JEE Main - 31 Jan (Shift 2) Question Paper

Question 1. The number of ways in which 21 identical apples can be distributed among three children such that each child gets at least 2 apples, is

1. 406

2. 130

3. 142

4. 136

Question 2. Let $A(a, b), B(3, 4)$ and $(-6, -8)$ respectively denote the centroid, circumcenter, and orthocenter of a triangle. Then, the distance of the point $P(2a + 3, 7b + 5)$ from the line $2x + 3y - 4 = 0$ measured parallel to the line $x - 2y - 1 = 0$ is

1. $\frac{15\sqrt{5}}{7}$

2. $\frac{17\sqrt{5}}{6}$

3. $\frac{17\sqrt{5}}{7}$

4. $\frac{\sqrt{5}}{17}$

Question 3. Let z_1 and z_2 be two complex numbers such that $z_1 + z_2 = 5$ and $z_1^3 + z_2^3 = 20 + 15i$. Then $\left| z_1^4 + z_2^4 \right|$ equals

1. $30\sqrt{3}$

2. 75

3. $15\sqrt{15}$

4. $25\sqrt{3}$

Question 4. Let a variable line passing through the center of the circle $x^2 + y^2 - 16x - 4y = 0$, meet the positive coordinate axes at the points A and B. Then the minimum value of $OA + OB$, where O is the origin, is equal to

1. 12

2. 18

3. 20

4. 24

Question 5. Let $f, g : (0, \infty) \to \mathbb{R}$ be two functions defined by

$$f(x) = \int_{-x}^{x} (|t| - t^2)e^{-t^2}\, dt \quad \text{and} \quad g(x) = \int_{0}^{x^2} t^{1/2}e^{-t}\, dt.$$

Then the value of $f\left(\sqrt{\log_e 9}\right) + g\left(\sqrt{\log_e 9}\right)$ is equal to

1. 6

2. 9

3. 8

4. 10

Question 6. Let (α, β, γ) be the mirror image of the point $(2, 3, 5)$ in the line

$$\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}.$$

Then $2\alpha + 3\beta + 4\gamma$ is equal to

1. 32

2. 33

3. 31

4. 34

Question 7. Let P **be a parabola with vertex** $(2, 3)$ **and directrix** $2x + y = 6$**. Let an ellipse** $E : \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$**, with** $a > b$ **and eccentricity** $\frac{1}{\sqrt{2}}$**, pass through the focus of the parabola** P**. Then the square of the length of the latus rectum of** E **is**

(1) $\frac{385}{8}$

(2) $\frac{347}{8}$

(3) $\frac{512}{25}$

(4) $\frac{656}{25}$

Question 8. The temperature $T(t)$ **of a body at time** $t = 0$ **is** $160°$ **F and it decreases continuously as per the differential equation**

$$\frac{dT}{dt} = -K(T - 80),$$

where K **is a positive constant. If** $T(15) = 120°$ **F, then** $T(45)$ **is equal to**

(1) $85°$ F

(2) $95°$ F

(3) $90°$ F

(4) $80°$ F

Question 9. Let 2nd**,** 8th**, and** 44th **terms of a non-constant A.P. be respectively the** 1st**,** 2nd**, and** 3rd **terms of a G.P. If the first term of the A.P. is 1, then the sum of the first 20 terms is equal to**

(1) 980

(2) 960

(3) 990

(4) 970

Question 10. Let $f : \mathbb{R} \to (0, \infty)$ **be a strictly increasing function such that** $\lim_{x \to \infty} \frac{f(7x)}{f(x)} = 1$**. Then, the value of** $\lim_{x \to \infty} \left[\frac{f(5x)}{f(x)} - 1 \right]$ **is equal to**

(1) 4

(2) 0

(3) $\frac{7}{5}$

(4) 1

Question 11. The area of the region enclosed by the parabola $y = 4x - x^2$ and $3y = (x-4)^2$ is equal to

(1) $\frac{32}{9}$

(2) 4

(3) 6

(4) $\frac{14}{3}$

Question 12. Let the mean and variance of 6 observations $a, b, 68, 44, 48, 60$ be 55 and 194, respectively. If $a > b$, then $a + 3b$ is

(1) 200

(2) 190

(3) 180

(4) 210

Question 13. If the function $f : (-\infty, -1] \to (a, b]$ defined by

$$f(x) = e^{x^3 - 3x + 1}$$

is one-one and onto, then the distance of the point $P(2b+4, a+2)$ from the line $x + e^{-3}y = 4$ is:

(1) $2\sqrt{1 + e^6}$

(2) $4\sqrt{1 + e^6}$

(3) $3\sqrt{1 + e^6}$

(4) $\sqrt{1 + e^6}$

Question 14. Consider the function $f : (0, \infty) \to \mathbb{R}$ defined by $f(x) = e^{-|\log x|}$. **If** m **and** n be respectively the number of points at which f is not continuous and f is not differentiable, then $m + n$ is

(1) 0

(2) 3

(3) 1

(4) 2

Question 15. The number of solutions of the equation $e^{\sin x} - 2e^{-\sin x} = 2$ **is**

(1) 2

(2) more than 2

(3) 1

(4) 0

Question 16. If $a = \sin^{-1}(\sin(5))$ **and** $b = \cos^{-1}(\cos(5))$**, then** $a^2 + b^2$ **is equal to**

(1) $4\pi^2 + 25$

(2) $8\pi^2 - 40\pi + 50$

(3) $4\pi^2 - 20\pi + 50$

(4) 25

Question 17. If for some m, n**:** ${}^6C_m + 2\left({}^6C_{m+1}\right) + {}^6C_{m+2} > 8C_3$ **and** ${}^{n-1}P_3 : {}^n P_4 = 1 : 8$**, then** ${}^n P_{m+1} + {}^{n+1}C_m$ **is equal to**

(1) 380

(2) 376

(3) 384

(4) 372

Question 18. A coin is based so that a head is twice as likely to occur as a tail. If the coin is tossed 3 times, then the probability of getting two tails and one head is

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

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

(3) $\frac{2}{27}$

(4) $\frac{1}{27}$

Question 19. Let A **be a** 3×3 **real matrix such that**

$$A \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} = 2 \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}, \quad A \begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix} = 4 \begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix}, \quad A \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} = 2 \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}.$$

Then, the system $(A - 3I) \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$ **has**

(1) unique solution

(2) exactly two solutions

(3) no solution

(4) infinitely many solutions

Question 20. The shortest distance between lines L_1 **and** L_2**, where** $L_1 : \frac{x-1}{2} = \frac{y+1}{-3} = \frac{z+4}{2}$ **and** L_2 **is the line passing through the points** $A(-4, 4, 3)$**,** $B(-1, 6, 3)$ **and perpendicular to the line** $\frac{x-3}{-2} = \frac{y}{3} = \frac{z-1}{1}$**, is**

(1) $\frac{121}{\sqrt{221}}$

(2) $\frac{24}{\sqrt{117}}$

(3) $\frac{141}{\sqrt{221}}$

(4) $\frac{42}{\sqrt{117}}$

Question 21.

$$\left|\frac{120}{\pi^3} \int_0^\pi \frac{x^2 \sin x \cos x}{\sin^4 x + \cos^4 x} \, dx\right| \text{ is equal to } _____.$$

Question 22. Let a, b, c **be the lengths of three sides of a triangle satisfying the condition**

$$(a^2 + b^2)x^2 - 2b(a + c)x + (b^2 + c^2) = 0.$$

If the set of all possible values of x **is the interval** (α, β)**, then** $12(\alpha^2 + \beta^2)$ **is equal to** _____.

Question 23. Let $A(-2, -1), B(1, 0), C(\alpha, \beta),$ **and** $D(\gamma, \delta)$ **be the vertices of a parallelogram** $ABCD$**. If the point** C **lies on** $2x - y = 5$ **and the point** D **lies on** $3x - 2y = 6$**, then the value of** $|\alpha + \beta + \gamma + \delta|$ **is equal to** _____.

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24. Let the coefficient of x^r **in the expansion of**

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

be α_r**. If** $\sum_{r=0}^{n} \alpha_r = \beta^n - \gamma^n$**,** $\beta, \gamma \in \mathbb{N}$**, then the value of** $\beta^2 + \gamma^2$ **equals** ____

Question 25. Let A **be a** 3×3 **matrix and** $\det(A) = 2$**. If**

$$n = \det(\mathbf{adj}(\mathbf{adj}(\ldots(\mathbf{adj}(A))\ldots))),$$

with adj(A) **taken 2024 times, then the remainder when** n **is divided by 9 is equal to** _____.

Question 26. Let $\vec{a} = 3\hat{i} + 2\hat{j} + \hat{k}, \vec{b} = 2\hat{i} - \hat{j} + 3\hat{k},$ **and** $\vec{c}$ **be a vector such that** $(\vec{a} + \vec{b}) \times \vec{c} = 2(\vec{a} \times \vec{b}) + 24\hat{j} - 6\hat{k}$ **and** $(\vec{a} - \vec{b} + i) \cdot \vec{c} = -3$**. Then** $|\vec{c}|^2$ **is equal to** _____.

