JEE Main 2024 6 April Shift 2 Solutions

1. Let ABC **be an equilateral triangle. A new triangle is formed by joining the midpoints of all sides of the triangle** ABC**, and the same process is repeated infinitely many times. If** P **is the sum of the perimeters and** Q **is the sum of areas of all the triangles formed in this process, then:**

(1) $\mathbf{P}^2 = 36\sqrt{3}Q$

(2) $P^2 = 6\sqrt{3}Q$

(3) $P = 36\sqrt{3}Q^2$

(4) $P^2 = 72\sqrt{3}Q$

2. Let $A = \{1, 2, 3, 4, 5\}$**. Let** R **be a relation on** A **defined by** xRy **if and only if** $4x \leq 5y$**. Let** n **be the number of elements in** R **and** m **be the minimum number of elements from** $A \times A$ **that are required to be added to** R **to make it a symmetric relation. Then** $m + n$ **is equal to:**

(1) 24

(2) 23

(3) 25

(4) 26

3. If three letters can be posted to any one of the 5 different addresses, then the probability that the three letters are posted to exactly two addresses is:

(1) $\frac{12}{25}$

(2) $\frac{18}{25}$

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

(4) $\frac{6}{25}$

4. Suppose the solution of the differential equation

$$\frac{dy}{dx} = \frac{(2 + \alpha)x - \beta y + 2}{\beta x - 2\alpha y - (\beta y - 4\alpha)}$$

represents a circle passing through origin. Then the radius of this circle is:

(1) $\sqrt{17}$

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

(3) $\frac{\sqrt{17}}{2}$

(4) 2

5. If the locus of the point, whose distances from the point (2, 1) and (1, 3) are in the ratio 5 : 4, is

$$ax^2 + by^2 + cxy + dx + ey + 170 = 0,$$

then the value of $a^2 + 2b + 3c + 4d + e$ is equal to:

(1) 5

(2) 27

(3) 37

(4) 437

6.

$$\lim_{n \to \infty} \frac{(1^2 - 1)(n - 1) + (2^2 - 2)(n - 2) + \cdots + ((n-1)^2 - (n-1))}{(1^3 + 2^3 + \cdots + n^3) - (1^2 + 2^2 + \cdots + n^2)}$$

is equal to:

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

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

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

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

7. Let $0 \leq r \leq n$. If $^{n+1}C_{r+1} : {}^nC_r : {}^{n-1}C_{r-1} = 55 : 35 : 21$, then $2n + 5r$ is equal to:

(1) 60

(2) 62

(3) 50

(4) 55

8. A software company sets up m number of computer systems to finish an assignment in 17 days. If 4 computer systems crashed on the start of the second day, 4 more computer systems crashed on the start of the third day, and so on, then it took 8 more days to finish

the assignment. The value of m is equal to:

(1) 125

(2) 150

(3) 180

(4) 160

9. If z_1, z_2 are two distinct complex numbers such that

$$\left| \frac{z_1 - 2z_2}{\frac{1}{2} - 2z_1 \overline{z_2}} \right| = 2,$$

then

(1) either z_1 lies on a circle of radius 1 or z_2 lies on a circle of radius $\frac{1}{2}$

(2) either z_1 lies on a circle of radius $\frac{1}{2}$ or z_2 lies on a circle of radius 1

(3) z_1 lies on a circle of radius $\frac{1}{2}$ and z_2 lies on a circle of radius 1

(4) both z_1 and z_2 lie on the same circle

10. If the function $f(x) = \left(\frac{1}{x}\right)^{2x}$; $x > 0$ attains the maximum value at $x = \frac{1}{e}$, then:

(1) $e^{\pi} < \pi^{e}$

(2) $e^{2\pi} < (2\pi)^{e}$

(3) $e^{\pi} > \pi^{e}$

(4) $(2e)^{\pi} > \pi^{2e}$

11. Let $\vec{a} = 6\hat{i} + \hat{j} - \hat{k}$ and $\vec{b} = \hat{i} + \hat{j}$. If $\vec{c}$ is a vector such that $|\vec{c}| \geq 6$, $\vec{a} \cdot \vec{c} = 6|\vec{c}|$, $|\vec{c} - \vec{a}| = 2\sqrt{2}$, and the angle between $\vec{a} \times \vec{b}$ and $\vec{c}$ is $60°$, then $|(\vec{a} \times \vec{b}) \times \vec{c}|$ is equal to:

