COMEDK Shift 2 2024 Question Paper

Time Allowed :3 Hour	**Maximum Marks :**180	**Total Questions :**180

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours duration.
2. The question paper consists of 180 questions. The maximum marks are 180.
3. There are three parts in the question paper consisting of Physics, Chemistry, and Mathematics, each having 60 questions of equal weightage.
4. Each part (subject) has two sections.
   (i) **Section-A:** This section contains 50 multiple-choice questions (MCQs) with only one correct answer. Each question carries 1 mark for a correct answer and 0.25 mark will be deducted for a wrong answer.
   (ii) **Section-B:** This section contains 10 questions, where the answer to each question is a numerical value. Each question carries 1 mark for a correct answer and 0.25 mark will be deducted for a wrong answer. For Section-B, the answer should be rounded off to the nearest integer.

1 MATHEMATICS

1. The rate of change of the volume of a sphere with respect to its surface area S is

(A) $\frac{1}{2}\sqrt{\frac{S}{\pi}}$

(B) $\sqrt{\frac{S}{\pi}}$

(C) $\frac{2}{3}\sqrt{\frac{S}{\pi}}$

(D) $\frac{1}{4}\sqrt{\frac{S}{\pi}}$

---

2. While shuffling a pack of cards, 3 cards were accidentally dropped, then find the probability that the missing cards belong to different suits?

(A) $\frac{104}{425}$

(B) $\frac{169}{425}$

(C) $\frac{261}{425}$

(D) $\frac{169}{261}$

---

3. The area of the triangle whose vertices are $(-2, a)$, $(2, -6)$, and $(5, 4)$ is 35 square units. Then the value of a is:

(A) 4

(B) $\frac{53}{3}$

(C) $-\frac{23}{3}$

(D) $\frac{128}{3}$

---

4. If $3A + 4B^t = \begin{pmatrix} 7 & -10 \\ 0 & 6 \end{pmatrix}$ and $2B - 3A^t = \begin{pmatrix} -1 & 18 \\ 4 & -6 \\ -5 & -7 \end{pmatrix}$, then find $(5B)^t$:

(A) $\begin{pmatrix} 5 & 5 \\ 15 & 0 \end{pmatrix}$

(B) $\begin{pmatrix} -5 & 5 \\ -15 & 0 \end{pmatrix}$

(C) $\begin{pmatrix} 5 & -5 \\ 15 & 0 \end{pmatrix}$

(D) $\begin{pmatrix} 5 & -5 \\ 15 & 0 \end{pmatrix}$

---

5. The domain of the function $y = \frac{1}{\log_{10}(3-x)} + \sqrt{x+7}$ is:

(A) $[-7, 3] \setminus \{1\}$

(B) $(-7, 3) \setminus \{0\}$

(C) $[-7, 3] \setminus \{2\}$

(D) $(-7, 3)$

---

6. Consider an infinite geometric series with first term a and common ratio r. If the sum of infinite geometric series is 4 and the second term is $\frac{3}{4}$, then:

(A) $a = 1, r = -\frac{3}{4}$

(B) $a = 3, r = \frac{1}{4}$

(C) $a = -3, r = -\frac{1}{4}$

(D) $a = -1, r = \frac{3}{4}$

---

7. Let α and β be the distinct roots of $ax^2 + bx + c = 0$, then

$$\lim_{x \to \alpha} \frac{1 - \cos(ax^2 + bx + c)}{(x - \alpha)^2}$$

is equal to:

(A) $\frac{a^2(\alpha-\beta)^2}{2}$

(B) $\frac{(\alpha-\beta)^2}{2}$

(C) $\frac{-a^2(\alpha-\beta)^2}{2}$

(D) 0

8. If two positive numbers are in the ratio $3+2\sqrt{2} : 3-2\sqrt{2}$, then the ratio between their A.M (arithmetic mean) and G.M (geometric mean) is:

(A) $3 : 4$

(B) $6 : 1$

(C) $3 : 2$

(D) $3 : 1$

---

9. The value of the integral

$$\int_{1/3}^{1} \frac{(x-x^3)^{\frac{1}{3}}}{x^4}\,dx$$

is:

(A) 4

(B) 0

(C) 3

(D) 6

---

10. The area of the region enclosed by the curve

$$\left\{(x,y) : 4x^2+25y^2=100\right\}$$

is:

(A) $\frac{16\pi}{3}$ sq units

(B) 9π sq units

(C) 10π sq units

(D) $\frac{9\pi}{5}$ sq units

---

11. The mean of five observations is 4 and their variance is 5.2. If three of these observations are 1, 2, and 6, then the other two observations are:

(A) 4, 7

(B) 2, 10

(C) 5, 6

(D) 2, 9

---

12. The line joining two points $A(2,0)$ and $B(3,1)$ is rotated about A in an anticlockwise direction through an angle of $15°$. If B goes to C in the new position, then the coordinates of C are:

(A) $\left(2+\frac{1}{\sqrt{3}}\sqrt{3}, 2\right)$

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

(C) $\left(2+\frac{1}{\sqrt{3}}, 1\right)$

(D) $\left(2+\frac{1}{\sqrt{2}}, \sqrt{3}\right)$

---

13. The value of

$$\lim_{x\to 1} \frac{x^{15}-1}{x^{10}-1}$$

is:

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

(B) 1

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

(D) Does not exist

---

14. Let A and B be two events such that

$$P(A/B) = \frac{1}{2}, \quad P(B/A) = \frac{1}{3}, \quad \text{and} \quad P(A \cap B) = \frac{1}{6}$$

Then, which one of the following is not true?

(A) A and B are not independent

(B) $P(A \cup B) = \frac{2}{3}$

(C) $P(A' \cap B) = \frac{1}{6}$

(D) A and B are independent

15. If

$$\frac{\cos x}{\cos(x-2y)} = \lambda \quad \text{then} \quad \tan(x-y)\tan y =$$

(A) $\frac{1+\lambda}{1-\lambda}$

(B) $\frac{1-\lambda}{1+\lambda}$

(C) $\frac{\lambda}{1-\lambda}$

(D) $\frac{\lambda}{1+\lambda}$

---

16. If

$$y = f(x),\ p = \frac{dy}{dx},\ q = \frac{d^2y}{dx^2},\ \text{then } \frac{d^2x}{dy^2} \text{ is equal to}$$

(A) $\frac{-q}{p^2}$

(B) $\frac{q}{p}$

(C) $\frac{-q}{p^3}$

(D) $\frac{q}{p^2}$

---

17. If $\hat{i}+\hat{j}-\hat{k}$ and $2\hat{i}-3\hat{j}+\hat{k}$ are adjacent sides of a parallelogram, then length of its diagonal is

A. $\sqrt{3}, \sqrt{14}$

B. $\sqrt{13}, \sqrt{14}$

C. $\sqrt{21}, \sqrt{3}$

D. $\sqrt{21}, \sqrt{13}$

---

18. Which of the following relations on the set of real numbers $\mathbb{R}$ is an equivalence relation?

(A) $aRb \iff |a| = |b|$

(B) $aRb \iff a$ divides b

(C) $aRb \iff a \geq b$

(D) $aRb \iff a < b$

19. A number consists of three digits in geometric progression. The sum of the right hand and left hand digits exceeds twice the middle digit by 1 and the sum of left hand and middle digits is two third of the sum of the middle and right hand digits. Then the sum of digits of number is

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

B. 19

C. 469

D. 109

---

20. If $y = \sqrt{\sin x + y}$, then find $\frac{dy}{dx}$ at $x = 0, y = 1$.

(A) 0

(B) 1

(C) 2

(D) -1

---

21. If

$$A = \begin{bmatrix} 5a & -b \\ 3 & 2 \end{bmatrix} \quad \text{and} \quad A \operatorname{adj} A = AA^t, \quad \text{then } 5a + b \text{ is equal to}$$

A. 5

B. -1

C. 4

D. 13

---

22. If $f(x) = \begin{cases} x, & 0 \le x \le 1 \\ 2x - 1, & x > 1 \end{cases}$, then:

(A) f is not continuous but differentiable at $x = 1$

(B) f is differentiable at $x = 1$

(C) f is continuous but not differentiable at $x = 1$

(D) f is discontinuous at $x = 1$

23. The measure of the angle between the lines

$$x = k + 1, \quad y = 2k - 1, \quad z = 2k + 3, \quad k \in \mathbb{R}$$

and

$$\frac{x-1}{2} = \frac{y+1}{1} = \frac{z-1}{2}$$

is:

(A) $\cos^{-1}\left(\frac{4}{9}\right)$

(B) $\sin^{-1}\left(\frac{4}{3}\right)$

(C) $\sin^{-1}\left(\frac{\sqrt{5}}{3}\right)$

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

---

24. Evaluate:

$$\cot^{-1}\left(-\frac{3}{\sqrt{3}}\right) - \sec^{-1}\left(-\frac{2}{\sqrt{2}}\right) - \csc^{-1}(-1) - \tan^{-1}(1)$$

(A) $\frac{\pi}{6}$

(B) $-\frac{2\pi}{3}$

(C) 0

(D) $\frac{\pi}{3}$

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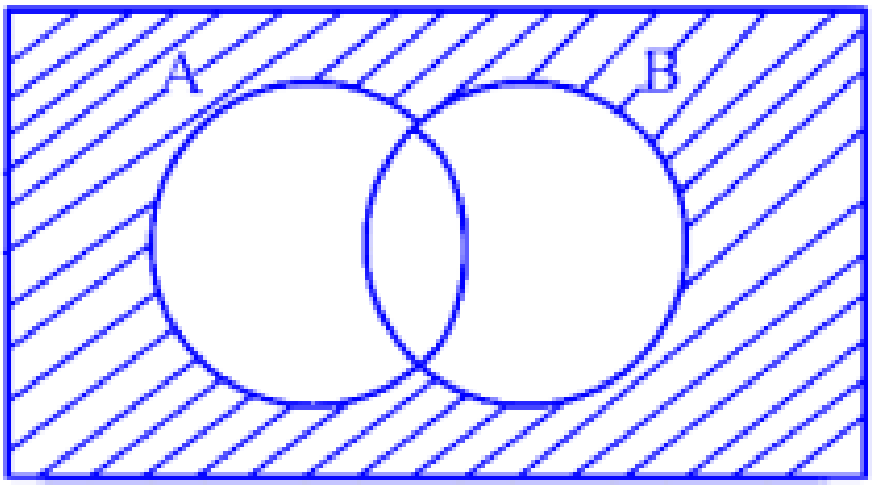
25. The shaded region in the Venn diagram represents