Question 27. If $\lim_{x \to 0} \frac{ax^2 e^x - b \log_e(1+x) + cxe^{-x}}{x^2 \sin x} = 1$**, then** $16(a^2 + b^2 + c^2)$ **is equal to** _____.

Question 28. A line passes through $A(4, -6, -2)$ and $B(16, -2, 4)$. The point $P(a, b, c)$, where a, b, c are non-negative integers, on the line AB lies at a distance of 21 units from the point A. The distance between the points $P(a, b, c)$ and $Q(4, -12, 3)$ is equal to _____.

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29. Let $y = y(x)$ **be the solution of the differential equation**

$$\sec^2 x\, dx + \left(e^{2y} \tan^2 x + \tan x\right) dy = 0,$$

for $0 < x < \frac{\pi}{2}$ **and** $y\left(\frac{\pi}{4}\right) = 0$. **If** $y\left(\frac{\pi}{6}\right) = \alpha$, **then** $e^{8\alpha}$ **is equal to** ____

Question 30. Let $A = \{1, 2, 3, \ldots, 100\}$. Let R be a relation on A defined by $(x, y) \in R$ if and only if $2x = 3y$. Let R_1 be a symmetric relation on A such that $R \subset R_1$ and the number of elements in R_1 is n. Then, the minimum value of n is _____.

Question 31. A light string passing over a smooth light fixed pulley connects two blocks of masses m_1 and m_2. If the acceleration of the system is $g/8$, then the ratio of masses is _____
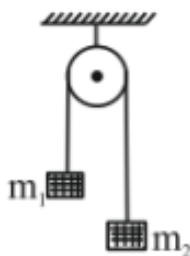
(1) $\frac{9}{7}$

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

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

(4) $\frac{5}{3}$

Question 32. A uniform magnetic field of 2×10^{-3} T acts along the positive Y-direction. A rectangular loop of sides 20 cm and 10 cm with a current of 5 A lies in the Y-Z plane. The current is in an anticlockwise sense with reference to the negative X axis. The magnitude

and direction of the torque are:

(1) 2×10^{-4} N m along positive Z-direction

(2) 2×10^{-4} N m along negative Z-direction

(3) 2×10^{-4} N m along positive X-direction

(4) 2×10^{-4} N m along positive Y-direction

Question 33.

The measured value of the length of a simple pendulum is 20 cm with 2 mm accuracy. The time for 50 oscillations was measured to be 40 seconds with 1 second resolution. From these measurements, the accuracy in the measurement of acceleration due to gravity is $N\%$. The value of N is:

(1) 4

(2) 8

(3) 6

(4) 5

Question 34. Force between two point charges q_1 and q_2 placed in a vacuum at r cm apart is F. Force between them when placed in a medium having dielectric $K = 5$ at $r/5$ cm apart will be:

(1) $\frac{F}{25}$

(2) $5F$

(3) $\frac{F}{5}$

(4) $25F$

Question 35. An AC voltage $V = 20\sin 200\pi t$ is applied to a series LCR circuit which drives a current $I = 10\sin\left(200\pi t + \frac{\pi}{3}\right)$. The average power dissipated is:

(1) 21.6 W

(2) 200 W

(3) 173.2 W

(4) 50 W

Question 36.When unpolarized light is incident at an angle of $60°$ on a transparent medium from air, the reflected ray is completely polarized. The angle of refraction in the medium is:

(1) $30°$

(2) $60°$

(3) $90°$

(4) $45°$

Question 37.The speed of sound in oxygen at S.T.P. will be approximately:

(Given, $R = 8.3\,\text{JK}^{-1}$, $\gamma = 1.4$)

(1) 310 m/s

(2) 333 m/s

(3) 341 m/s

(4) 325 m/s

Question 38.A gas mixture consists of 8 moles of argon and 6 moles of oxygen at temperature T. Neglecting all vibrational modes, the total internal energy of the system is:

(1) $29\,RT$

(2) $20\,RT$

(3) $27\,RT$

(4) $21\,RT$

Question 39.The resistance per centimeter of a meter bridge wire is r, with $X\,\Omega$ resistance

in the left gap. The balancing length from the left end is at 40 cm with 25 Ω resistance in the right gap. Now the wire is replaced by another wire of $2r$ resistance per centimeter. The new balancing length for the same settings will be at:

(1) 20 cm

(2) 10 cm

(3) 80 cm

(4) 40 cm

Question 40.Given below are two statements:

Statement I: Electromagnetic waves carry energy as they travel through space, and this energy is equally shared by the electric and magnetic fields.