(1) $\frac{9}{2}(6 - \sqrt{6})$

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

(3) $\frac{3}{2}\sqrt{6}$

(4) $\frac{9}{2}(6 + \sqrt{6})$

12. If all the words with or without meaning made using all the letters of the word "NAGPUR" are arranged as in a dictionary, then the word at the 315th position in this arrangement is:

(1) NRAGUP

(2) NRAGPU

(3) NRAPGU

(4) NRAPUG

13. Suppose for a differentiable function h**,** $h(0) = 0$**,** $h(1) = 1$**, and** $h'(0) = h'(1) = 2$**. If** $g(x) = h(e^x)e^{h(x)}$**, then** $g'(0)$ **is equal to:**

(1) 5

(2) 3

(3) 8

(4) 4

14. Let $P(\alpha, \beta, \gamma)$ **be the image of the point** $Q(3, -3, 1)$ **in the line**

$$\frac{x - 0}{1} = \frac{y - 3}{1} = \frac{z - 1}{-1}$$

and let R **be the point** $(2, 5, -1)$**. If the area of the triangle** PQR **is** λ **and** $\lambda^2 = 14K$**, then** K **is equal to:**

(1) 36

(2) 72

(3) 18

(4) 81

15. If $P(6, 1)$ **be the orthocentre of the triangle whose vertices are** $A(5, -2)$**,** $B(8, 3)$**, and** $C(h, k)$**, then the point** C **lies on the circle:**

(1) $x^2 + y^2 - 65 = 0$

(2) $x^2 + y^2 - 74 = 0$

(3) $x^2 + y^2 - 61 = 0$

(4) $x^2 + y^2 - 52 = 0$

16. Let $f(x) = \frac{1}{7 - \sin 5x}$ **be a function defined on** $\mathbb{R}$**. Then the range of the function** $f(x)$ **is equal to:**

(1) $\left[\frac{1}{8}, \frac{1}{5}\right]$

(2) $\left[\frac{1}{7}, \frac{1}{6}\right]$

(3) $\left[\frac{1}{7}, \frac{1}{5}\right]$

(4) $\left[\frac{1}{8}, \frac{1}{6}\right]$

17. Let $\vec{a} = 2\hat{i} + \hat{j} - \hat{k}$, $\vec{b} = ((\vec{a} \times (\hat{i} + \hat{j})) \times \hat{i}) \times \hat{i}$. **Then the square of the projection of** $\vec{a}$ **on** $\vec{b}$ **is:**

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

(2) 2

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

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

18. If the area of the region

$$\left\{ (x, y) : \frac{a}{x^2} \le y \le \frac{1}{x}, \ 1 \le x \le 2, \ 0 < a < 1 \right\}$$

is

$$(\log_2 2) - \frac{1}{7}$$

then the value of $7a - 3$ **is equal to:**

(1) 2

(2) 0

(3) -1

(4) 1

19. If

$$\textbf{If } \int \frac{1}{a^2 \sin^2 x + b^2 \cos^2 x} \, dx = \frac{1}{12} \tan^{-1}(3 \tan x) + \textbf{ constant,}$$

then the maximum value of $a \sin x + b \cos x$ **is:**

(1) $\sqrt{40}$

(2) $\sqrt{39}$

(3) $\sqrt{42}$

(4) $\sqrt{41}$

20. If A is a square matrix of order 3 such that

$\det(A) = 3 \, and$

$\det(\mathbf{adj}(-4\,\mathbf{adj}(-3\,\mathbf{adj}(3\,\mathbf{adj}((2A)^{-1}))))) = 2^m 3^n,$

then **m + $|2n|$ is equal to:**

(1) 3

(2) 2

(3) 4

(4) 6

21. Let $\lfloor t \rfloor$ denote the greatest integer less than or equal to t. Let $f : [0, \infty) \to \mathbb{R}$ be a function defined by

$$f(x) = \left\lfloor \frac{x}{2} + 3 \right\rfloor - \lfloor \sqrt{x} \rfloor .$$

Let S be the set of all points in the interval $[0, 8]$ at which f is not continuous. Then $\sum_{a \in S} a$ is equal to _____.