(A) $A' \cap B$

(B) $A \cap B$

(C) $(A \cap B)'$

(D) $A' \cap B'$

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26. The solution set for the inequality

$$13x - 5 \leq 15x + 4 < 7x + 12; \quad x \in W$$

(A) $\{0\}$

(B) $\{0, 1\}$

(C) $\{\}$

(D) $\{-4, -3, -2, -1, 0\}$

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27. The general solution of the differential equation

$$x\frac{dy}{dx} = y + x\tan\left(\frac{y}{x}\right)$$

(A) $\sin\left(\frac{y}{x}\right) = \frac{C}{x}$

(B) $\sin\left(\frac{y}{x}\right) = Cx$

(C) $\sin\left(\frac{x}{y}\right) = Cx$

(D) $\sin\left(\frac{x}{y}\right) = Cy$

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28. Evaluate the following expression:

$$\sqrt{2 + \sqrt{2} + \sqrt{2 + 2\cos(2\theta)}} \quad \text{where} \quad \theta \in \left[-\frac{\pi}{8}, \frac{\pi}{8}\right]$$

(A) $\sin 2\theta$

(B) $2\cos\theta$

(C) $\cos 2\theta$

(D) $2\sin\theta$

---

29. The turning point of the function $y = \frac{ax-b}{(x-1)(x-4)}$ at the point $P(2, -1)$ is (A) neither a

maximum nor a minimum

(B) both maximum and a minimum

(C) a minimum

(D) a maximum

---

30. A coin is tossed until a head appears or until the coin has been tossed three times. Given that 'head' does not appear on the first toss, what is the probability that the coin is tossed thrice?

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

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

(C) $\frac{1}{8}$

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

---

31. The value of $\int \frac{dx}{\sqrt{2ax-x^2}}$ (A) $\sin^{-1}(x-1) + C$

(B) $\sin^{-1}(2x-1) + C$

(C) $\sin^{-1}(x+1) + C$

(D) $-\sqrt{2ax - x^2} + C$

---

32. The equation of the circle which touches the x-axis, passes through the point (1, 1) and whose centre lies on the line $x + y = 3$ in the first quadrant is (A)

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

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

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

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

---

33. If the matrix A is such that

$$A\begin{pmatrix} -1 & 2 \\ 3 & 1 \end{pmatrix} = \begin{pmatrix} -4 & 1 \\ 7 & 7 \end{pmatrix}$$ then A is equal to

(A) $\begin{pmatrix} 1 & 2 \\ 1 & -3 \end{pmatrix}$

(B) $\begin{pmatrix} -1 & 2 \\ 1 & 3 \end{pmatrix}$

(C) $\begin{pmatrix} 1 & -2 \\ 1 & 3 \end{pmatrix}$

(D) $\begin{pmatrix} 1 & 2 \\ 3 & -1 \end{pmatrix}$

---

34. In the parabola

$y^2 =$

$4axthelengthofthelatusrectumis6unitsandthereisachordpassingthroughitsvertexandthenegativeendoft$

(A) $x + 2y = 0$

(B) $2x + y = 0$

(C) $x - 2y = 0$

(D) $2x - y = 0$

---

35. The points on the

x-axis whose perpendicular distance from the line $\frac{x}{3} + \frac{y}{4} = 1$ is 4 units are

(A) $(8, 0)$ and $(-2, 0)$

(B) $(-8, 0)$ and $(-2, 0)$

(C) $(8, 0)$ and $(2, 0)$

(D) $(-8, 0)$ and $(2, 0)$

---

36. The side of a cube is equal to the diameter of a sphere. If the side and radius increase at the same rate then the ratio of the increase of their surface area is

(A) $3 : \pi$

(B) $\pi : 6$

(C) $2\pi : 3$

(D) $3 : 2\pi$

---

37. Suppose we have three cards identical in form except that both sides of the first card are coloured red, both sides of the second are coloured black, and one side of the third card is coloured red and the other side is coloured black. The three cards are mixed and a card is picked randomly. If the upper side of the chosen card is coloured red, what is the probability that the other side is coloured black?

(A) $\frac{1}{6}$

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

(C) 0

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

---

38. The function $f(x) = \tan^{-1}(\sin x + \cos x)$ is an increasing function in

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

(B) $(0, \frac{\pi}{2})$

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

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

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39. For an examination a candidate has to select 7 questions from three different groups A, B and C. The three groups contain 4, 5 and 6 questions respectively. In how many different ways can a candidate make his selection if he has to select at least 2 questions from each group?

(A) 1500

(B) 1800

(C) 2700

(D) 2100

---

40. The letters of the word "COCHIN" are permuted and all the permutations are arranged in alphabetical order as in an English dictionary. The number of words that appear before the word "COCHIN" is

(A) 48

(B) 96

(C) 192

(D) 360

---

41. The co-ordinate of the foot of the perpendicular from $P(1, 8, 4)$ on the line joining $R(0, -1, 3)$ and $Q(2, -3, -1)$ is

(A) $\left(\frac{-5}{3}, \frac{-2}{3}, \frac{-19}{3}\right)$

(B) $\left(\frac{5}{3}, \frac{2}{3}, \frac{-19}{3}\right)$

(C) $\left(\frac{-5}{3}, \frac{2}{3}, \frac{19}{3}\right)$

(D) $\left(\frac{5}{3}, \frac{2}{3}, \frac{19}{3}\right)$

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42. The general solution of the differential equation

$$(1 + \tan y)(dx - dy) + 2x\, dx\, dy = 0$$

(A) $y(\sin x + \cos x) = \sin x + ce^{x}$

(B) $y(\sin x + \cos x) = \sin x + ce^{-x}$

(C) $x(\sin y + \cos y) = \sin x + ce^{y}$

(D) $x(\sin y + \cos y) = \sin x + ce^{-y}$

---

43. If a real number a is such that $\int_0^a x\, dx \leq a + 4$, then what is the range of a?

(1) $-2 \leq a \leq 0$

(2) $0 \leq a \leq 4$

(3) $-2 \leq a \leq 4$

(4) $a \leq -2$ or $a \geq 4$

---

44. Find the value of 'b' such that the scalar product of the vector $\hat{i} + \hat{j} + \hat{k}$ with the unit vector parallel to the sum of the vectors $2\hat{i} + 4\hat{j} - 5\hat{k}$ and $b\hat{i} + 2\hat{j} + 3\hat{k}$ is unity.

(1) -2

(2) 0

(3) -1

(4) 1

---

45. Value of $\cos 105^\circ$

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

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

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

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

---

46. The area bounded by the curve $y = \cos x$, $x = 0$, and $x = \pi$ is

(1) 2 sq units

(2) 1 sq units

(3) 4 sq units

(4) 3 sq units

---

47. If $I_n = \int_0^\pi \tan^n x \, dx$, for $n \geq 2$, then $I_n + I_{n-2} =$

(1) $\frac{n}{n-1}$

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

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

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

---

48. In the expansion of $\left(\frac{1}{x} + x \sin x\right)^{10}$, the coefficient of the 6th term is equal to $7^7 g$, then

the principal value of x is.

(1) 45°

(2) 60°

(3) 25°

(4) 30°

---

49. If $(1-4i)^3 = a+ib$, then the value of a and b is

(A) $-47, 52$

(B) $49, -74$

(C) $-74, 49$

(D) $-48, -52$

---

50. Two finite sets have m and n number of elements respectively. The total number of subsets of the first set is 112 more than the total number of subsets of the second set. Then the values of m and n are respectively.

(A) $7, 4$

(B) $7, 7$

(C) $4, 4$

(D) $4, 7$

---

51. The sum of the order and degree of the differential equation

$$\left(\frac{d^5y}{dx^5}\right) + 4\left(\frac{d^4y}{dx^4}\right) + \left(\frac{d^3y}{dx^3}\right) = x^2 - 1$$

(A) 4

(B) 5

(C) 6

(D) 8

---

52. The integral

$$\int e^x \left[\frac{x^2+1}{(x+1)^2}\right] dx$$

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

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

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

(D) $xe^x + C$

---

53. Evaluate:

$$\cos^{-1}\left(\cos\frac{35\pi}{18}\right) - \sin^{-1}\left(\sin\frac{35\pi}{18}\right)$$

(A) 0

(B) $\frac{\pi}{9}$

(C) $\frac{\pi}{18}$

(D) π

---

54. The maximum value of $P = 500x + 400y$ for the given constraints

$$x + y \leq 200, \quad x \geq 20, \quad y \geq 4x, \quad y \geq 0$$

(A) 96,000

(B) 84,000

(C) 98,000

(D) 82,000

---

55. If

$$y = \sin^{-1}\left(\frac{5x + 12\sqrt{1-x^2}}{13}\right)$$

then $\frac{dy}{dx}$ equals

(A) $\frac{-2x}{\sqrt{1-x^2}}$

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

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

(D) $\frac{2x}{\sqrt{1-x^2}}$

---

56. If the straight lines

$$\frac{x-2}{1}=\frac{y-3}{1}=\frac{z-4}{-t} \quad \text{and} \quad \frac{x-1}{t}=\frac{y-4}{2}=\frac{z-5}{1} \quad \text{are intersecting, then } t \text{ can have:}$$

(A) Exactly three values

(B) Exactly two values

(C) Any number of values

(D) Exactly one value

---

57. If

$$\frac{dy}{dx}=y+3 \quad \text{and} \quad y(0)=2, \quad \text{then} \quad y(\log 2) \text{ is equal to:}$$

(A) 5

(B) 13

(C) -2

(D) 7

---

58. What is the probability of a randomly chosen 2-digit number being divisible by 3?

(A) $\frac{2}{9}$

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

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

(D) $\frac{1}{9}$

---

59. If

$$A=\begin{bmatrix} 0 & x & 16 \\ x & 5 & 7 \\ 0 & 9 & x \end{bmatrix}$$

is a singular matrix, then x is equal to

(1) -12

(2) 21

(3) -144

(4) 144

---

60. What is the nature of the function $f(x) = x^3 - 3x^2 + 4x$ on real numbers?

(A) Strictly decreasing

(B) Decreasing

(C) Increasing

(D) Constant

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2 CHEMISTRY

61. Given are 4 statements related to the chemical properties of Glucose. Identify the two incorrect statements from the following.

