frac{dx}{\sin 2x(\tan^4 x - \cot^4 x)}$$

- (A)  $\frac{1}{8} \log \frac{4}{5}$
  - (B)  $2 \tan^{-1} \left( \frac{4}{5} \right)$
  - (C) 0
  - (D) 1
- 

79. If  $a, b$  are arbitrary constants, then the differential equation corresponding to family

$$y = ax^2 - 2abx + ab^2$$

is

- (A)  $2x \frac{d^2y}{dx^2} = \left( \frac{dy}{dx} \right)^2$
  - (B)  $2y \frac{d^2y}{dx^2} = \left( \frac{dy}{dx} \right)^2$
  - (C)  $2x \left( \frac{dy}{dx} \right)^2 = \frac{d^2y}{dx^2}$
  - (D)  $2y \left( \frac{dy}{dx} \right)^2 = \frac{d^2y}{dx^2}$
- 

80. The general solution of the differential equation

$$\frac{dy}{dx} = x^2y^2 + 3x^2y - 2xy^2 - 6xy$$

is

- (A)  $y = c(y + 3)e^{(x^3-3x^2)}$
  - (B)  $y = c(y + 3)(x + 2)e^{x^2}$
  - (C)  $y = c(x + 2)e^{(y^3-3y^2)}$
  - (D)  $y = c(x + 2)e^{(x^4-3x^3)}$
- 

**81. The unification of electromagnetism and optics is based on the discovery that**

- (A) Light is an electromagnetic wave
  - (B) Light travels with a speed equal to speed of sound
  - (C) Light wave consists of electrons
  - (D) Light waves are deflected by electric and magnetic fields
- 

**82. If  $B$  is magnetic induction,  $e$  is charge of electron,  $m$  is mass and  $c$  is speed of light in vacuum, then the physical quantity having dimensions of**

$$\frac{4\pi mc}{Be}$$

is

- (A) Energy
  - (B) Electric potential
  - (C) Length
  - (D) Time
- 

**83. A body is thrown vertically upwards from earth with velocity  $60 \text{ ms}^{-1}$ . The ratio of displacements during first, second and third seconds is**

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

- (A) 1 : 3 : 5
  - (B) 11 : 9 : 7
  - (C) 1 : 1 : 1
  - (D) 1 : 2 : 3
-

---

84. If minimum velocity of a projectile is  $15 \text{ ms}^{-1}$  and maximum height reached is 20 m, then velocity of projection is

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

- (A)  $35 \text{ ms}^{-1}$
  - (B)  $30 \text{ ms}^{-1}$
  - (C)  $20 \text{ ms}^{-1}$
  - (D)  $25 \text{ ms}^{-1}$
- 

85. A block slides down a  $30^\circ$  inclined plane. Coefficient of friction on upper half is

$$\mu_1 = \frac{1}{2\sqrt{3}}$$

and on lower half is

$$\mu_2 = \frac{1}{4\sqrt{3}}$$

Find ratio of velocities at midpoint and bottom.

- (A) 2 : 3
  - (B)  $\sqrt{2} : \sqrt{5}$
  - (C) 2 : 5
  - (D)  $\sqrt{2} : \sqrt{3}$
- 

86. The power  $P$  (in watt) acting on a body of mass 2 kg is given by

$$4.5P = 8t^2 + 14t + 9$$

where  $t$  is time in second. If the body starts from rest at  $t = 0$ , then the velocity of the body at time  $t = 3 \text{ s}$  is

- (A)  $15 \text{ ms}^{-1}$
  - (B)  $12 \text{ ms}^{-1}$
  - (C)  $6 \text{ ms}^{-1}$
  - (D)  $9 \text{ ms}^{-1}$
-

87. A bomb of mass  $m$  at rest explodes into three parts. If these three parts move horizontally with equal speeds in different directions, then the masses of the three parts can be

- (A)  $\frac{3m}{11}, \frac{m}{3}, \frac{13m}{33}$
  - (B)  $\frac{m}{6}, \frac{m}{3}, \frac{m}{2}$
  - (C)  $\frac{4m}{19}, \frac{5m}{19}, \frac{10m}{19}$
  - (D)  $\frac{6m}{29}, \frac{8m}{29}, \frac{15m}{29}$
- 

88. A body P of mass 1.5 kg moving with velocity  $10 \text{ ms}^{-1}$  makes a one dimensional elastic collision with another body Q at rest. If ratio of velocities after collision is 1 : 3, then velocity of centre of mass is

- (A)  $8.5 \text{ ms}^{-1}$
  - (B)  $6.5 \text{ ms}^{-1}$
  - (C)  $5.5 \text{ ms}^{-1}$
  - (D)  $7.5 \text{ ms}^{-1}$
- 

89. A solid sphere rolls down without slipping on an inclined plane of angle  $30^\circ$ . If angle increases to  $45^\circ$ , percentage increase in acceleration is nearly