Statement II: When electromagnetic waves strike a surface, a pressure is exerted on the surface.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but Statement II is correct

(2) Both Statement I and Statement II are correct

(3) Both Statement I and Statement II are incorrect

(4) Statement I is correct but Statement II is incorrect

Question 41.In a photoelectric effect experiment, a light of frequency 1.5 times the threshold frequency is made to fall on the surface of a photosensitive material. Now if the frequency is halved and intensity is doubled, the number of photoelectrons emitted will be:

(1) Doubled

(2) Quadrupled

(3) Zero

(4) Halved

Question 42. A block of mass $5\,\text{kg}$ is placed on a rough inclined surface as shown in the figure. If F_1 is the force required to just move the block up the inclined plane and F_2 is the force required to just prevent the block from sliding down, then the value of $|F_1 - F_2|$ is:

[**Use** $g = 10\,\text{m/s}^2$]
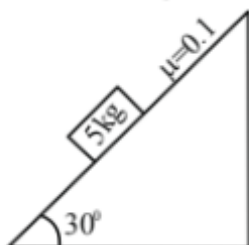
(1) $25\sqrt{3}\,\text{N}$

(2) $5\sqrt{3}\,\text{N}$

(3) $\frac{5\sqrt{3}}{2}\,\text{N}$

(4) 10 N

Question 43. By what percentage will the illumination of the lamp decrease if the current drops by 20%?

(1) 46%

(2) 26%

(3) 36%

(4) 56%

Question 44. If two vectors A and B having equal magnitude R are inclined at an angle θ, then

(1) $|\mathbf{A} - \mathbf{B}| = \sqrt{2}R\sin\left(\frac{\theta}{2}\right)$

(2) $|\mathbf{A} + \mathbf{B}| = 2R\sin\left(\frac{\theta}{2}\right)$

(3) $|\mathbf{A} + \mathbf{B}| = 2R\cos\left(\frac{\theta}{2}\right)$

(4) $|\mathbf{A} - \mathbf{B}| = 2R\cos\left(\frac{\theta}{2}\right)$

12

Question 45. The mass number of nucleus having radius equal to half of the radius of nucleus with mass number 192 is:

(1) 24

(2) 32

(3) 40

(4) 20

Question 46. The mass of the moon is $\frac{1}{144}$ times the mass of a planet and its diameter is $\frac{1}{16}$ times the diameter of a planet. If the escape velocity on the planet is v, the escape velocity on the moon will be:

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

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

(3) $\frac{v}{12}$

(4) $\frac{v}{6}$

Question 47. A small spherical ball of radius r, falling through a viscous medium of negligible density, has terminal velocity v. Another ball of the same mass but of radius $2r$, falling through the same viscous medium, will have terminal velocity:

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

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

(3) $4v$

(4) $2v$

Question 48. A body of mass $2\,\mathrm{kg}$ begins to move under the action of a time-dependent force given by

$$\mathbf{F} = \left(6t\,\hat{i} + 6t^2\,\hat{j}\right)\ \mathbf{N}.$$

The power developed by the force at time t is given by:

(1) $(6t^4 + 9t^3)\,\mathrm{W}$

(2) $(3t^3 + 6t^5)\,\mathrm{W}$

(3) $(9t^5 + 6t^3)\,\mathrm{W}$

(4) $(9t^3 + 6t^5)\,\mathrm{W}$

Question 49.The output of the given circuit diagram is:
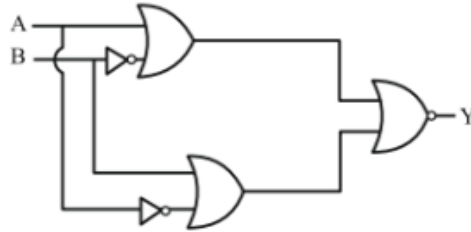
1.

A	B	Y
0	0	0
1	0	0
0	1	0
1	1	1

2.

A	B	Y
0	0	0
1	0	1
0	1	1
1	1	0

3.

A	B	Y
0	0	0
1	0	0
0	1	0
1	1	0

A	B	Y
0	0	0
1	0	0
0	1	1
1	1	0

4.