(A) It reacts with Br_2 (aq) to form Saccharic acid.

(B) Reacts with Acetic anhydride to form Glucose tetraacetate.

(C) Reacts with Hydroxylamine to give Glucose oxime.

(D) It reacts with ammoniacal $AgNO_3$ to form ammonium salt of Gluconic acid with deposition of silver.

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62. At 700 K, the Equilibrium constant value for the formation of HI from H_2 and I_2 is 49.0. 0.7 mole of HI(g) is present at equilibrium. What will be the concentrations of H_2 and I_2 gases if we initially started with HI(g) and allowed the reaction to reach equilibrium at the same temperature?

(A) 0.1195

(B) 0.3442

(C) 0.4692

(D) 0.521

---

63. A compound having molecular formula $C_4H_{11}N$, reacts with $CHCl_3$ in alcoholic KOH, on heating, to form a compound with a foul smell. Identify the optically active isomer of the compound which also shows the above reaction.

(A) 2-Methylpropan-1-amine

(B) Butan-1-amine

(C) Butan-2-amine

(D) N-Methylpropan-1-amine

---

64. A Hydrocarbon $[A]$ (molecular formula C_3H_6) on reaction with Br_2/CCl_4 gave $[B]$. When $[B]$ is heated with 2 moles of alcoholic KOH, it gave compound $[C]$. 3 moles of Compound $[C]$ when passed through red hot Iron tube forms $[D]$. Identify $[D]$.

(A) Polypropene

(B) Benzene

(C) Polystyrene

(D) 1, 3, 5-Trimethylbenzene

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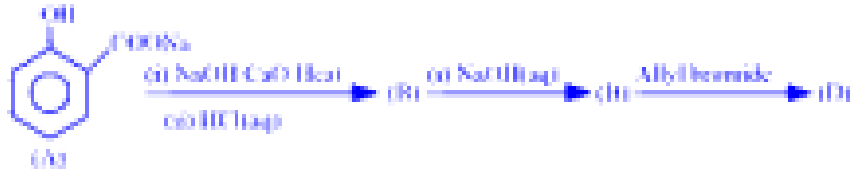
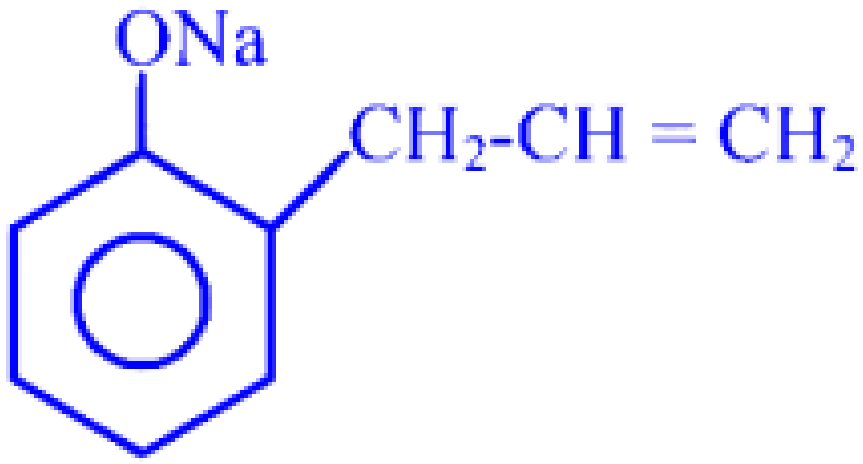
65. Identify the end-product $[D]$ formed when solution salicylate undergoes the following series of reactions.



(A)



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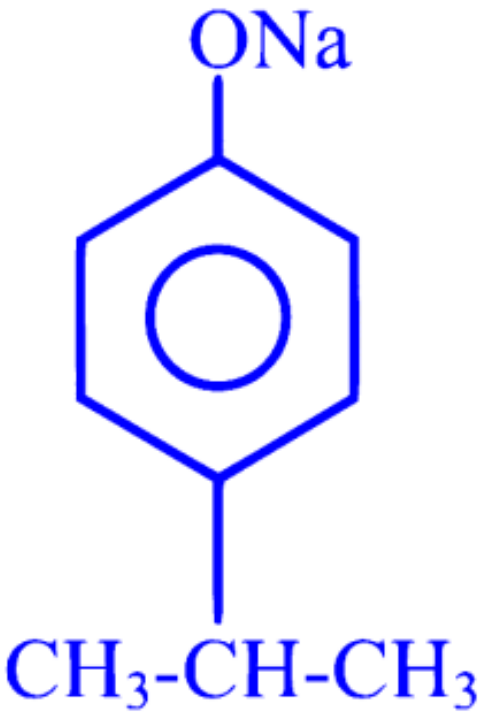

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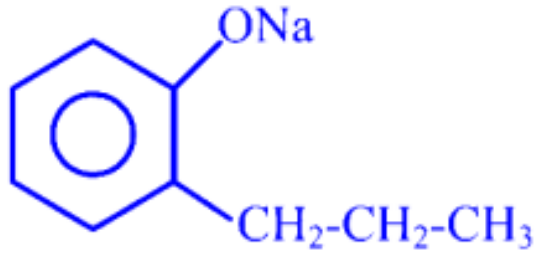
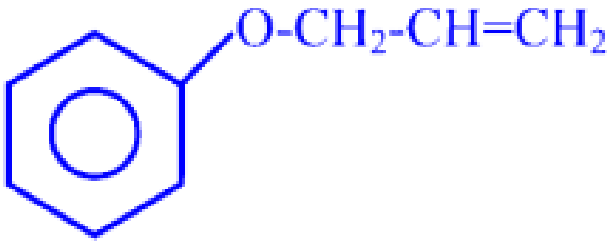


(D)



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66. For a given reaction, $X(g) + Y(g) \rightarrow Z(g)$, the order of reaction with respect to X and Y are m and n respectively. If the concentration of X is tripled and that of Y is decreased to one third, what is the ratio between the new rate to the original rate of the reaction?

(A) $3^{(m-n)}$

(B) $3^{(m)}$

(C) $(m+n)$

(D) $\frac{1}{3^{(m+n)}}$

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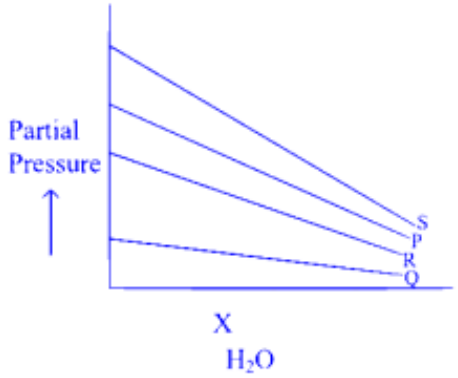
67. Study the graph between partial pressure and mole fraction of some gases and arrange the gases P, Q, R, and S dissolved in H_2O, in the decreasing order of their K_H values.



(A) $S > P > R > Q$

(B) $R > Q > P > S$

(C) $P > R > S > Q$

(D) $Q > R > P > S$

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68. Identify the final product formed when Toluene undergoes a series of reactions with reagents given in the order:

(i) Cl_2/Sunlight

(ii) $H_2O/373\,K$

(iii) Acetophenone / OH^- at 293 K

(A) 1, 3-Diphenylprop-2-en-1-one

(B) 4-Chloro-2-hydroxyacetophenone

(C) 2, 4-Dichloroacetophenone

(D) p-Hydroxyacetophenone

---

69. 4 statements are given below. Identify the incorrect statement

(A) Phenol has lower pK_a value than p-cresol.

(B) 2-Chlorophenol is more acidic than phenol.

(C) Ortho and para nitrophenols can be separated by steam distillation since p-Nitrophenol is more steam volatile than o-Nitrophenol.

(D) Phenol on reaction with $Cr_2O_7^{2-}/H^+$ yields a conjugated diketone.

(A) C

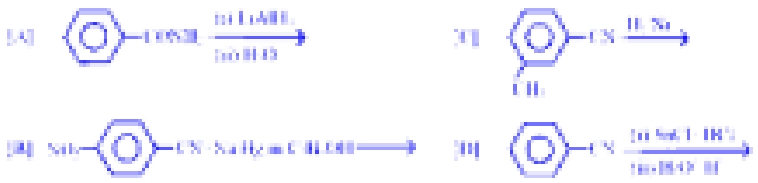
(B) B

(C) D

(D) A

---

70. One of the reactions A, B, C, D given below yields a product which will not answer Hinsberg's test when reacted with Benzene sulphonyl chloride. Identify the reaction.



(A) C

(B) B

(C) A

(D) D

---

71. Identify the correct statement from the following.

(A) The green manganate ion shows diamagnetic nature but the permanganate ion exhibits paramagnetic nature

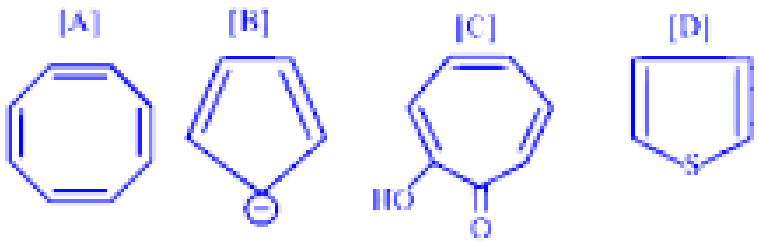
(B) Interstitial compounds of transition metals have lower melting points than that of pure transition metals and their compounds are chemically reactive

(C) Cerium is a lanthanoid metal which exists in a stable oxidation state of +4, besides exhibiting an oxidation state of +3

(D) Cr(VI) is more stable than W(VI) and hence acts as a good oxidizing agent

---

72. Identify the compound which is non-aromatic in nature.



(A) Compound [A]

(B) Compound [B]

(C) Compound [C]

(D) Compound [D]

---

73. Given that the freezing point of benzene is $5.48°C$ and its K_f value is $5.12°C/m$, what would be the freezing point of a solution of 20 g of propane in 400 g of benzene?