- (A) 73.2
  - (B) 41.4
  - (C) 21.2
  - (D) 36.6
- 

90. For a particle executing simple harmonic motion, if the velocities at distances 6 cm and 8 cm from mean position are  $16\pi \text{ cms}^{-1}$  and  $12\pi \text{ cms}^{-1}$  respectively, then maximum acceleration is

- (A)  $40\pi^2$
  - (B)  $4\pi^2$
  - (C)  $0.4\pi^2$
  - (D)  $400\pi^2$
- 

91. The energy required to transfer a satellite of mass  $m$  from an orbit of height  $0.5R$  from the surface of the earth to an orbit of height  $2R$  from the surface of the earth is (where  $g$  is acceleration due to gravity and  $R$  is radius of earth)

- (A)  $\frac{mgR}{4}$   
(B)  $\frac{mgR}{2}$   
(C)  $\frac{mgR}{6}$   
(D)  $\frac{mgR}{3}$
- 

92. A wire of length 100 cm is made of a material of Young's modulus  $1.6 \times 10^{11} \text{ Nm}^{-2}$ . If work done in stretching this wire by 0.1 cm is 2 J, then the area of cross-section of the wire (in  $10^{-5} \text{ m}^2$ ) is

- (A) 5.0  
(B) 1.25  
(C) 1.5  
(D) 2.5
- 

93. Water flows through a horizontal pipe AB of non-uniform cross section. Water enters at A of area  $4\text{cm}^2$  with pressure  $10^5 \text{ Nm}^{-2}$  and velocity  $20\text{ms}^{-1}$ . It leaves at B of area  $8\text{cm}^2$ . The pressure at B is

- (A)  $0.5 \times 10^5 \text{ Nm}^{-2}$   
(B)  $2.5 \times 10^5 \text{ Nm}^{-2}$   
(C)  $3.5 \times 10^5 \text{ Nm}^{-2}$   
(D)  $4.5 \times 10^5 \text{ Nm}^{-2}$
- 

94. If a capillary tube of inner radius  $0.5\text{mm}$  is immersed vertically in water, then mass of water risen in capillary tube is (Surface tension =  $0.07\text{Nm}^{-1}$ ,  $g = 10\text{ms}^{-2}$ )

- (A)  $33\text{mg}$   
(B)  $11\text{mg}$   
(C)  $22\text{mg}$   
(D)  $44\text{mg}$
- 

95. Water of mass 3 kg in a kettle of mass 1 kg at an initial temperature of  $30^\circ\text{C}$  is heated by a heater of power 2 kW. When the lid is open, heat is lost at a constant rate of  $250 \text{ Js}^{-1}$ . If specific heat capacity of kettle material is half that of water, then time required to raise temperature to  $80^\circ\text{C}$  is

- (A) 13
  - (B) 7
  - (C) 9
  - (D) 21
- 

96. Two spherical black bodies A and B of equal radii are at temperatures  $2T$  and  $3T$ . If surrounding temperature is  $T$ , then ratio of radiant powers emitted by A and B is

- (A) 15 : 16
  - (B) 3 : 8
  - (C) 1 : 2
  - (D) 2 : 3
- 

97. A Carnot engine operates between  $33^\circ\text{C}$  and  $133^\circ\text{C}$ . During adiabatic expansion, relation is  $T\sqrt{V} = \text{constant}$ . The work done by 10 moles during adiabatic expansion is

- (A)  $500R$
  - (B)  $1000R$
  - (C)  $2000R$
  - (D)  $1500R$
- 

98. 5 moles of monoatomic gas and one mole of rigid diatomic gas are mixed. The internal energy at temperature  $127^\circ\text{C}$  is (Given  $R = 8.31\text{Jmol}^{-1}\text{K}^{-1}$ )

- (A) 66.48
  - (B) 33.24
  - (C) 49.86
  - (D) 83.10
- 

99.

The length of an open pipe is half of the length of another closed pipe. When the two pipes are vibrated, four nodes are formed in both the cases. The ratio of the frequencies of the open and the closed pipes is:

- (A) 1 : 1
- (B) 16 : 7

(C) 16 : 3

(D) 7 : 3

---

**100.**

**A source of sound of frequency 660 Hz and an observer are moving towards each other with speeds of 31 kmph and 23 kmph respectively. If the wind blows with a speed of 5 kmph from observer towards the source, then the frequency of the sound heard by the observer is: (Speed of sound in air =  $340 \text{ ms}^{-1}$ )**

(A) 630 Hz

(B) 660 Hz

(C) 690 Hz

(D) 720 Hz

---

**101.**

**When a thin convex lens is immersed in a liquid of refractive index 1.2, the focal length of the lens becomes 48 cm. If the ratio of the radii of curvature of the lens is 2 : 3 and the refractive index of the material of the lens is 1.5, then the radii of curvature of the lens are:**

(A) 20 cm, 30 cm

(B) 10 cm, 15 cm

(C) 08 cm, 12 cm

(D) 16 cm, 24 cm

---

**102.**

**In an astronomical telescope of 135 cm length kept in normal adjustment, if the difference between the focal lengths of the objective and eyepiece is 125 cm, then the magnification of the telescope is:**

(A) 13.5

(B) 12.5

(C) 26

(D) 28

---

103.