22. The length of the latus rectum and directrices of a hyperbola with eccentricity e are 9 and

$$x = \pm \frac{4}{\sqrt{3}},$$

respectively. Let the line

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

touch this hyperbola at (x_0, y_0). If m is the product of the focal distances of the point (x_0, y_0), then $4e^2 + m$ is equal to _____.

23. If $S(x) = (1+x)+2(1+x)^2+3(1+x)^3+\ldots+60(1+x)^{60}$, $x \neq 0$, and $(60)^2 S(60) = a(b)^b + b$, where $a, b \in \mathbb{N}$, then $(a + b)$ is equal to _____.

24. Let $\lfloor t \rfloor$ denote the largest integer less than or equal to t. If

$$\int_0^3 \left(\lfloor x^2 \rfloor + \left\lfloor \frac{x^2}{2} \right\rfloor \right) dx = a + b\sqrt{2} - \sqrt{3} - \sqrt{5} + c\sqrt{6} - \sqrt{7},$$

where $a, b, c \in \mathbb{Z}$, **then** $a + b + c$ **is equal to** _____.

25. From a lot of 12 items containing 3 defectives, a sample of 5 items is drawn at random. Let the random variable X **denote the number of defective items in the sample. Let items in the sample be drawn one by one without replacement. If the variance of** X **is** $\frac{m}{n}$**, where** $\gcd(m, n) = 1$**, then** $n - m$ **is equal to** _____.

26. In a triangle ABC**,** $BC = 7$**,** $AC = 8$**,** $AB = \alpha \in \mathbb{N}$**, and** $\cos A = \frac{2}{3}$**. If** $49 \cos(3C) + 42 = \frac{m}{n}$**, where** $\gcd(m, n) = 1$**, then** $m + n$ **is equal to** _____.

27. If the shortest distance between the lines

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

and

$$\frac{x + 2}{-3} = \frac{y + 5}{2} = \frac{z - 4}{4}$$

is

$$\frac{44}{\sqrt{30}},$$

then the largest possible value of $|\lambda|$ **is equal to** _____.

28. Let α, β **be roots of** $x^2 + \sqrt{2}x - 8 = 0$**. If** $U_n = \alpha^n + \beta^n$**, then**

$$\frac{U_{10} + \sqrt{12}U_9}{2U_8}$$

is equal to _____.

29. If the system of equations

$$2x + 7y + \lambda z = 3$$

$$3x + 2y + 5z = 4$$

$$x + \mu y + 32z = -1$$

has infinitely many solutions, then $(\lambda - \mu)$ **is equal to** _____.

30. If the solution $y(x)$ of the given differential equation

$$(e^y + 1)\cos x\, dx + e^y \sin x\, dy = 0$$

passes through the point $\left(\frac{\pi}{2}, 0\right)$, then the value of $e^{y\left(\frac{\pi}{6}\right)}$ is equal to _____.

31. The longest wavelength associated with Paschen series is: (Given $R_H = 1.097 \times 10^7$ SI unit)

(1) 1.094×10^{-6} m

(2) 2.973×10^{-6} m

(3) 3.646×10^{-6} m

(4) 1.876×10^{-6} m

32. A total of 48 J heat is given to one mole of helium kept in a cylinder. The temperature of helium increases by $2°$C. The work done by the gas is: (Given, $R = 8.3$ J K^{-1}mol^{-1})

(1) 72.9 J

(2) 24.9 J

(3) 48 J

(4) 23.1 J

33. In finding out the refractive index of a glass slab, the following observations were made through a travelling microscope: 50 vernier scale division = 49 MSD; 20 divisions on the main scale in each cm.

For mark on paper:

   MSR = 8.45 cm, VC = 26

For mark on paper seen through slab:

   MSR = 7.12 cm, VC = 41

For powder particle on the top surface of the glass slab:

   MSR = 4.05 cm, VC = 1

(MSR = Main Scale Reading, VC = Vernier Coincidence)

The refractive index of the glass slab is:

(1) 1.42

(2) 1.52

(3) 1.24

(4) 1.35

34. In the given electromagnetic wave

$$E_y = 600 \sin(\omega t - kx)\,\mathbf{Vm}^{-1},$$

the intensity of the associated light beam is (in W/m²); (Given $\varepsilon_0 = 9 \times 10^{-12}\,\mathbf{C^2 N^{-1} m^{-2}}$)

(1) 486

(2) 243

(3) 729

(4) 972

35. Assuming the earth to be a sphere of uniform mass density, a body weighed 300 N on the surface of the earth. How much would it weigh at $R/4$ depth under the surface of the earth?