(A) $-0.34°C$

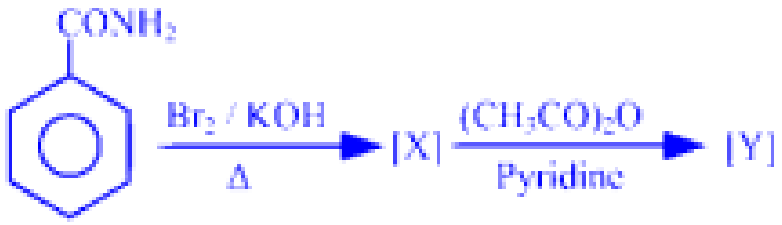
(B) $-0.17°C$

(C) $-5.8°C$

(D) $-0.2°C$

---

74. Identify the final product formed when Benzamide undergoes the following reactions:



(A) Acetanilide

(B) Acetophenone

(C) Aniline

(D) Benzoic acid

---

75. Identify the correct statement regarding corrosion of iron rod left exposed to atmosphere.

(A) The reaction occurring at the cathodic area is:

$$O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-$$

(B) The reaction occurring at the cathodic area is:

$$O_2(g) + 4H^+(aq) + 4e^- \rightarrow 2H_2O(l); E^\circ = +1.23V$$

(C) Reaction occurring at anodic area is:

$$2Fe(s) \rightarrow 2Fe^{2+}(aq) + 4e^-$$

(D) The overall reaction occurring during the corrosion process is:

$$2Fe(s) + 3O_2(g) + 6H_2O(l) \rightarrow 2Fe^{3+}(aq) + 3OH^-(aq); E^\circ = -1.23V$$

---

76. Two statements, Assertion and Reason are given below. Choose the correct option.

Assertion:

n-propyl tert-butyl ether can be readily prepared in the laboratory by Williamson's synthesis.

Reason: The reaction occurs by S_N1 attack of Primary alkoxide on Tert-alkyl halide to give a good yield of the product, n-propyl tert-butyl ether.

(A) Assertion is incorrect but reason is correct.

(B) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion.

(C) Assertion is correct but Reason is incorrect.

(D) Both Assertion and Reason are correct but Reason is not the correct explanation for Assertion.

77. Two statements, Assertion and Reason are given. Choose the correct option from the following.

Assertion: In the secondary structure of RNA, double helix structure is formed.

Reason: In the double structure of RNA, two nucleic acid chains are wound about each other and held together by hydrogen bonds between pairs of bases.

A. Assertion is correct but Reason is incorrect.

B. Both Assertion and Reason are correct and Reason is the correct explanation for Assertion.

C. Assertion is incorrect but Reason is correct.

D. Both Assertion and Reason are correct but Reason is not the correct explanation for Assertion.

---

78. An inorganic compound W undergoes the following reactions:

$$W + \text{Na}_2\text{CO}_3 \xrightarrow{\text{O}_2/\text{heat}} X + H^+ \rightarrow Y(s)$$

$$Y(aq) + \text{KCl}(aq) \rightarrow Z(s)$$

Z appears in the form of orange crystals and is used as an oxidising agent in acid medium. Identify the compound W.

(A) $\text{K}_2\text{Cr}_2\text{O}_4$

(B) FeCr_2O_4

(C) $\text{Cu}(\text{Cr}_2\text{O}_4)_2$

(D) $\text{Na}_2\text{Cr}_2\text{O}_7$

---

79. Given are the names of 4 compounds. Two of these compounds will not undergo Cannizzaro's reaction. Identify the two.

(A) 2-Chlorobutanal

(B) 2,2-Dimethylpropanal

(C) Benzaldehyde

(D) 2-Phenyl ethanol

---

80. Identify the product [C] formed at the end of the reaction below:

$$1,1,2,2-\text{Tetrabromopropane} + 2\text{Zn (s)}/\text{Ethanol} \rightarrow [B]$$

$$[B] + 2\text{moles of HBr} \rightarrow [C]$$

(A) 2,2-Dibromopropane

(B) 1,1-Dibromopropane

(C) 1,3-Dibromopropane

(D) 1,2-Dibromopropane

---

81. What is/are the product/s formed when Benzaldehyde and Ethanal react in the presence of dil. NaOH followed by heating the intermediate product formed?

(A) 2-Methylpent-2-enal & But-2-enal

(B) 3-Phenylprop-2-enal & But-2-enal

(C) Only product is But-2-enal

(D) Only product is 2-Phenylprop-2-enal

---

82. In the estimation of element X in an organic compound, 0.8 g of the compound containing X was heated with fuming HNO and the cooled product was treated with barium chloride. The mass of barium sulphate precipitated was 1.2 g. What is the percentage of element X and what is the formula of the violet-coloured compound formed when Lassaigne's extract of the organic compound is treated with sodium nitroprusside?

(A) 30.24 % & Na[Fe(CN)NOS]

(B) 20.6 % & Na[Fe(CN)NOS]

(C) 40.27 % & Na[Fe(CN)NOS]

(D) 9.16 % & Na[Fe(CN)NO]

---

83. Identify the pair of molecules in which one of them is a molecule with an odd electron and the other has an expanded octet.

(A) BeCl HNO

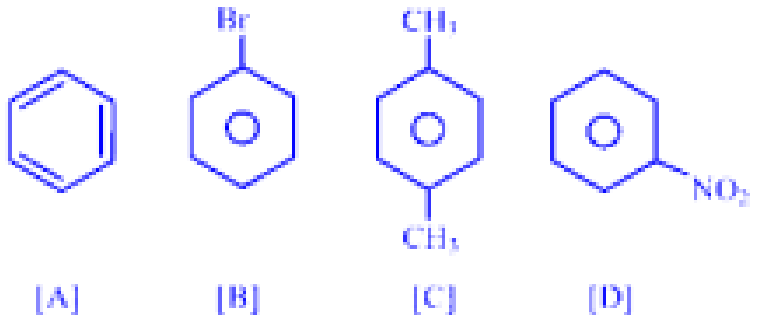
(B) NO PF

(C) BCl NO

(D) SCl NH

---

84. Arrange the following compounds in the increasing order of their reactivity when each of them is reacted with chloroethane / anhydrous AlCl.



(A) [Benzene with Br]

(B) [Benzene with CH]

(C) [Benzene with NO]

(D) [Benzene with NO]

---

85. What mass of Silver chloride, in grams, gets precipitated when 150 ml of 32% solution of Silver nitrate is reacted with 150 ml of 11% Sodium chloride solution?

Atomic mass in g/mol: Ag = 108, Na = 23, Cl = 35.5, N = 14, O = 16.

(A) 40.47

(B) 32.45

(C) 48.0

(D) 16.52

---

86. Which of the following 2 compounds exhibit both Geometrical and Structural isomerism?

A = $[Co(NH_3)_4Cl_2]NO_2$

B = $[Co(NH_3)_4Br]SO_4$

C = $[Co(NH_3)_3(NO_2)_2]$

D = $[Cr(H_2O)_6]Cl_3$

(A) A & C

(B) C & B

(C) B & D

(D) A & B

---

87. What is the wave number (Units cm^{-1}) of the longest wavelength transition in the Balmer series of the Hydrogen spectrum? $Z = 1$ **for** H

(A) 27419.6

(B) 15233.3

(C) 39605.6

(D) 1354

---

88. Given below are 2 statements: Assertion and Reason. Choose the correct option.

Assertion: When Molar conductivity for a strong electrolyte is plotted versus $\sqrt{C}$ (mol/L)$^{1/2}$, a straight line is obtained with intercept equal to Molar conductivity at infinite dilution for the electrolyte and slope equal to $-A$. All electrolytes of a given type have the same A value.

Reason: At infinite dilution, strong electrolytes of the same type will have different numbers of ions due to incomplete dissociation.

(A) Assertion is correct but Reason is incorrect statement.

(B) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(C) Both Assertion and Reason are incorrect statements.

(D) Assertion is incorrect but Reason is correct statement.

---

89. Based on Valence Bond Theory, match the complexes listed in Column I with the number of unpaired electrons on the central metal ion, given in Column II.

No.	Complex Ions	No.	Number of unpaired electrons
(A)	$[FeF_6]^{3-}$	(P)	0
(B)	$[Fe(CN)_6]^{4-}$	(P)	1
(C)	$[Fe(H_2O)_6]^{2+}$	(R)	5
(D)	$[Fe(CN)_6]^{3-}$	(S)	4

(A) A = S B = Q C = R D = P

(B) A = R B = Q C = P D = R

(C) A = R B = P C = Q D = Q

(D) A = S B = C C = Q D = P

---

90. What are the Principal & Azimuthal quantum number values of the valence electrons in tripositive Lutetium?

(A) $n = 4 \quad l = 2$

(B) $n = 5 \quad l = 2$

(C) $n = 5 \quad l = 1$

(D) $n = 4 \quad l = 3$

---

91. What is the quantity of charge, in Faraday units, required for the reduction of 3.5 moles of $Cr_2O_7^{2-}$ in acid medium?

(A) 6.0

(B) 10.5

(C) 21.0

(D) 3.0

---

92. A dry cell consists of a moist paste of NH_4Cl and $ZnCl_2$ contained in a Zn casing which encloses a carbon rod surrounded by black MnO_2 paste. What is the role of $ZnCl_2$ in it?

(A) It prevents pressure being developed in the cell due to NH_3 gas formation.

(B) It serves as cathode thus permitting Carbon rod to act as anode.

(C) It acts as the anode while Carbon rod acts as the cathode.

(D) It keeps the contents dry and prevents leakage of electrolyte.

---

93. Compounds A and B, having the same molecular formula

Compounds A and B, having the same molecular formula (C_4H_8O), react separately with CH_3MgBr, followed by reaction with dil. HCl to form compounds X and Y respectively. Compound Y undergoes acidic dehydration in presence of Conc. H_2SO_4 much more readily than X. Compound Y also reacts with Lucas reagent, much more readily than X, with appearance of turbidity. Identify X and Y.