If a parallel beam of light of wavelength 500 nm is incident on a convex lens of focal length 20 cm having a circular aperture of diameter 5 cm, then the radius of the central bright diffraction spot formed on the focal plane of the lens is nearly (in  $\mu\text{m}$ ):

- (A) 1.83
  - (B) 0.61
  - (C) 1.22
  - (D) 2.44
- 

104.

An electron is moving in a stable circular orbit of radius 0.1 m around a thin infinitely long positively charged straight wire. If the orbital velocity of the electron around the wire is  $4 \times 10^7 \text{ ms}^{-1}$ , then the linear charge density of the wire is nearly:

- (A)  $4.5 \times 10^{-7} \text{ Cm}^{-1}$
  - (B)  $9 \times 10^{-7} \text{ Cm}^{-1}$
  - (C)  $5 \times 10^{-7} \text{ Cm}^{-1}$
  - (D)  $2.5 \times 10^{-7} \text{ Cm}^{-1}$
- 

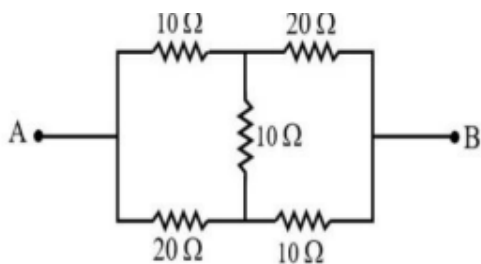
105.

Two charges  $+6 \mu\text{C}$  and  $-3 \mu\text{C}$  are placed at points  $(-2.7 \text{ cm}, 0)$  and  $(2.7 \text{ cm}, 0)$  respectively in an external electric field of  $1.8 \times 10^5 r^{-2} \text{ NC}^{-1}$ , where  $r$  is the distance of a charge from the origin. Then the net electrostatic energy of the system of the two charges is:

- (A) 63 J
  - (B) 17 J
  - (C) 23 J
  - (D) 3 J
- 

106.

The effective resistance between the points A and B of the circuit shown in the figure is:



- (A)  $14\ \Omega$   
 (B)  $7\ \Omega$   
 (C)  $21\ \Omega$   
 (D)  $15\ \Omega$

107.

When a cell is connected to either  $2\ \Omega$  or  $4.5\ \Omega$  resistors, if the power consumption is same in both the cases, then the internal resistance of the cell is:

- (A)  $1\ \Omega$   
 (B)  $2\ \Omega$   
 (C)  $3\ \Omega$   
 (D)  $4\ \Omega$

108.

If an electron moving with a velocity of  $4 \times 10^6\ \text{ms}^{-1}$  enters a uniform magnetic field of  $\frac{\pi}{2}\ \text{mT}$  at an angle of  $60^\circ$  with the direction of the magnetic field, then the pitch of the helical path of the electron is: (Mass of the electron =  $9 \times 10^{-31}\ \text{kg}$ )

- (A) 1.5 cm  
 (B) 3 cm  
 (C) 4.5 cm  
 (D) 6 cm

109.

A thin conducting wire of length  $L$  carrying a current of 2 A is bent into a square loop of 2 turns and another thin conducting wire of length  $2L$  carrying a current of 3 A is bent into

a circular loop of 3 turns. If the magnetic moment of the circular loop is  $\frac{4}{\pi} \text{ A} \cdot \text{m}^2$ , then the magnetic moment of the square loop is:

- (A)  $0.5\pi \text{ A} \cdot \text{m}^2$
  - (B)  $0.5 \text{ A} \cdot \text{m}^2$
  - (C)  $0.25\pi \text{ A} \cdot \text{m}^2$
  - (D)  $0.25 \text{ A} \cdot \text{m}^2$
- 

110.

The magnetic field at a point A on the axis of a short bar magnet is 1500% more than the magnetic field at a point B on the normal bisector of the magnet. If the distance of point A from the centre of the magnet is 18 cm, then the distance of point B from the centre of the magnet is:

- (A) 72 cm
  - (B) 36 cm
  - (C) 48 cm
  - (D) 54 cm
- 

111.

If a conducting rod of length 100 cm rotates about one of its ends with a constant frequency of 14 revolutions per second in a plane perpendicular to a uniform magnetic field of 2 T, then the induced emf between the two ends of the rod is:

- (A) 144 V
  - (B) 88 V
  - (C) 122 V
  - (D) 230 V
- 

112.

When an inductor is connected to a 200 V dc supply, the current through it is 5 A and when the same inductor is connected to a 200 V ac supply of angular frequency  $300 \text{ rad s}^{-1}$ , the current through it is 4 A. The inductance of the inductor is:

- (A) 100 mH
  - (B) 200 mH
  - (C) 50 mH
  - (D) 75 mH
- 

113.