Question 50. Consider two physical quantities A and B related to each other as $E = \frac{B-x^2}{At}$ where E, x, and t have dimensions of energy, length, and time respectively. The dimension of AB is:

(1) $L^{-2}MT^0$

(2) $L^2M^{-1}T^1$

(3) $L^{-3}MT^{-1}$

(4) $L^0M^{-1}T^1$

Question 51. In the following circuit, the battery has an emf of 2 V and an internal resistance of $\frac{2}{3}\,\Omega$. The power consumption in the entire circuit is W.
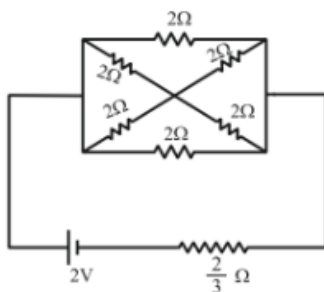
Question 52. Light from a point source in air falls on a convex curved surface of radius 20 cm and refractive index 1.5. If the source is located at 100 cm from the convex surface, the image will be formed at ____ cm from the object.

Question 53. The magnetic flux Φ (in weber) linked with a closed circuit of resistance $8\,\Omega$

varies with time t (in seconds) as $\Phi = 5t^2 - 36t + 1$. **The induced current in the circuit at** $t = 2\,\text{s}$ **is** _____ **A.**

Question 54.Two blocks of mass 2 kg and 4 kg are connected by a metal wire going over a smooth pulley as shown in the figure. The radius of the wire is $4.0 \times 10^{-5}\,\text{m}$ **and Young's modulus of the metal is** $2.0 \times 10^{11}\,\text{N/m}^2$. **The longitudinal strain developed in the wire is** $\frac{1}{\alpha\pi}$. **The value of** α **is** _____. **[Use** $g = 10\,\text{m/s}^2$**].**

2 kg

4 kg
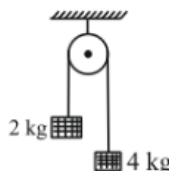
Question 55.A body of mass m **is projected with a speed** u **making an angle of** $45°$ **with the ground. The angular momentum of the body about the point of projection, at the highest point, is expressed as** $\frac{\sqrt{2}\,mu^3}{Xg}$. **The value of** X **is** _____.

Question 56. Two circular coils P **and** Q **of 100 turns each have the same radius of** $\pi\,\text{cm}$. **The currents in** P **and** Q **are 1 A and 2 A, respectively.** P **and** Q **are placed with their planes mutually perpendicular with their centers coinciding. The resultant magnetic field induction at the center of the coils is** $\sqrt{x}\,\text{mT}$, **where** $x = $ _____. **[Use** $\mu_0 = 4\pi \times 10^{-7}\,\text{TmA}^{-1}$**]**

Question 57. The distance between charges $+q$ **and** $-q$ **is** $2l$ **and between** $+2q$ **and** $-2q$ **is** $4l$. **The electrostatic potential at point** P **at a distance** r **from center** O **is** $-\alpha \left(\frac{ql}{r^2}\right) \times 10^9\,\text{V}$, **where the value of** α **is** _____.$(Use \frac{1}{4\pi\epsilon_0} = 9 \times 10^9\,\text{Nm}^2\text{C}^{-2})$

Question 58. Two identical spheres each of mass $2\,\text{kg}$ **and radius** $50\,\text{cm}$ **are fixed at the ends of a light rod so that the separation between the centers is** $150\,\text{cm}$. **Then, the moment of inertia of the system about an axis perpendicular to the rod and passing through its middle point is** $\frac{x}{20}\,\text{kg m}^2$, **where the value of** x **is** ____.

Question 59. The time period of simple harmonic motion of mass M in the given figure is $\pi\sqrt{\frac{\alpha M}{5k}}$, where the value of α is ____.
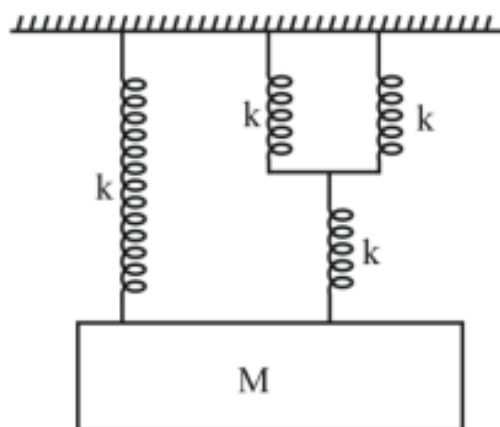
Question 60. A nucleus has mass number A_1 and volume V_1. Another nucleus has mass number A_2 and volume V_2. If the relation between mass numbers is $A_2 = 4A_1$, then $\frac{V_2}{V_1} =$ _____ .