(A) X = Pentan - 1 - ol Y = Pentan - 2 - ol

(B) X = Butan - 2 - ol Y = 2-Methylpropan - 2 - ol

(C) X = Pentan - 1 - ol Y = 2 - Methylpentan - 2 - ol

(D) X = Pentan - 2 - ol Y = 2 - Methylbutan - 2 - ol

---

94. Match the names of reactions given in Column I with the appropriate reactions given in Column II

No.	Name of reaction	No.	Equations representing reactions
(A)	Sandmeyer	(P)	$2C_6H_5Cl + Na$ (dry ether) $\rightarrow$ Diphenyl.
(B)	Fittig	(Q)	$CH_3 - CHBr - CH_3 + AgF \rightarrow CH_3 - CHF - CH$
(C)	Swarts	(R)	$CH_3 - CH_2 - Br + NaI$ (Acetone) $\rightarrow CH_3 - CH_2$
(D)	Finkelstein	(S)	$C_6H_5N_2 + Cl - + Cu_2Br_2/HBr \rightarrow C_6H_5Br + N_2$

(A) A = S B = P C = Q D = R

(B) A = C B = R C = S D = P

(C) A = B B = R C = Q D = S

(D) A = R B = P C = S D = Q

---

95. With reference to Pauling's Electronegativity scale, which one of the following options shows the correct order of electronegativity values of elements?

(A) Na > Cs > K

(B) Mg > Al > Si

(C) B > C > Al

(D) N > S > P

---

96. What volume of 0.2 M Acetic acid is to be added to 100ml of 0.4M Sodium acetate so that a Buffer solution of pH equal to 4.94 is obtained? (pK_a of CH_3COOH = 4.76)

(A) 132.1 ml

(B) 125.3 ml

(C) 150.2 ml

(D) 110.6 ml

---

97. Arrange the compounds A, B, C, and D in the increasing order of their reactivity towards SN_1 reaction.

A = $C_6H_5CH_2Cl$

B = C_6H_5Cl

C = CH_2=CH–Cl

D = CH_3–CH_2–Cl

(A) D ¡ B ¡ A ¡ C

(B) D ¡ C ¡ B ¡ A

(C) B ¡ D ¡ C ¡ A

(D) C ¡ A ¡ D ¡ B

---

98. For a reaction $5X + Y \rightarrow 3Z$, the rate of formation of Z is 2.4×10^{-5} mol $L^{-1}s^{-1}$. Calculate the average rate of disappearance of X.

(A) 4.8×10^{-7} mol $L^{-1}s^{-1}$

(B) 13.33×10^{-6} mol $L^{-1}s^{-1}$

(C) 4.0×10^{-5} mol $L^{-1}s^{-1}$

(D) 12.0×10^{-5} mol $L^{-1}s^{-1}$

---

99. In the redox reaction between $Cr_2O_7^{2-}$ / H^+ and sulphite ion, what is the number of moles of electrons involved in producing 3.0 moles of the oxidised product?

(A) 8

(B) 2

(C) 3

(D) 6

---

100. Which of the following two molecular species are Diamagnetic in nature?

(1) O_2

(2) N_2^+

(3) C_2

(4) O_2^{2-}

---

101. A solute X is found to exist as a dimer in water. A 4 molal solution of X shows a boiling point of 101.04°C. What is the percentage association of X?

($K_b for water = 0.52 K/m$).

(1) 75

(2) 100

(3) 80

(4) 40

---

102. The Lanthanoid ion which would form coloured compounds is ————.

Atomic numbers: Yb = 70, Lu = 71, Pr = 59, La = 57

(1) Yb^{2+}

(2) La^{3+}

(3) Lu^{3+}

(4) Pr^{3+}

---

103. Given below are 4 statements. Two of these are correct statements. Identify them.

(1) Co^{2+} is easily oxidised to Co^{3+} in the presence of a strong ligand like CN^{-}

(2) $[Fe(CN)_6]^{4-}$ is an octahedral complex ion which is paramagnetic in nature.

(3) Removal of H_2O molecules from $[Ti(H_2O)_6]Cl_3$ on strong heating converts it to a colourless compound.

(4) Crystal Field splitting in Octahedral and Tetrahedral complexes is given by the equation $\Delta_0 = 4/9\Delta_t$

---

104. The Enthalpy of combustion of C_6H_6COOH(s) at 25°C and 1.0 atm pressure is -2546 kJ/mol. What is the Internal energy change for this reaction?

(1) -2544.8 kJ

(2) -2539.8 kJ

(3) -2560.3 kJ

(4) -2552.2 kJ

---

105. Sulphuric acid used in Lead Storage battery has a concentration of 4.5 M and a density of 1.28 g/ml. The molality of the acid is

(1) 4.012

(2) 2.568

(3) 5.364

(4) 3.516

---

106. Given:

$\Delta H_f^\circ\, CO_2(g) = -393.5\,\text{kJ/mol}$

$\Delta H_f^\circ\, H_2O(l) = -286\,\text{kJ/mol}$

$\Delta H_f^\circ\, C_3H_6(g) = +20.6\,\text{kJ/mol}$

$\Delta H^{\circ}_{\text{isomerization of Cyclopropane to Propene}} = -33\,\text{kJ/mol}$

What is the standard enthalpy of combustion of Cyclopropane?

(1) -2092 kJ/mol

(2) -1985 kJ/mol

(3) +2384 kJ/mol

(4) -2051 kJ/mol

---

107. A current of 3.0 A is passed through 750 ml of 0.45 M solution of CuSO for 2 hours with a current efficiency of 90%. If the volume of the solution is assumed to remain constant, what would be the final molarity of CuSO solution?

(1) 0.296

(2) 0.4

(3) 0.237

(4) 0.316

---

108. Match the Vitamins given in Column I with the diseases caused by their deficiency as given in Column II.

	Vitamin		Deficiency
(A)	K	(P)	Cheilosis
(B)	B_12	(Q)	Osteomalacia
(C)	B_2	(R)	Permicious Anaemia
(D)	D	(S)	Haemophilia

A. A-S B-R C-P D-Q

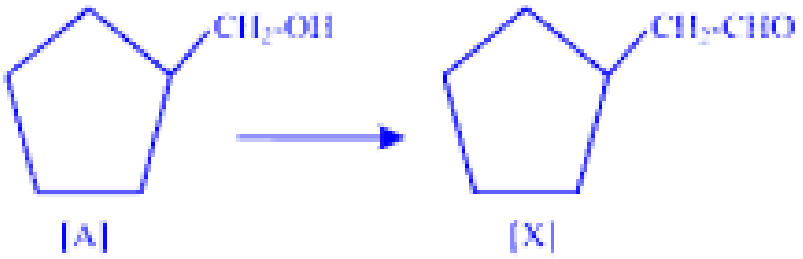
B.A-Q B-P C-S D-R

C A-S B-R C-Q D-P

D A-P B-S C-Q D-R

---

109. Which one of the following is the correct order of reagents to be used to convert [A] to [X]?



(A) KCN / H_2O^-, PCC, PCl_5, $LiAlH_4$

(B) PCC, PCl_5, $LiAlH_4$, KCN / H_2O^-

(C) $LiAlH_4$, KCN / H_2O^-, PCC, PCl_5

(D) PCC, KCN / H_2O^-, $LiAlH_4$, PCl_5

---

110. Arrange the following redox couples in the increasing order of their reducing strength:

(A) Cu^{2+}/Cu^+ $E^\circ = -0.34$ V

(B) Ag^+/Ag $E^\circ = -0.8$ V

(C) Ca^{2+}/Ca $E^\circ = +2.87$ V

(D) Cr^{3+}/Cr^{2+} $E^\circ = +0.74$ V

---

111. In the presence of a catalyst at a given temperature of 27°C, the Activation energy of a specific reaction is reduced by 100 J/mol. What is the ratio between the rate constants for the catalysed (k_2) and uncatalysed (k_1) reactions?

(A) 1.04×10^{-2}

(B) 2.32×10^{-2}

(C) 1.97

(D) 1.04

---

112. 5.0 moles of an Ideal gas at 3.0 atm pressure and 27°C is compressed isothermally to half its volume by application of an external pressure of 3.5 atm. What is the amount of work done (in joules) on the gas? Given: 1 L atm = 101.3 J, R = 0.082 L atm K^{-1} mol^{-1}

(A) -3559.9 J

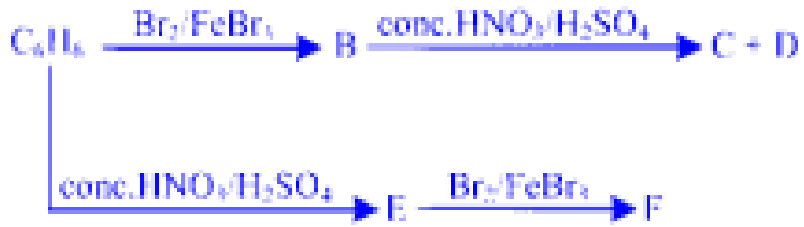
(B) 7268.3 J

(C) -10367.4 J

(D) 14359.2 J

---

113. Identify the products C, D, and F formed in the following sets of reactions.



(A) C = p-nitrobromobenzene D = m-nitrobromobenzene F = p-nitrobromobenzene

(B) C = o-nitrobromobenzene D = m-nitrobromobenzene F = p-nitrobromobenzene

(C) C = o-nitrobromobenzene D = p-nitrobromobenzene F = o-nitrobromobenzene

(D) C = m-nitrobromobenzene D = p-nitrobromobenzene F = o-nitrobromobenzene

---

114. Given below are 4 reactions. Two of these reactions will give product which is an equimolar mixture of the d and l forms. Identify these 2 reactions.