If a plane electromagnetic wave of intensity  $9 \times 10^5 \text{ W} \cdot \text{m}^{-2}$  incidents normally on a perfectly absorbing surface of area  $2 \text{ m}^2$  for a time of 180 s, then the average force exerted by the electromagnetic wave on the surface during this time is:

- (A) 3 mN
  - (B) 12 mN
  - (C) 6 mN
  - (D) 9 mN
- 

114.

When photons of wavelength  $4000 \text{ \AA}$  are incident on a photosensitive material of cut-off wavelength  $4800 \text{ \AA}$ , the stopping potential is  $V$ . If the same photons are incident on another photosensitive material of cut-off wavelength  $6000 \text{ \AA}$ , then the stopping potential is:

- (A)  $1.5V$
  - (B)  $0.5V$
  - (C)  $4V$
  - (D)  $2V$
- 

115.

If the wavelength of a spectral line in the Balmer series of hydrogen spectrum is  $\frac{7.2}{R}$ , then the ratio of the radii of the higher and lower orbits between which the transition of electron takes place is ( $R$  - Rydberg constant):

- (A) 9 : 4
- (B) 4 : 1

(C) 25 : 4

(D) 8 : 1

---

**116.**

**If the nuclear force between a proton and a neutron is attractive, then the distance between them can be:**

(A) 0.12 fm

(B)  $10^{-3}$  fm

(C) 1.1 fm

(D) 0.3 fm

---

**117.**

**If the radius of  ${}_{13}\text{Al}^{27}$  nucleus is 3.6 fm, then the number of neutrons in a nucleus of atomic number 29 and radius 4.8 fm is:**

(A) 64

(B) 35

(C) 42

(D) 49

---

**118.**

**The electron and hole concentrations in a semiconductor are  $5 \times 10^{18} \text{ m}^{-3}$  and  $8 \times 10^{19} \text{ m}^{-3}$  respectively. If the mobilities of the electron and hole are  $0.24 \text{ m}^2\text{V}^{-1}\text{s}^{-1}$  and  $0.01 \text{ m}^2\text{V}^{-1}\text{s}^{-1}$  respectively, then the conductivity of the semiconductor is:**

(A)  $0.48 \text{ Sm}^{-1}$

(B)  $0.16 \text{ Sm}^{-1}$

(C)  $0.32 \text{ Sm}^{-1}$

(D)  $0.64 \text{ Sm}^{-1}$

---

**119.**

If A, B and C represent the power gain, base resistance and collector resistance respectively of a transistor connected in common emitter configuration, then the common emitter current amplification factor is:

- (A)  $\frac{AB}{C}$
  - (B)  $\frac{AC}{B}$
  - (C)  $\sqrt{\frac{AC}{B}}$
  - (D)  $\sqrt{\frac{AB}{C}}$
- 

120.

If the length of a linear antenna is increased by 60% and the wavelength of the signal is decreased by 20%, then the percentage increase in the effective power radiated by the antenna is:

- (A) 50
  - (B) 250
  - (C) 300
  - (D) 150
- 

121.

In hydrogen atom, electron is present in  $n_x$  state. The energy of Lyman spectral line of hydrogen spectrum originated from  $n_x$  state is  $1.635 \times 10^{-18}$  J. What is the approximate energy (in J) required to excite this electron from  $n_x$  state to  $(n_x + 1)$  state?

- (A)  $3 \times 10^{-19}$
  - (B)  $3 \times 10^{-18}$
  - (C)  $1.6 \times 10^{-18}$
  - (D)  $3 \times 10^{-20}$
- 

122.

In H atom, electron is present in  $n_x$  state. The angular momentum of this electron is  $1.051 \times 10^{-34}$  Js. What is the energy (in J) required to excite this electron from  $n_x$  state to  $(n_x + 1)$  state? ( $h = 6.6 \times 10^{-34}$  Js;  $\pi = 3.14$ )

- (A)  $2.18 \times 10^{-18}$   
(B)  $0.545 \times 10^{-18}$   
(C)  $1.93 \times 10^{-19}$   
(D)  $1.635 \times 10^{-18}$
- 

123.

The element with atomic number 114 has outer shell electron configuration as that of element 'X'. What is X?

- (A) Ar  
(B) Ge  
(C) Se  
(D) Ti
- 

124.

Consider the following oxides:  $\text{SO}_2$ ,  $\text{P}_2\text{O}_5$ ,  $\text{SO}_3$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{K}_2\text{O}$ ,  $\text{MgO}$ . The most acidic and most basic oxides are respectively:

- (A)  $\text{SO}_3$ ,  $\text{MgO}$   
(B)  $\text{SO}_3$ ,  $\text{K}_2\text{O}$   
(C)  $\text{P}_2\text{O}_5$ ,  $\text{K}_2\text{O}$   
(D)  $\text{P}_2\text{O}_5$ ,  $\text{SO}_2$
- 

125.

The difference in bond angles between  $\text{SO}_2$  and  $\text{H}_2\text{O}$  is:

- (A)  $12.5^\circ$   
(B)  $17.5^\circ$   
(C)  $15.0^\circ$   
(D)  $13.0^\circ$
- 

126.