Question 61. Match List I with List II

LIST - I	LIST - II
(Complex ion)	(Electronic Configuration)
A. $[Cr(H_2O)_6]^{3+}$	I. $t_{2g}^2 e_g^0$
B. $[Fe(H_2O)_6]^{3+}$	II. $t_{2g}^3 e_g^0$
C. $[Ni(H_2O)_6]^{2+}$	III. $t_{2g}^6 e_g^2$
D. $[V(H_2O)_6]^{3+}$	IV. $t_{2g}^3 e_g^1$

Choose the correct answer from the options given below:

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

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

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

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

Question 62. A sample of $CaCO_3$ and $MgCO_3$ weighed 2.21 g is ignited to constant

weight of 1.152 g. The composition of mixture is:

(Given molar mass in g mol^{-1}: CaCO$_3$: 100, MgCO$_3$: 84)

(1) 1.187 g CaCO$_3$, +1.023 g MgCO$_3$

(2) 1.023 g CaCO$_3$, +1.023 g MgCO$_3$

(3) 1.187 g CaCO$_3$, +1.187 g MgCO$_3$

(4) 1.023 g CaCO$_3$, +1.187 g MgCO$_3$

Question 63. Identify A and B in the following reaction sequence:
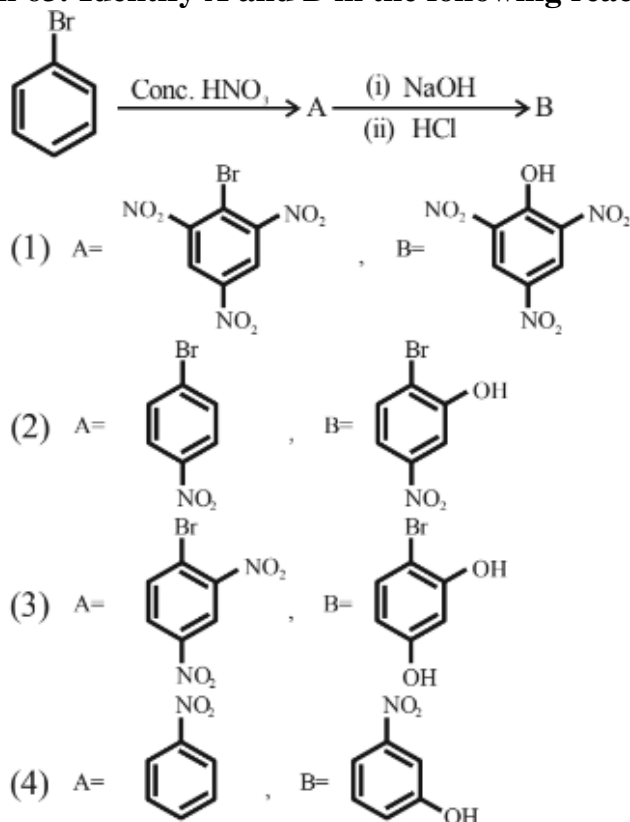
Question 64. Given below are two statements:

Statement I: S_8 solid undergoes disproportionation reaction under alkaline conditions to form S^{2-} and $S_2O_3^{2-}$.

Statement II: ClO$_4^-$ can undergo disproportionation reaction under acidic condition.

In the light of the above statements, choose the **most appropriate answer** from the options given below:
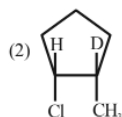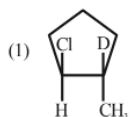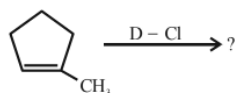
(1) Statement I is correct but statement II is incorrect.

(2) Statement I is incorrect but statement II is correct.

(3) Both statement I and statement II are incorrect.

(4) Both statement I and statement II are correct.

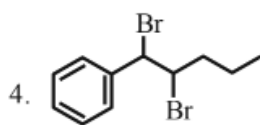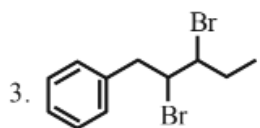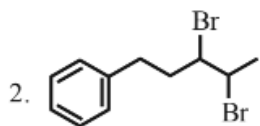**Question 65. Identify major product 'P' formed in the following reaction:**
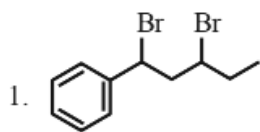

(1)

(2)

(3)