[A] 2-Methylpropene + HBr $\rightarrow$ ———

[B] But-1-ene + HBr $\rightarrow$ ———

[C] 3-Methylbut-1-ene + HI $\rightarrow$ ———

[D] 3-Phenylpropene + HBr (Peroxide) $\rightarrow$ ———

(A) C & A

(B) D & B

(C) B & C

(D) A & D

---

115. 200 ml of an aqueous solution contains 3.6 g of Glucose and 1.2 g of Urea maintained at a temperature equal to 27°C. What is the Osmotic pressure of the solution in atmosphere units?

R = 0.082 L atm K^{-1} mol^{-1}

Molecular Formula: Glucose = $C_6H_{12}O_6$, Urea = NH_2CONH_2

(A) 6.24

(B) 1.56

(C) 9.84

(D) 4.92

---

116. The following data was recorded for the decomposition of XY compound at 750K

[XY] mol / L	Rate of decomposition of XY mol / L s
0.4	5.5×10^{-7}
0.8	22.0×10^{-7}
1.2	49.5×10^{-7}

What is the order of reaction with respect to decomposition of XY?

(A) 0

(B) 2

(C) 1

(D) 1.5

---

117. Identify the final product [D] formed when Benzyl alcohol undergoes the following series of reactions:

$$C_6H_5CH_2OH + SOC_2 \rightarrow [A] \quad + \quad KCN \rightarrow [B] \quad + \quad H_2O^+(\text{partial hydrolysis}) \rightarrow [C] \quad + \quad [D]$$

(A) 4-Chlorobenzoic acid

(B) Benzoic acid

(C) 2-Chlorobenzoic acid

(D) 2-Phenylethanolic acid

---

118. Choose the incorrect statement from the following:

(A) Isoletronic molecules/ions have the same bond order.

(B) Dipole moment of NH_3 is greater than that of NF_3.

(C) The Carbon in Methyl Carbocation is sp^3 hybridised.

(D) The stability of an ionic compound is measured in terms of its lattice enthalpy and not simply based on attaining Octet configuration.

---

119. Based on Crystal Field theory, match the Complex ions listed in Column I with the electronic configuration in the d orbitals of the central metal ion listed in Column II.

No.	Complexion	No.	d orbital configuration of central metal ion.
(A)	$[Mn(CN)_6]^{4-}$	(P)	$e_g^2 t_{2g}^3$
(B)	$[Co(H_2O)_6]^{2+}$	(Q)	$t_{2g}^4 e_g^2$
(C)	$[Fe(H_2O)_6]^{2+}$	(R)	t_{2g}^5
(D)	$[MnCl_4]^{2-}$	(S)	$t_{2g}^5 e_g^2$

(A) $[Mn(CN)_6]^{4-}$ (P) $e_g^2 t_{2g}^3$

(B) $[Co(H_2O)_6]^{2+}$ (Q) $t_{2g}^6 e_g^0$

(C) $[Fe(H_2O)_6]^{2+}$ (R) $t_{2g}^6 e_g^2$

(D) $[MnCl_4]^{2-}$ (S) $e_g^3 t_{2g}^4$

---

120. The Activation energy for the reaction A $\rightarrow$ B + C, at a temperature T_K was 0.04606 RT J/mol. What is the ratio of Arrhenius factor to the Rate constant for this reaction?

A. 1.585

B. 3.2 $\times 10^{-2}$

C. 1.047 $\times 10^{-2}$

D. 1.047

---

3 PHYSICS

121. The binding energy per nucleon for ^{12}C is 7.68 MeV and that for ^{13}C is 7.47 MeV. The energy required to remove a neutron from ^{13}C is

A. 7.92×10^{-13} MeV

B. 4.95×10^{-13} eV

C. 7.92×10^{-13} J

D. 7.92×10^{-19} J

---

122. The distance of closest approach when an alpha particle of kinetic energy 6.5 MeV strikes a nucleus of atomic number 50 is

A. 0.221 fm

B. 1.101 fm

C. 0.0221 fm

D. 4.42 fm

---

123. A scooter moves with a speed of 7 m/s on a straight road and is stopped by applying the brakes. Before stopping, the scooter travels 10 m. If the weight of the scooter is W, then the total resistance to the motion of the scooter will be

A. $\frac{1}{2}W$

B. $\frac{1}{4}W$

C. 4W

D. 2W

---

124. In Young's double slit experiment light of wavelength 500 nm is used to form interference pattern. A uniform glass plate of refractive index 1.5 and thickness 0.1 mm is introduced in the path of one of the interfering beams. The number of fringes that will shift due to this is

A. 100

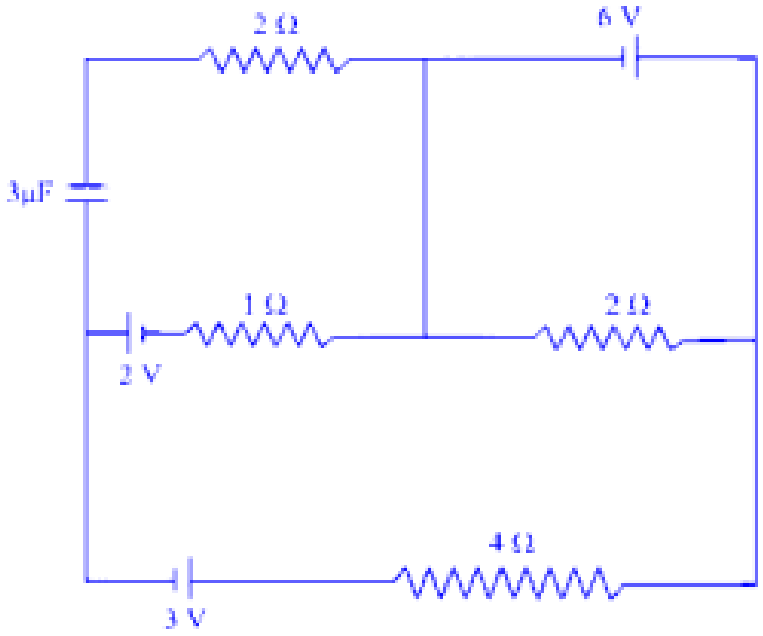
B. 400

C. 300

D. 200

---

125. Figure below shows a network of resistors, cells, and a capacitor at steady state.



What is the current through the resistance 4 ?

A. 1.0 A

B. 0.2 A

C. Zero

D. 0.5 A

---

126. A cricketer of height 2.5 m throws a ball at an angle of 30° with the horizontal such that it is received by another cricketer of the same height standing at a distance of 50 m from the first one. The maximum height attained by the ball is (tan 30° = 0.577).

A. 7.9 m

B. 10 m

C. 10.7 m

D. 9.7 m

---

127. If an electron in a hydrogen atom jumps from the third orbit to the second orbit, it emits a photon of wavelength λ. When it jumps from the second to the first orbit, the corresponding wavelength of the photon will be:

A. $\frac{5\lambda}{27}$

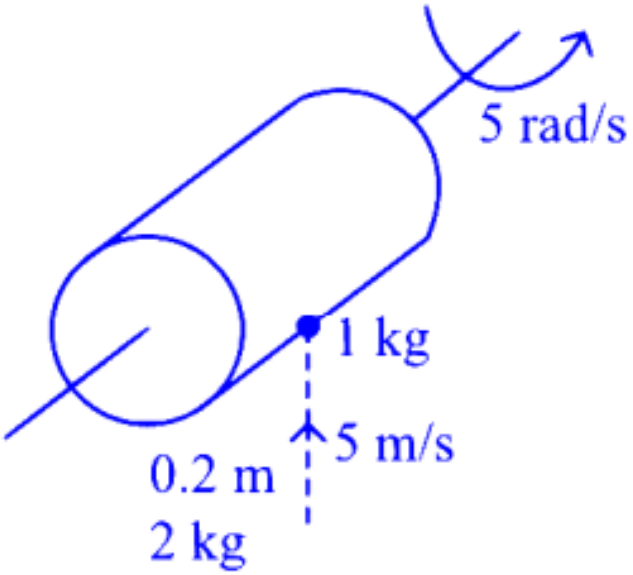
B. $\frac{7\lambda}{20}$

C. $\frac{16\lambda}{9}$

D. $\frac{20\lambda}{7}$

---

128. A solid cylinder of mass 2 kg and radius 0.2 m is rotating about its own axis without friction with angular velocity 5 rad/s. A particle of mass 1 kg moving with a velocity of 5 m/s strikes the cylinder and sticks to it as shown in figure.



The angular velocity of the system after the particle sticks to it will be:

A. 15.0 rad/s

B. 12.0 rad/s

C. 10.0 rad/s

D. 30.0 rad/s

---

129. A neutral water molecule is placed in an electric field $E = 2.5 \times 10^4$ N/C. The work done to rotate it by 180° is 5×10^{-25} J. Find the approximate separation of the center of charges.

A. 1.25×10^{-10} m

B. 0.625×10^{-10} m

C. 0.625×10^{-9} m

D. 0.998×10^{-10} m

---

130. A telescope has an objective of focal length 60 cm and eyepiece of focal length 5

cm. The telescope is focused for least distance of distinct vision 300 cm away from the object. The magnification produced by the telescope at least distance of distinct vision is

A. +1.5

B. +2

C. -1.5

D. -2

---

131. A parallel plate capacitor having a dielectric constant 5 and dielectric strength 10^6 V/m is to be designed with a voltage rating of 2 kV. The field should never exceed 10% of its dielectric strength. To have the capacitance of 60 pF, the minimum area of the plates should be

A. $2.71 \times 10^{-4}\,\mathrm{m}^2$

B. $2.7 \times 10^{-2}\,\mathrm{m}^2$

C. $2.71 \times 10^{-4}\,\mathrm{m}^2$

D. $2.7 \times 10^{-2}\,\mathrm{m}^2$

---

132. The coefficient of volume expansion of glycerine is $49 \times 10^{-5}\,\mathrm{K}^{-1}$. The percentage change in its density for a 50°C rise in temperature is

A. 3.54

B. 5.24

C. 4.25

D. 2.45

---

133. A current I flows in an infinitely long wire with cross section in the form of semi-circular ring of radius 1 m. The magnitude of the magnetic induction along its axis is

A. $\frac{\mu_0 I}{2r}$ T

B. $\frac{\mu_0 I}{4r}$ T

C. $\frac{\mu_0 I}{2\pi r}$ T

D. $\frac{\mu_0 I}{2\pi r^2}$ T

---

134. Three bulbs of 40 W, 60 W, and 100 W are arranged in series with a 220 V source.

The maximum light is obtained from

A. 40 W

B. 60 W

C. All give the same light

D. 100 W

---

135. A photon emitted during the de-excitation of electron from a state n to the second excited state in a hydrogen atom, irradiates a metallic electrode of work function 0.5 eV, in a photocell, with a stopping voltage of 0.47 V. Obtain the value of quantum number of the state 'n'.