$\text{BF}_3$  reacts with  $\text{NH}_3$  in 1:1 ratio and gives 'X'. The hybridization and geometry around B and N atoms in 'X' respectively are:

- (A)  $sp^3$ , tetrahedral ;  $sp^3$ , tetrahedral  
(B)  $sp^2$ , trigonal planar ;  $sp^3$ , tetrahedral  
(C)  $sp^2$ , trigonal planar ;  $sp^3$ , pyramidal  
(D)  $sp^3$ , tetrahedral ;  $sp^2$ , trigonal planar
- 

127.

A gaseous mixture contains  $H_2$  and  $O_2$ . The pressure of the mixture is 1 bar. The weight percentage of  $O_2$  is 80. The ratio of partial pressures of  $H_2$  and  $O_2$  is:

- (A) 5  
(B) 4  
(C) 0.2  
(D) 0.25
- 

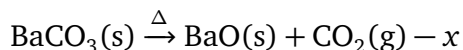
128.

$KMnO_4$  oxidizes  $M^{2+}$  to  $M^{4+}$  in acid medium. 500 mL of 0.02M  $M^{2+}$  solution requires 500 mL of  $x$  M  $MnO_4^-$  solution for complete oxidation. The value of  $x$  is:

- (A)  $16 \times 10^{-3}$   
(B)  $8 \times 10^{-3}$   
(C)  $4 \times 10^{-3}$   
(D)  $2 \times 10^{-3}$
-

129.

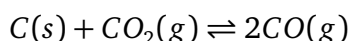
The  $\Delta_f H^\ominus$  of  $\text{BaCO}_3(\text{s})$ ,  $\text{BaO}(\text{s})$  and  $\text{CO}_2(\text{g})$  is respectively  $-1216.3$ ,  $-553.5$  and  $-393.5 \text{ kJ mol}^{-1}$ . What is the value of  $x$  (in  $\text{kJ mol}^{-1}$ ) in the following reaction?



- (A)  $-269.3$
  - (B)  $269.3$
  - (C)  $2163$
  - (D)  $-2163$
- 

130.

The following equilibrium is established at  $1100 \text{ K}$  in a closed  $V \text{ L}$  flask:



The pressure of equilibrium mixture is  $1 \text{ atm}$ . Among the gaseous compounds,  $\text{CO}$  has  $84\%$  by mass.  $K_c$  of this reaction is (approximately) ( $R = 0.082 \text{ L atm mol}^{-1}\text{K}^{-1}$ ). Assume that  $\text{CO}$  and  $\text{CO}_2$  are ideal gases.

- (A)  $1 \times 10^{-2}$
  - (B)  $3 \times 10^{-2}$
  - (C)  $1 \times 10^{-1}$
  - (D)  $> 8 \times 10^{-2}$
- 

131.

Which of the following represents the water-gas shift reaction?

- (A)  $\text{C}(\text{s}) + \text{H}_2\text{O}(\text{g}) \xrightarrow{1270\text{K}} \text{CO}(\text{g}) + \text{H}_2(\text{g})$
  - (B)  $\text{CH}_4(\text{g}) + \text{H}_2\text{O}(\text{g}) \xrightarrow[\text{Ni}]{1270\text{K}} \text{CO}(\text{g}) + 3\text{H}_2(\text{g})$
  - (C)  $\text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g}) \xrightarrow[\text{catalyst}]{673\text{K}} \text{CO}_2(\text{g}) + \text{H}_2(\text{g})$
  - (D)  $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$
- 

132.

**Which of the following is not the correct statement about group 1 elements?**

- (A) Hydration enthalpy is highest for  $Li^+$  ion
  - (B) Boiling point is highest for caesium
  - (C) Density of potassium is lesser than sodium and rubidium
  - (D) They have inert gas configuration in  $(n - 1)$  shell
- 

**133.**

**Which of the following statements are correct?**

- I. Liquid sodium metal is used as coolant in fast breeder nuclear reactor
  - II. LiCl is deliquescent
  - III. LiF and CsI have low solubility in water
- (A) I, III only
  - (B) II, III only
  - (C) I, II only
  - (D) I, II, III
- 

**134.**

**The correct order of metallic radius of Al, Ga, In, Tl is**

- (A)  $Tl > In > Al > Ga$
  - (B)  $Tl > In > Ga > Al$
  - (C)  $In > Ga > Al > Tl$
  - (D)  $Ga > In > Tl > Al$
- 

**135.**

**Given below are two statements**

Statement-I: Silicones have high thermal stability and high dielectric strength

Statement-II: In silica Si-O bond enthalpy is very high

- (A) Both statements I and II are correct
  - (B) Both statements I and II are not correct
  - (C) Statement I is correct, but statement II is not correct
  - (D) Statement I is not correct, but statement II is correct
-

---

136.

In winter, polar stratospheric clouds formed over Antarctica provide surface on which compound X responsible for depletion of ozone is formed. What is X?

- (A) Peroxyacetyl nitrate
  - (B) Acrolein
  - (C) Chlorine nitrate
  - (D) Sulphuryl chloride
- 

137.