(1) 75 N

(2) 375 N

(3) 300 N

(4) 225 N

36. The acceptor level of a p-type semiconductor is 6 eV. The maximum wavelength of light which can create a hole would be: (Given $hc = 1240\,\mathbf{eV\,nm}$)

(1) 407 nm

(2) 414 nm

(3) 207 nm

(4) 103.5 nm

37. A car of 800 kg is taking a turn on a banked road of radius 300 m and angle of banking $30°$. If the coefficient of static friction is 0.2, then the maximum speed with which the car can negotiate the turn safely is: ($g = 10\,\mathbf{m/s^2}$, $\sqrt{3} = 1.73$)

(1) 70.4 m/s

(2) 51.4 m/s

(3) 264 m/s

(4) 102.8 m/s

38. Two identical conducting spheres P and S with charge Q on each, repel each other with a force of 16 N. A third identical uncharged conducting sphere R is successively brought in contact with the two spheres. The new force of repulsion between P and S is:

(1) 4 N

(2) 6 N

(3) 1 N

(4) 12 N

39. In a coil, the current changes from $-2\,\text{A}$ to $+2\,\text{A}$ in $0.2\,\text{s}$ and induces an emf of $0.1\,\text{V}$. The self-inductance of the coil is:

(1) 5 mH

(2) 1 mH

(3) 2.5 mH

(4) 4 mH

40. For the thin convex lens, the radii of curvature are at 15 cm and 30 cm respectively. The focal length of the lens is 20 cm. The refractive index of the material is:

(1) 1.2

(2) 1.4

(3) 1.5

(4) 1.8

41. Energy of 10 non-rigid diatomic molecules at temperature T is:

(1) $\frac{7}{2}RT$

(2) $70\,k_BT$

(3) $35\,RT$

(4) $35\,k_BT$

42. A body of weight 200 N is suspended from a tree branch through a chain of mass 10 kg. The branch pulls the chain by a force equal to (if $g = 10\,\text{m/s}^2$):

(1) 150 N

(2) 300 N

(3) 200 N

(4) 100 N

43. When UV light of wavelength 300 nm is incident on the metal surface having work function 2.13 eV, electron emission takes place. The stopping potential is: (Given $hc = 1240\,\text{eV nm}$)

(1) 4 V

(2) 4.1 V

(3) 2 V

(4) 1.5 V

44. The number of electrons flowing per second in the filament of a 110 W bulb operating at 220 V is: (Given $e = 1.6 \times 10^{-19}\,\text{C}$)

(1) 31.25×10^{17}

(2) 6.25×10^{18}

(3) 6.25×10^{17}

(4) 1.25×10^{19}
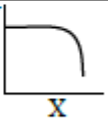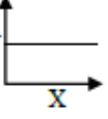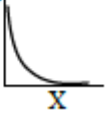
45. When the kinetic energy of a body becomes 36 times its original value, the percentage increase in the momentum of the body will be:

(1) 500%

(2) 600%

(3) 6%

(4) 60%

46. Pressure inside a soap bubble is greater than the pressure outside by an amount: (Given: R = Radius of bubble, S = Surface tension of bubble)

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

(2) $\frac{4R}{S}$

(3) $\frac{S}{R}$

(4) $\frac{2S}{R}$

47. Match List-I with List-II

	List-I (Y vs X)		List-II (Shape of Graph)
(A)	Y = magnetic susceptibility X = magnetising field	(I)	
(B)	Y = magnetic field X = distance from centre of a current carrying wire for x < a (where a=radius of wire)	(II)	
(C)	Y = magnetic field X = distance from centre of a current carrying wire for x > a (where a = radius of wire)	(III)	
(D)	Y= magnetic field inside solenoid X = distance from center	(IV)	

Choose the correct answer from the options given below:

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

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

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

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

48. In a vernier caliper, when both jaws touch each other, zero of the vernier scale shifts towards the left, and its 4th division coincides exactly with a certain division on the main scale. If 50 vernier scale divisions equal 49 main scale divisions and zero error in the

instrument is 0.04 mm, then how many main scale divisions are there in 1 cm?