A. 5

B. 6

C. 4

D. 3

---

136. The acceleration due to gravity at pole and equator can be related as

A. $g_e = g_p < g$

B. $g_e = g_p = g$

C. $g_e < g_p$

D. $g_e > g_p$

---

137. A bar magnet is held perpendicular to a uniform field. If the couple acting on the magnet is to be halved, by rotating it, the angle by which it is to be rotated is

A. 90°

B. 30°

C. 60°

D. 45°

---

138. A negative charge particle is moving upward in a magnetic field which is towards north. The particle is deflected towards

A. North

B. South

C. East

D. West

---

139. Two point charges M and N having charges +q and -q respectively are placed at a distance apart. Force acting between them is F. If 30% of charge of N is transferred to M, then the force between the charges becomes:

A. $\frac{100}{49}F$

B. $\frac{49}{100}F$

C. $\frac{49}{16}F$

D. $\frac{9}{16}F$

---

140. A conducting circular loop is placed in a uniform magnetic field $B = 0.125$ T with its plane perpendicular to the loop. If the radius of the loop is made to shrink at a constant rate of 2 mm/s, then the induced emf when the radius is 4 cm is:

A. $0.52\,\mu V$

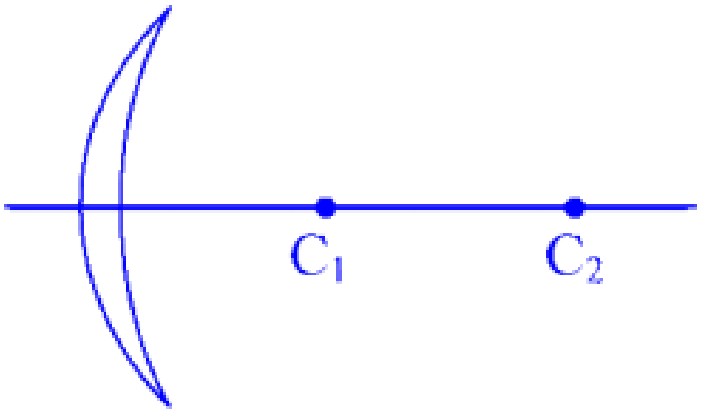
B. $20\,\mu V$

C. $\frac{3}{5}\,\mu V$

D. $\frac{3}{2}\,\mu V$

---

141. Figure below shows a lens of refractive index, $\mu = 1.4$. C_1 and C_2 are the centres of curvature of the two faces of the lens of radii of curvature 4 cm and 8 cm respectively.



The lens behaves as a

A. diverging lens of focal length 20 cm

B. converging lens of focal length 20 cm

C. converging lens of focal length 12 cm

D. diverging lens of focal length 12 cm

---

142. The temperature of a wire is doubled. The Young's modulus of elasticity

A. Will decrease

B. Will also double

C. Will become four times

D. Will remain the same

---

143. A wire of length 2 m carries a current of 1 A along the x axis. A magnetic field B $= B_0(i + j + k)$ **tesla exists in space. The magnitude of the magnetic force on the wire is**

A. $2B_0$ N

B. Zero

C. $3B_0$ N

D. $2\sqrt{3}B_0$ N

---

144. The dimension $[ML^{-1}T^{-2}]$ **is the physical quantity of**

A. Pressure $\times$ Area

B. Force $\times$ Pressure

C. Power $\times$ Time

D. Energy density

---

145. The resistance of a 10 m long wire is 10 Ω**. Its length is increased by 25% by stretching the wire uniformly. The new resistance is**

A. 18.6 Ω

B. 15.6 Ω

C. 12.8 Ω

D. 14.9 Ω

---

146. A body is executing SHM. When its displacements from the mean position are 4 cm and 5 cm, it has velocity 10 cm/s and 8 cm/s respectively. Its periodic time t **is**

A. $\frac{2\pi}{3}$ sec

B. 2π sec

C. $\frac{3\pi}{2}$ sec

D. π sec

---

147. When water falls from a height of 80 m at the rate of 20 kg s^{-1} to operate a turbine the losses due to frictional force are 20% of input energy. How much power is generated by the turbine?

A. 12.8 KW

B. 62.5 KW

C. 25.6 KW

D. 21.6 KW

---

148. An electron has a mass of 9.1×10^{-31} kg. It revolves round the nucleus in a circular orbit of radius 0.529×10^{-10} m at a speed of 2.2×10^{6} m/s. The magnitude of its angular momentum is

A. 1.06×10^{-34} Kg m^2s^{-1}

B. 1.06×10^{-24} Kg m^2s^{-1}

C. 2.06×10^{-34} Kg m^2s^{-1}

D. 2.06×10^{-24} Kg m^2s^{-1}

---

149. If the nuclear radius of ^{27}Al is 3.6 fermi, the nuclear radius of ^{125}Fe is

A. 6×10^{-10} m

B. 6×10^{-13} m

C. 6×10^{-15} m

D. 6×10^{-12} m

---

150. When an A.C. source is connected to a inductive circuit,

A. voltage and current are in same phase.

B. voltage is ahead of current in phase.

C. the phase between voltage and current depends upon the value of inductance.

D. voltage lags behind current in phase.

---

151. A satellite is revolving around the earth in a circular orbit with kinetic energy of 1.69×10^{10} J. The additional kinetic energy required for just escaping into the outer space is

A. 3.38×10^{10} J

B. 1.69×10^{10} J

C. 0.89×10^{10} J

D. 1.35×10^{10} J

---

152. A ball is moving in a circular path of radius 5 m. If tangential acceleration at any instant is $10\,\text{m/s}^2$ and the net acceleration makes an angle of 30° with the centripetal acceleration, then, the instantaneous speed is

A. $5.4\,\text{m/s}$

B. $50\sqrt{3}\,\text{m/s}$

C. $6.6\,\text{m/s}$

D. $9.3\,\text{m/s}$

---

153. If 216 drops of the same size are charged at 200 V each and they combine to form a bigger drop, the potential of the bigger drop will be

A. 2400 V

B. 7200 V

C. 1200 V

D. 8200 V

---

154. The conductivity of a semiconductor increases with increase in temperature because

A) number density of free current carriers increases

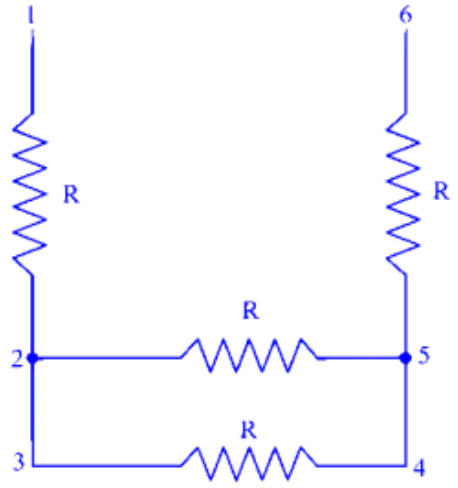
B) relaxation time increases

C) both number density of carriers and relaxation time increase

D) number density of current carriers increases, relaxation time decreases but effect of decrease in relaxation time is much less than increase in number density

---

155. Four resistors, each of resistance R, are connected as shown in the figure below.



A. The total resistance between points 1 and 3 is 0.5 R.

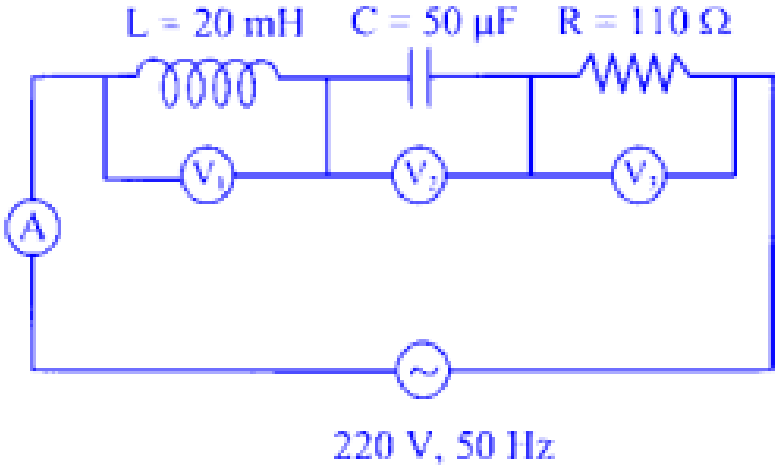
B. The total resistance between points 1 and 6 is 3.5 R.

C. The total resistance between points 3 and 6 is 2 R.

D. The total resistance between points 2 and 4 is 0.5 R.

---

156. In the A.C. circuit given below, voltmeters V_1 and V_2 read 100 V each. Find the reading of the voltmeter V_3 and the ammeter A.