(4)
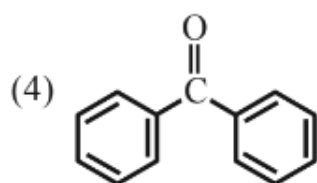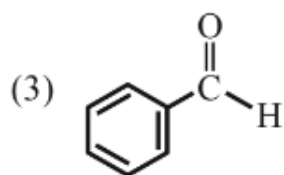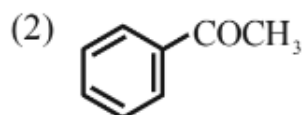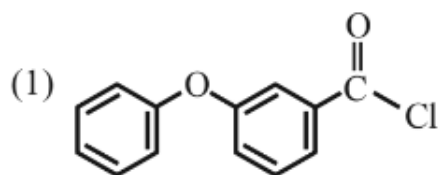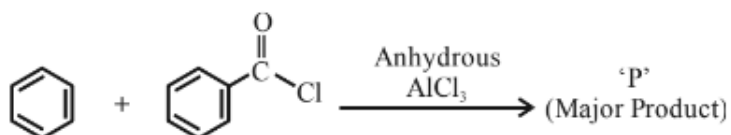
Question 66. Major product of the following reaction is:

(1)   (2)

(3)   (4)
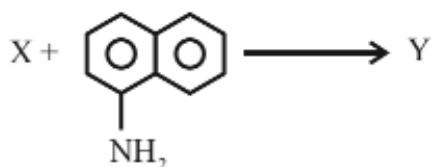
19
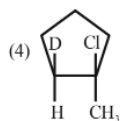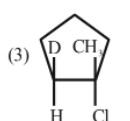
Question 67. Identify the structure of 2,3-dibromo-1-phenylpentane.

Question 68. Select the option with the correct property -

(1) $[Ni(CO)_4]$ and $[NiCl_4]^{2-}$ both diamagnetic

(2) $[Ni(CO)_4]$ and $[NiCl_4]^{2-}$ both paramagnetic

(3) $[NiCl_4]^{2-}$ diamagnetic, $[Ni(CO)_4]$ paramagnetic

(4) $[Ni(CO)_4]$ diamagnetic, $[NiCl_4]^{2-}$ paramagnetic

Question 69. The azo-dye (Y) formed in the following reactions is Sulphanilic acid + $NaNO_2$ + $CH_3COOH \rightarrow X$

X + [naphthalene ring with NH$_2$] $\longrightarrow$ Y

1. HSO$_3$—◯—N=N—◯
   ◯—N=N—◯—SO$_3$H

2. HO$_3$S—◯—N=N—◯—NH$_2$
   HO$_3$S—◯—N=N—◯

3. HSO$_3$—◯—N=N—◯
   ◯—NH$_2$

4. HSO$_3$—◯—N=N—◯—NH$_2$
   ◯

Question 70. Given below are two statements:

Statement I: Aniline reacts with conc. H$_2$SO$_4$ followed by heating at 453-473 K gives *p*-aminobenzene sulphonic acid, which gives blood red color in the *Tassaignes's test*.

Statement II: In Friedel-Crafts alkylation and acylation reactions, aniline forms salt with the AlCl$_3$ catalyst. Due to this, nitrogen of aniline acquires a positive charge and acts as a deactivating group.

In the light of the above statements, choose the **correct answer** from the options given below:

1. Statement I is false but Statement II is true

2. Both Statement I and Statement II are false

3. Statement I is true but Statement II is false

4. Both Statement I and Statement II are true

Question 71.

$A_{(g)} \rightleftharpoons B_{(g)} + \frac{1}{2}C_{(g)}$ The correct relationship between K_P, α, and equilibrium pressure P is:

(1) $K_P = \frac{\alpha^{1/2}P^{1/2}}{(2+\alpha)^{1/2}}$

(2) $K_P = \frac{\alpha^{3/2}P^{1/2}}{(2+\alpha)^{1/2}(1-\alpha)}$

(3) $K_P = \frac{\alpha^{1/2}P^{3/2}}{(2+\alpha)^{3/2}}$

(4) $K_P = \frac{\alpha^{1/2}P^{1/2}}{(2+\alpha)^{3/2}}$

Question 72. Choose the correct statements from the following:

A. All group 16 elements form oxides of general formula EO_2 and EO_3 where E = S, Se, Te, and Po. Both types of oxides are acidic in nature.

B. TeO_2 is an oxidising agent while SO_2 is reducing in nature.

C. The reducing property decreases from H_2S to H_2Te down the group.

D. The ozone molecule contains five lone pairs of electrons.

Choose the correct answer from the options given below:

1. A and D only

2. B and C only

3. C and D only

4. A and B only

Question 73. Identify the name reaction.
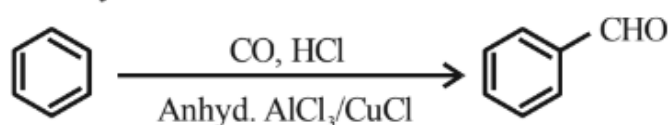
(1) Stephen reaction

(2) Etard reaction

(3) Gatterman-Koch reaction

(4) Rosenmund reduction

Question 74. Which of the following is least ionic?