(1) 40

(2) 5

(3) 20

(4) 10

49. Given below are two statements:

Statement (I): Dimensions of specific heat is $[L^2 T^{-2} K^{-1}]$

Statement (II): Dimensions of gas constant is $[M L^2 T^{-2} K^{-1}]$

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

(2) Both statement (I) and statement (II) are incorrect

(3) Statement (I) is correct but statement (II) is incorrect

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

50. A body projected vertically upwards with a certain speed from the top of a tower reaches the ground in t_1. If it is projected vertically downwards from the same point with the same speed, it reaches the ground in t_2. Time required to reach the ground, if it is dropped from the top of the tower, is:

(1) $\sqrt{t_1 t_2}$

(2) $\sqrt{t_1 - t_2}$

(3) $\sqrt{\dfrac{t_1}{t_2}}$

(4) $\sqrt{t_1 + t_2}$

51. In the Franck-Hertz experiment, the first dip in the current-voltage graph for hydrogen is observed at $10.2\,\text{V}$. The wavelength of light emitted by the hydrogen atom when excited to the first excitation level is ____ nm.

(Given $hc = 1245\,\text{eV nm}$, $e = 1.6 \times 10^{-19}\,\text{C}$)

52. For a given series LCR circuit, it is found that maximum current is drawn when

the value of variable capacitance is $2.5\,\text{nF}$. **If resistance of $200\,\Omega$ and $100\,\text{mH}$ inductor is being used in the given circuit, the frequency of the AC source is ____ $\times 10^3\,\text{Hz}$. (Given $\pi^2 = 10$)**

53.A particle moves in a straight line so that its displacement x at any time t is given by:

$$x^2 = 1 + t^2.$$

Its acceleration at any time t is x^{-n}, where $n = $ ____.

54. Three balls of masses 2 kg, 4 kg, and 6 kg respectively are arranged at the center of the edges of an equilateral triangle of side 2 m. The moment of inertia of the system about an axis through the centroid and perpendicular to the plane of the triangle will be ____ kg m^2.

55. A coil having 100 turns, area of $5 \times 10^{-3}\,\text{m}^2$, carrying a current of 1 mA is placed in a uniform magnetic field of 0.20 T such that the plane of the coil is perpendicular to the magnetic field. The work done in turning the coil through 90° is ____ µJ.

56. In the given figure, an ammeter A consists of a $240\,\Omega$ coil connected in parallel to a $10\,\Omega$ shunt. The reading of the ammeter is ____ mA.
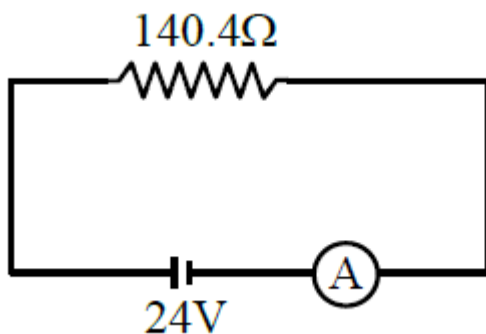
57. A wire of cross-sectional area A, modulus of elasticity $2 \times 10^{11}\,\text{Nm}^{-2}$, and length 2 m is stretched between two vertical rigid supports. When a mass of 2 kg is suspended at the middle, it sags lower from its original position making an angle $\theta = \frac{1}{100}$ radian on the points of support. The value of A is ____ $\times 10^{-4}\,\text{m}^2$.
**(Given: $g = 10\,\text{m/s}^2$)**
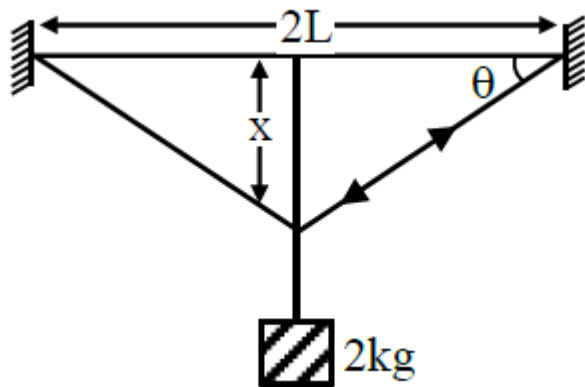
58. Two coherent monochromatic light beams of intensities I and $4I$ are superimposed. The difference between maximum and minimum possible intensities in the resulting beam is x. The value of x is ____.