A. 220 V, 2 A

B. 110 V, 2 A

C. 110 V, 4 A

D. 220 V, 1 A

---

157. Joule second is the unit of

A. Energy

B. Power

C. Angular momentum

D. Linear momentum

---

158. When a biconvex lens of glass of refractive index 1.5 is dipped in a liquid, it acts like a plane sheet of paper. This means the refractive index of the liquid is

A. Greater than that of glass

B. Less than that of glass

C. Equal to that of glass

D. Less than one

---

159. The latent heat of vaporisation of water is 2240 J. If the work done in the process of vaporisation of 1 g is 168 J, the increase in internal energy is

A. 1408 J

B. 2072 J

C. 2208 J

D. 2408 J

---

160. A particle of mass 2 mg has the same wavelength as a neutron moving with a velocity of 3×10^5 ms^{-1}. The velocity of the particle is (mass of neutron is 1.67×10^{-27} Kg)

A. 2.5×10^{-16} ms^{-1}

B. 1.5×10^{-13} ms^{-1}

C. 2.5×10^{-13} ms^{-1}

D. 1.5×10^{-16} ms^{-1}

---

161. Two narrow parallel slits illuminated by a coherent monochromatic light produces an interference pattern on a screen placed at a distance D from the slits. The separation between the dark lines of the interference pattern can be increased by

A. decreasing the distance between the screen and the slits

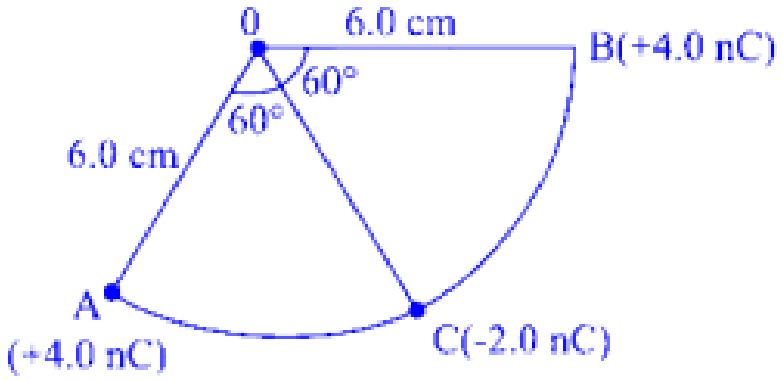
B. increasing the distance between the slits

C. using monochromatic light of a longer wavelength

D. using monochromatic light of higher frequency

---

162. Three point charges are located on a circular arc at A, B and C as shown in the figure below. The total electric field at the centre of the arc (C) is



A. 15000 N C^{-1}

B. 10000 N C^{-1}

C. 20000 N C^{-1}

D. 5000 N C^{-1}

---

163. A voltmeter of resistance $1000\,\Omega$ **and** 0.5 **V/div is to be converted into a voltmeter to make it read** 1 **V/div. The value of high resistance to be connected in series with it is**

A. 6000 Ω

B. 5000 Ω

C. 4000 Ω

D. 1000 Ω

---

164. Column - I lists the waves of the electromagnetic spectrum. Column - II gives approximate frequency range of these waves. Match Column - I and Column - II and choose the correct match from the given choices.

	Column I		Column II
(A)	Radiowaves	(P)	10^{18} to 10^{20} Hz
(B)	Microwaves	(P)	10^{11} to 5×10^{14} Hz
(C)	Infrared	(R)	10^{4} to 10^{8} Hz
(D)	X-rays	(S)	10^{9} to 10^{12} Hz

A. (A)-(R) (B)-(S) (C)-(Q) (D)-(P)

B. (A)-(R) (B)-(S) (C)-(Q) (D)-(Q)

C. (A)-(P) (B)-(Q) (C)-(S) (D)-(R)

D. (A)-(R) (B)-(S) (C)-(P) (D)-(Q)

---

165. A monochromatic light of wavelength 800 nm is incident normally on a single slit of width 0.020 mm to produce a diffraction pattern on a screen placed 1 m away. Estimate the number of fringes obtained in Young's double slit experiment with slit separation 0.20 mm, which can be accommodated within the range of total angular spread of the central maximum due to single slit.

A. 25

B. 30

C. 20

D. 15

---

166. Internal energy of n_1 moles of hydrogen at temperature T is equal to internal energy of m_2 moles of helium at temperature $2T$. The ratio $\frac{n_1}{n_2}$ is

A. $\frac{6}{5}$

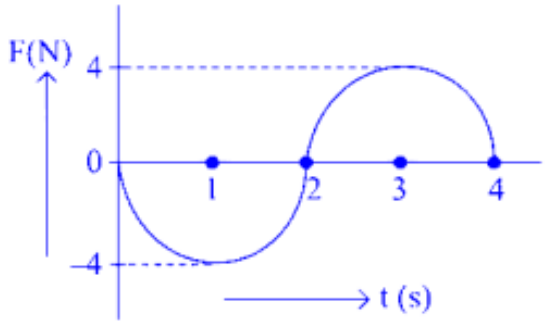
B. $\frac{3}{7}$

C. $\frac{5}{3}$

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

---

167. A body initially at rest undergoes rectilinear motion. The force-time (F-t) graph for the motion of the body is given below. Find the linear momentum gained by the body in 2 s.



A. $\pi\,\mathrm{N}\cdot\mathrm{s}$

B. $\frac{3}{2}\,\mathrm{N}\cdot\mathrm{s}$

C. $\frac{\pi}{4}\,\mathrm{N}\cdot\mathrm{s}$

D. $2\pi\,\mathrm{N}\cdot\mathrm{s}$

---

168. Incident light of wavelength $\lambda = 800$ nm produces a diffraction pattern on a screen 1.5 m away when it passes through a single slit of width 0.5 mm. The distance between the first dark fringes on either side of the central bright fringe is

A. $2.4\,\mathrm{mm}$

B. $2.4\,\mathrm{cm}$

C. $4.8\,\mathrm{cm}$

D. $4.8\,\mathrm{mm}$

---

169. A transformer of 100% efficiency has 200 turns in the primary and 40000 turns in the secondary. It is connected to a 220 V main supply and secondary feeds to a 100 KΩ resistance. The potential difference per turn is

A. 11 V

B. 18 V

C. 25 V

D. 1.1 V

---

170. Action and reaction can never balance out because

A. They are unequal in magnitudes

B. Though they are equal in magnitude and opposite in direction they act on different bodies

C. They are equal in magnitude but not opposite always.

D. They are unequal in magnitudes even though opposite in direction

---

171. The current in a coil changes steadily from 3 A to 5 A in 0.2 s when an emf of 2 μV is induced in it. The self-inductance of the coil is

A. 0.2 mH

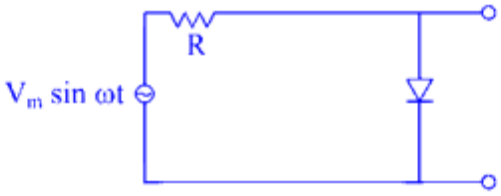
B. 20 μH

C. 2 μH

D. 0.2 μH

---

172. The output of the given circuit is



A. Negatively rectified half wave

B. Positively rectified half wave

C. Negatively rectified full wave

D. Zero all times

---

173. For a paramagnetic material, the dependence of the magnetic susceptibility χ on the absolute temperature is given as

A. Independent of T

B. $\chi \propto \frac{1}{T}$

C. $\chi \propto T$

D. $\chi \propto \frac{1}{T^{3/2}}$

---

174. The magnetic flux linked with a coil is given by the equation:

$$\phi = 8t^2 + t + 10$$

The e.m.f. induced in the coil in the 3rd second will be

A. 49 V

B. 33 V

C. 16 V

D. 20 V

---

175. A cylinder of fixed capacity 44.81 contains hydrogen gas at STP. What is the amount of heat needed to raise the temperature of the gas in the cylinder by 20° C?

$$(R = 8.31\,\text{J mol}^{-1}\,\text{K}^{-1})$$

A. 541 J

B. 374 J

C. 831 J

D. 743 J

---

176. A hollow prism is filled with water and placed in air. It will deviate the incident rays

A. Towards or away from the base

B. Away from the base

C. Parallel to the base

D. Towards the base

---

177. The number of possible natural oscillations of air column in a pipe closed at one end of length 85 cm whose frequencies lie below 1250 Hz are (velocity of sound = 340 ms^{-1})

A. 6

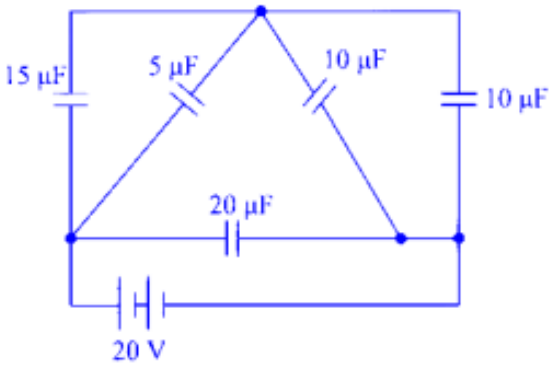
B. 8

C. 4

D. 5

---

178. The figure shows a network of five capacitors connected to a 20 V battery. Calculate the charge acquired by each 10 µF capacitor.



A. 2×10^{-4} C

B. 4×10^{-4} C

C. 6×10^{-4} C

D. 1×10^{-4} C

---

179. What is the relation obeyed by the angles of contact θ_1, θ_2 and θ_3 of 3 liquids of different densities P_1, P_2, and P_3 respectively $(P_1 < P_2 < P_3)$ when they rise to the same capillary height in 3 identical capillaries and having nearly the same surface tension T?

A. $0 < \theta_3 < \theta_2 < \theta_1 < \frac{\pi}{2}$

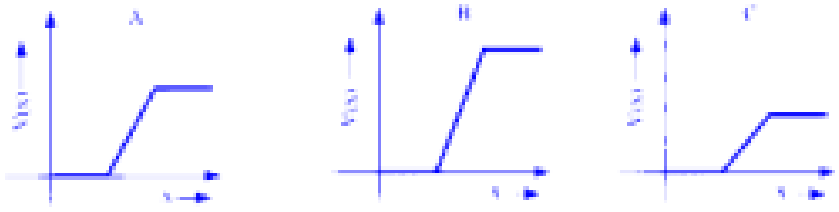
B. $\frac{\pi}{2} > \theta_1 > \theta_2 > \theta_3 > 0$

C. $\frac{\pi}{2} > \theta_1 > \theta_2 > \theta_3 < \frac{\pi}{2}$

D. $0 < \theta_1 < \theta_2 < \theta_3 < \frac{\pi}{2}$

---

180. The following are the graphs of potential barrier versus width of the depletion region for a p-n junction diode.



Which of the following is correct?

I	II	III	IV
A - unbiased diode	A - Forward biased diode	A - unbiased diode	A - unbiased diode
B - Reverse biased	B - Reverse biased	B - Forward biased	B - unused diode
C - Forward biased	C - unbiased	C - Reverse biased	C - Forward biased

A. II

B. III

C. IV

D. I