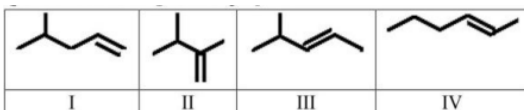
Match the extra element present in the organic compound with reagent used for its detection.

List-1 ಜಾಬಿತ್-1		List-2 ಜಾಬಿತ್-2	
A	N	I	$(\text{NH}_4)_2\text{MoO}_4$
B	S	II	$\text{AgNO}_3$
C	P	III	$\text{FeSO}_4   \text{H}^+$
D	I	IV	$\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]$

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

138.

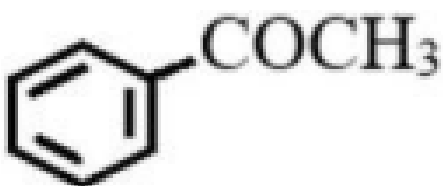
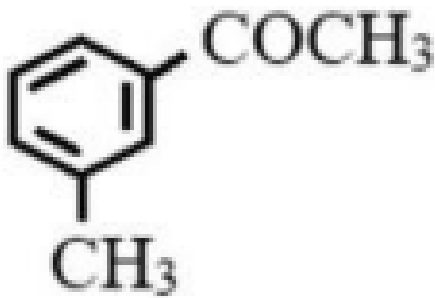
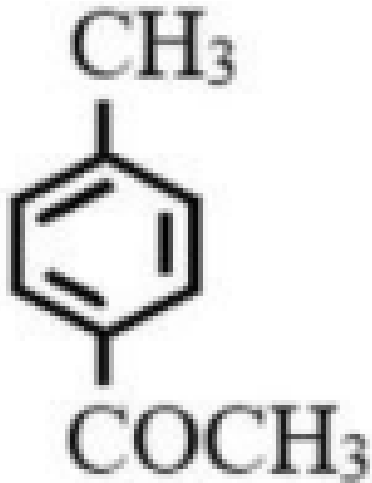
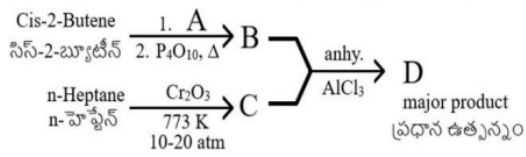
Which of the following are Position isomers?



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

139.

Observe the reaction set and identify A and D.

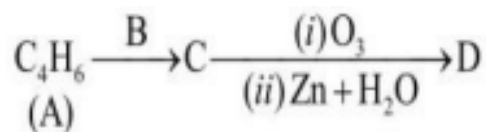


- (A) figA
- (B) figB
- (C) figC
- (D) figD

---

140.

Observe the reaction sequence

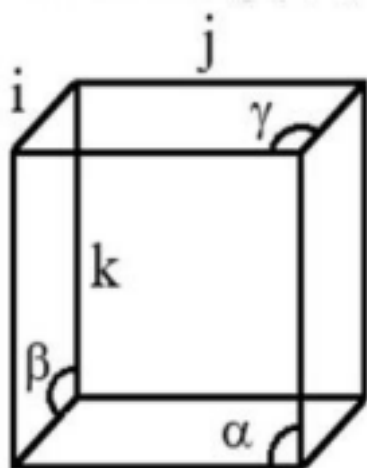


Compound A forms sodium derivative with  $\text{NaNH}_2$ . Find B and D.

- (A)  $\text{H}_2/\text{Ni}$ ;  $\text{CH}_3\text{CH}_2\text{CHO} + \text{HCHO}$   
(B)  $\text{H}_2/\text{Ni}$ ;  $\text{CH}_3\text{CHO} + \text{CH}_3\text{CHO}$   
(C)  $\text{H}_2/\text{Pd} - \text{C}$ , quinoline;  $\text{CH}_3\text{CH}_2\text{CHO} + \text{HCHO}$   
(D)  $\text{H}_2/\text{Pd} - \text{C}$ , quinoline;  $\text{CH}_3\text{CHO} + \text{CH}_3\text{CHO}$
- 

141.

Identify the edge lengths ( $a, b, c$ ) in the unit cell shown below.



- (A)  $i = a, j = b, k = c$   
(B)  $i = a, j = c, k = b$   
(C)  $i = c, j = b, k = a$   
(D)  $i = b, j = c, k = a$
- 

142.

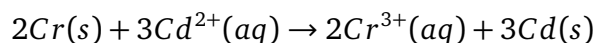
A water sample is contaminated with compound X (molar mass =  $120\text{g mol}^{-1}$ ). Its molality is  $10^{-4}\text{m}$ . What is its concentration in ppm?

- (A) 120

- (B) 1200  
(C) 12  
(D)  $12 \times 10^3$
- 

143.

The following reaction takes place in a galvanic cell



What is  $\Delta_r G^\circ$  of this cell?

Given:

$$F = 96500 \text{ C mol}^{-1}$$

$$E_{Cd^{2+}/Cd}^\circ = -0.4V$$

$$E_{Cr^{3+}/Cr}^\circ = -0.74V$$

- (A) -196.86  
(B) -1968.6  
(C) -32.81  
(D) -19.686
- 

144.