(1) $BaCl_2$

(2) $AgCl$

(3) KCl

(4) $CoCl_2$

Question 75. The fragrance of flowers is due to the presence of some steam volatile organic compounds called essential oils. These are generally insoluble in water at room temperature but are miscible with water vapour in the vapour phase. A suitable method for the extraction of these oils from the flowers is:

1. Crystallisation

2. Distillation under reduced pressure

3. Distillation

4. Steam distillation

Question 76. Given below are two statements:

Statement I: Group 13 trivalent halides get easily hydrolyzed by water due to their covalent nature.

Statement II: $AlCl_3$, upon hydrolysis in acidified aqueous solution, forms octahedral $[Al(H_2O)_6]^{3+}$ ion.

In the light of the above statements, choose the **correct answer** from the options given below:

1. Statement I is true but statement II is false

2. Statement I is false but statement II is true

3. Both statement I and statement II are false

4. Both statement I and statement II are true

Question 77. The four quantum numbers for the electron in the outermost orbital of potassium (atomic no. 19) are

(1) $n = 4, l = 2, m = -1, s = +\frac{1}{2}$

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

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

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

Question 78. Choose the correct statements from the following:

A. Mn_2O_7 is an oil at room temperature

B. V_2O_4 reacts with acid to give VO_2^{2+}

C. CrO is a basic oxide

D. V_2O_5 does not react with acid

Choose the correct answer from the options given below:

1. A, B and D only

2. A and C only

3. A, B and C only

4. B and C only

Question 79. The correct order of reactivity in electrophilic substitution reaction of the following compounds is:
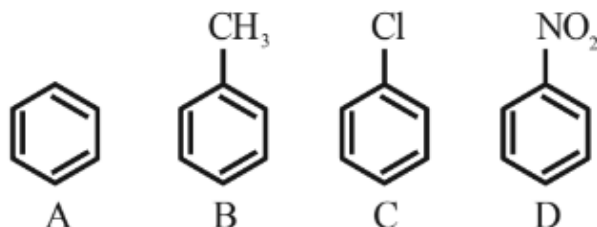
A   B   C   D

1. B > C > A > D

2. D > C > B > A

3. A > B > C > D

4. B > A > C > D

Question 80. Consider the following elements.

Which of the following is/are true about A', B', C', and D'?

A. Order of atomic radii: $B' < A' < D' < C'$

B. Order of metallic character: $B' < A' < D' < C'$

C. Size of the element: $D' < C' < B' < A'$

D. Order of ionic radii: $B^+ < A^{++} < D^{++} < C^{++}$

Choose the correct answer from the options given below:

1. A only

2. A, B and D only

3. A and B only

4. B, C and D only

Question 81. A diatomic molecule has a dipole moment of 1.2 D. If the bond distance is $1\,\text{Å}$, then the fractional charge on each atom is ____ $\times 10^{-1}$ esu.

Question 82. $r = k[A]$ for a reaction, 50% of A is decomposed in 120 minutes. The time taken for 90% decomposition of A is ____ minutes.

Question 83. A compound (x) with molar mass $108\,\text{g mol}^{-1}$ undergoes acetylation to give a product with molar mass $192\,\text{g mol}^{-1}$. The number of amino groups in the compound (x) is ____.

Question 84. Number of isomeric products formed by monochlorination of 2-methylbutane in presence of sunlight is ____.

Question 85. Number of moles of H^+ ions required by 1 mole of MnO_4^- to oxidize oxalate ion to CO_2 is ____.

Question 86. In the reaction of potassium dichromate, potassium chloride, and sulfuric acid (conc.), the oxidation state of the chromium in the product is $(+)$ ____.

Question 87. The molarity of 1 L orthophosphoric acid H_3PO_4 having **70%** purity by weight (specific gravity $1.54\,\text{g/cm}^3$) is ____ **M.**

Question 88. The values of conductivity of some materials at 298.15 K in S m^{-1} are **2.1 $\times$ 10^3, 1.0 $\times$ 10^{-16}, 1.2 $\times$ 10, 3.91, 1.5 $\times$ 10^{-2}, 1 $\times$ 10^{-7}, 1.0 $\times$ 10^3.** The number of conductors among the materials is ____.

Question 89. From the vitamins A, B_1, B_6, B_{12}, C, D, E, and K, the number of vitamins that can be stored in our body is ____.

Question 90. If 5 moles of an ideal gas expands from 10 L to a volume of 100 L at 300 K under isothermal and reversible conditions, then work, w, is $-x$ J. The value of x is ____.