Given below are two statements

Statement-I: Rate of first order reaction decreases with time

Statement-II: Rate of zero order reaction decreases with time

- (A) Both statements I and II are correct  
(B) Both statements I and II are incorrect  
(C) Statement I correct but II incorrect  
(D) Statement I incorrect but II correct
-

145.

Gold number of a protective colloid A is  $x$ . A mixture is prepared by adding 50 mL of 10% NaCl solution to 500 mL gold sol. What minimum mass of A is needed to prevent coagulation?

- (A)  $50x$
  - (B)  $500x$
  - (C)  $5x$
  - (D)  $0.5x$
- 

146.

The metal refined by Mond process is X and the metal refined by Van Arkel method is Y. What are X and Y respectively?

- (A) Mn, Ga
  - (B) In, Zr
  - (C) Ti, Ni
  - (D) Ni, Zr
- 

147.

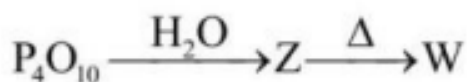
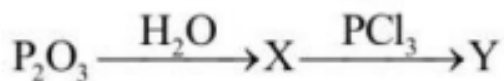
In which of the following sets, the reaction and catalyst are correctly matched?

	Reaction (చర్య)	Catalyst (ఉత్ప्रेరకం)
I	$\text{SO}_2(g) + \text{Cl}_2(g) \rightarrow \text{SO}_2\text{Cl}_2(l)$	Charcoal చార్కోల్
II	$2\text{SO}_2(g) + \text{O}_2(g) \rightarrow 2\text{SO}_3(g)$	$\text{V}_2\text{O}_5$
III	$4\text{HCl} + \text{O}_2 \xrightarrow{723\text{K}} 2\text{Cl}_2 + 2\text{H}_2\text{O}$	$\text{CuCl}_2$

- (A) I, II, III
  - (B) I, II only
  - (C) II, III only
  - (D) I, III only
- 

148.

Observe the following reactions



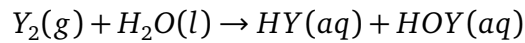
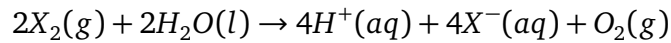
Which are common for both Y and W?

- I. Four P-OH bonds
  - II. Two P-H bonds
  - III. Two  $P = O$  bonds
  - IV. One P-O-P bond
- (A) I, III, IV only  
(B) I, II, III only  
(C) II, III, IV only  
(D) III, IV only

---

149.

What are X and Y in the following reactions?



- (A)  $X = F, Y = I$   
(B)  $X = I, Y = Cl$   
(C)  $X = F, Y = Cl$   
(D)  $X = Cl, Y = I$

---

150.

Match the following orders with their properties.

List-1 (Order) జాబితా-1 (క్రమము)		List-2 (Property) జాబితా-2 (ధర్మము)	
A	Fe > Cr > Mn	I	Melting point ద్రవీభవన స్థానం
B	Co > Fe > Mn	II	Metallic Radius లోహ వ్యాసార్థం
C	Ti > V > Cr	III	Enthalpy of atomization పరమాణీకరణ ఎంథాల్పీ
D	Cr > V > Mn	IV	Density సాంద్రత

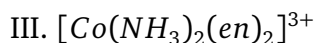
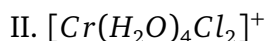
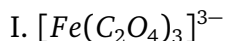
- (A) A-I, B-II, C-I, D-IV  
(B) A-II, B-I, C-IV, D-III  
(C) A-IV, B-III, C-II, D-I

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

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151.

Which of the following exhibit optical isomerism?



(A) I, II only

(B) I, III only

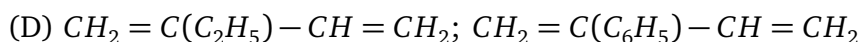
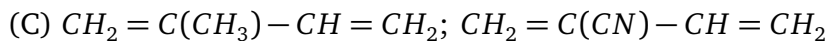
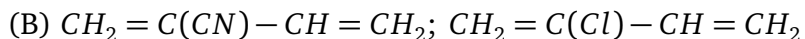
(C) II, III only

(D) I, II, III

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152.

Natural rubber is the addition polymer of monomer X and neoprene is the addition polymer of monomer Y. What are X and Y respectively?



153.

Glycosidic linkage in maltose is present between

(A) C-1 of  $\alpha$ -D-glucose and C-4 of  $\alpha$ -D-glucose

(B) C-1 of  $\alpha$ -D-glucose and C-4 of  $\beta$ -D-galactose

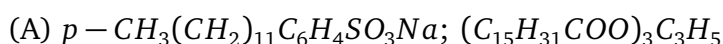
(C) C-1 of  $\beta$ -D-glucose and C-4 of  $\alpha$ -D-glucose

(D) C-1 of  $\beta$ -D-glucose and C-4 of  $\beta$ -D-glucose

---

154.

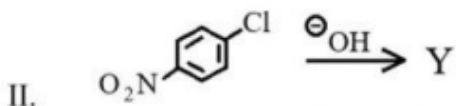
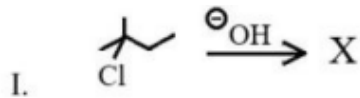
The detergent used in tooth pastes is 'X' and in hair conditioners is 'Y'. What are X and Y respectively?



- (B)  $(C_{17}H_{33}COO)_3C_3H_5$ ;  $CH_3(CH_2)_{15}N(CH_3)_3Br$   
 (C)  $CH_3(CH_2)_{10}CH_2OSO_3Na$ ;  $p-C_9H_{19}C_6H_4O(CH_2CH_2O)_5CH_2CH_2OH$   
 (D)  $CH_3(CH_2)_{10}CH_2OSO_3Na$ ;  $CH_3(CH_2)_{15}N(CH_3)_3Br$

155.

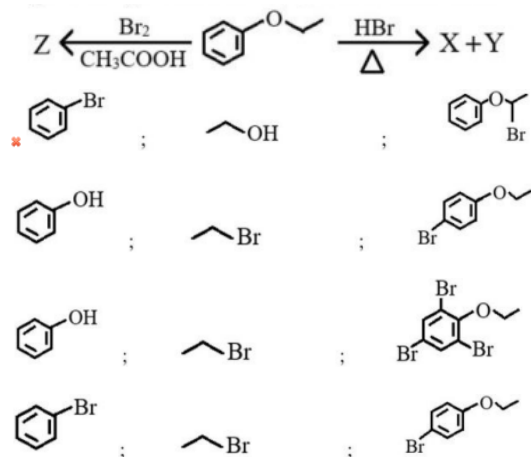
Rate determining step in the following reactions I and II respectively is



- (A) Cleavage of C-Cl bond in both I and II  
 (B) Cleavage of C-Cl bond in I, attack of OH in II  
 (C) Attack of OH in I, C-Cl bond cleavage in II  
 (D) Attack of OH in both I and II

156.

What are X, Y, Z in the following reactions?



- (A) figA  
 (B) figB  
 (C) figC  
 (D) figD

157.

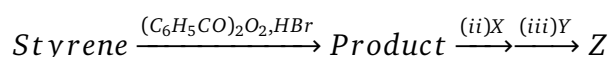
Benzene gets converted to X in reaction (A) and Y in reaction (B). X is oxidized by ammoniacal

$\text{AgNO}_3$  but Y is not. Identify A and B.

- (A) Stephen; Fittig  
 (B) Fittig; Stephen  
 (C) Gattermann-Koch; Friedel-Crafts  
 (D) Friedel-Crafts; Gattermann-Koch

158.

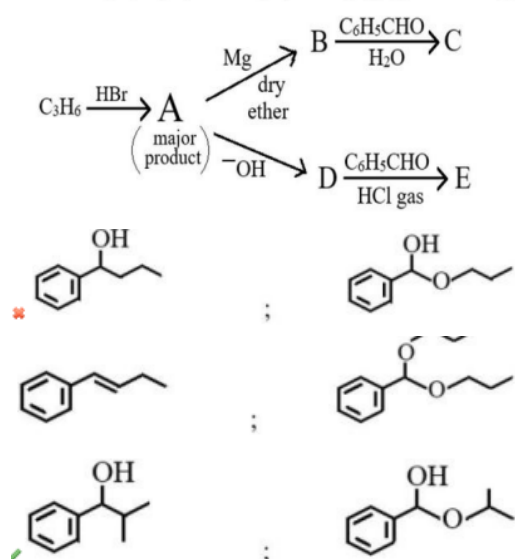
Identify correct set(s) of X, Y, Z in the following reaction sequence.

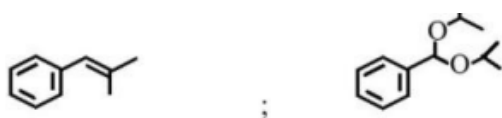


- (I) KCN;  $\text{H}_3\text{O}^+$ ;  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$   
 (II) Zn/ $\text{H}^+$ ;  $\text{KMnO}_4/\text{OH}^-$ ; same acid  
 (III) Mg/dry ether;  $\text{CO}_2$ ,  $\text{H}_2\text{O}$ ; same acid  
 (IV) KCN;  $\text{H}_3\text{O}^+$ ;  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$   
 (A) I, II, III  
 (B) II, III only  
 (C) I, III only  
 (D) IV only

159.

What are C and E in the following reaction sequence?





- (A) figA  
 (B) figB  
 (C) figC  
 (D) figD
- 

**160.**

**Which of the following statements about  $C_6H_5N_2BF_4$  are correct?**

- I. With NaF gives  $C_6H_5F$   
 II. With  $NaNO_2/Cu$  gives  $C_6H_5NO_2$   
 III. On heating gives  $C_6H_5F$   
 IV. With  $HNO_3$  gives  $C_6H_5NO_2$

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