59. Two open organ pipes of length 60 cm and 90 cm resonate at 6th and 5th harmonics respectively. The difference of frequencies for the given modes is ____ Hz.
(Velocity of sound in air $v = 333\,\text{m/s}$)

60. A capacitor of 10 μF capacitance whose plates are separated by 10 mm through air and each plate has an area $4\,\text{cm}^2$ is now filled with two dielectric media of $K_1 = 2, K_2 = 3$ respectively as shown in the figure. If new force between the plates is 8 N, the supply voltage is ____ V.
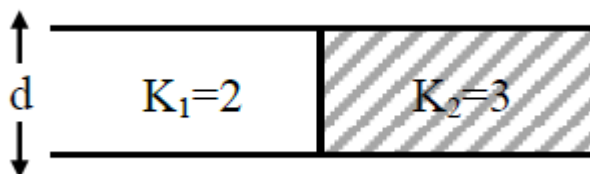
61. The correct arrangement for decreasing order of electrophilic substitution for the above compounds is ____.

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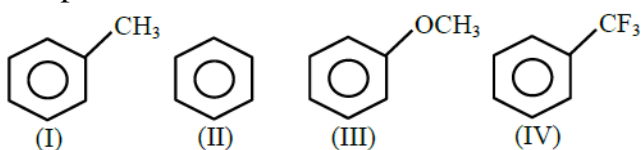
(1) $(IV) > (I) > (II) > (III)$

(2) $(III) > (I) > (II) > (IV)$

(3) $(II) > (IV) > (III) > (I)$

(4) $(III) > (IV) > (II) > (I)$

62. Molality (m) of 3 M aqueous solution of NaCl is:

(Given: Density of solution = 1.25 g mL^{-1}, Molar mass in g mol^{-1}: Na = 23, Cl = 35.5)

(1) 2.90 m

(2) 2.79 m

(3) 1.90 m

(4) 3.85 m

63. The incorrect statements regarding enzymes are:

(A) Enzymes are biocatalysts.

(B) Enzymes are non-specific and can catalyse different kinds of reactions.

(C) Most Enzymes are globular proteins.

(D) Enzyme - oxidase catalyses the hydrolysis of maltose into glucose.

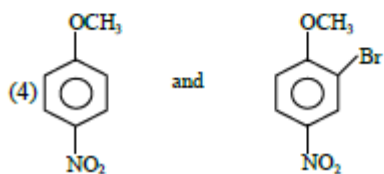**Choose the correct answer from the options given below:**

(1) (B) and (C)

(2) (B), (C) and (D)

(3) (B) and (D)

(4) (A), (D) and (C)

64. Consider the above chemical reaction. Product "A" is:

$$\text{(cyclohexyl-CHCl-CH}_2\text{-CH}_3) + \text{NaOH} \xrightarrow{\text{H}_2\text{O}} \text{Major Product "A"}$$

Consider the above chemical reaction. Product "A" is:

(1)   (2)

(3)   (4)
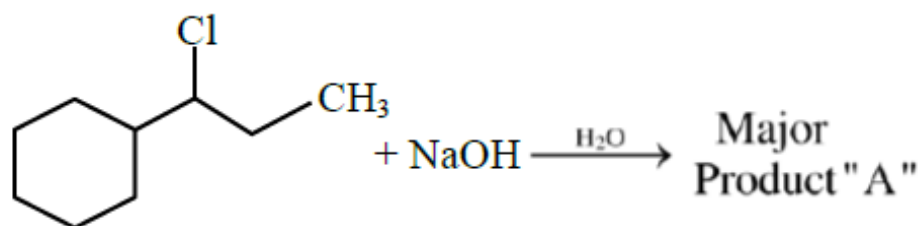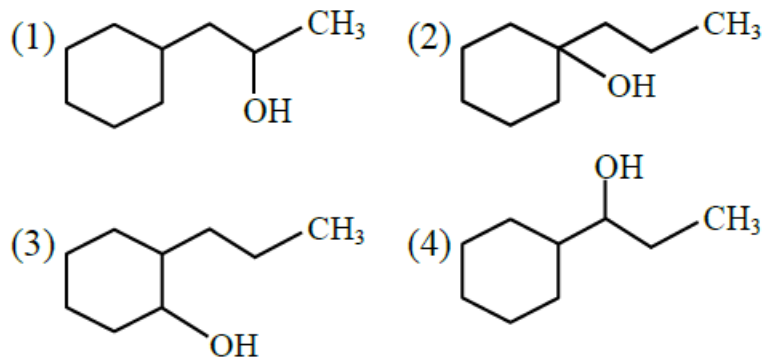
65. During the detection of acidic radical present in a salt, a student gets a pale yellow precipitate soluble with difficulty in NH$_4$OH solution when sodium carbonate extract was first acidified with dilute HNO$_3$ and then AgNO$_3$ solution was added. This indicates the presence of:

(1) Br$^-$

(2) CO$_3^{2-}$

(3) I$^-$

(4) Cl$^-$

66. How can an electrochemical cell be converted into an electrolytic cell?

(1) Applying an external opposite potential greater than E^0_{cell}

(2) Reversing the flow of ions in the salt bridge.

(3) Applying an external opposite potential lower than E^0_{cell}.

(4) Exchanging the electrodes at anode and cathode.

67. Arrange the following elements in the increasing order of number of unpaired electrons in it.

(A) Sc

(B) Cr

(C) V

(D) Ti

(E) Mn

17

Choose the correct answer from the options given below:

(1) $(C) < (E) < (B) < (A) < (D)$

(2) $(B) < (C) < (D) < (E) < (A)$

(3) $(A) < (D) < (C) < (B) < (E)$

(4) $(A) < (D) < (C) < (E) < (B)$

68. Match List-I with List-II.

List-I	List-II
Alkali Metal	Emission Wavelength in nm
(A) Li	(I) 589.2
(B) Na	(II) 455.5
(C) Rb	(III) 670.8
(D) Cs	(IV) 780.0

Choose the correct answer from the options given below:

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

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

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

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

69. The major products formed:

$$\text{(OCH}_3\text{ substituted benzene)} \xrightarrow{HNO_3, H_2SO_4} 'A' \xrightarrow[Fe]{Br_2 (excess)} 'B'$$

A and B respectively are:

(1) 2-methoxy-nitrobenzene and 2-bromo-4-bromo-6-nitro-methoxybenzene structures

(2) 4-methoxy-nitrobenzene and 2,6-dibromo-4-nitro-methoxybenzene structures

(3) 2-methoxy-nitrobenzene and 4-bromo-2-nitro-methoxybenzene structures

(4) 4-methoxy-nitrobenzene and 2-bromo-4-nitro-methoxybenzene structures
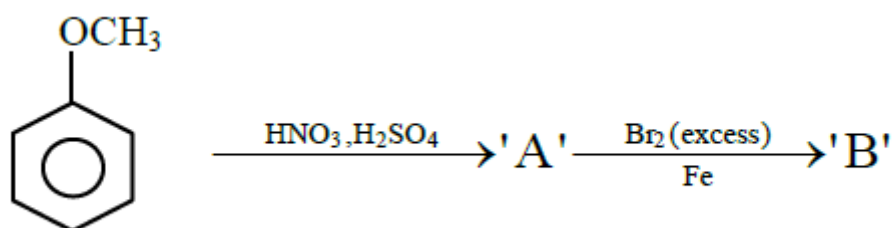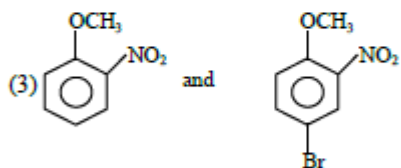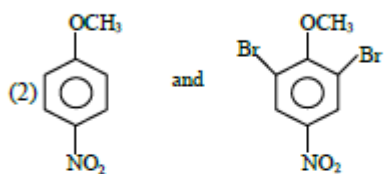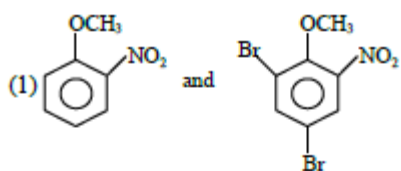
70. The incorrect statement regarding the geometrical isomers of 2-butene is:

(1) cis-2-butene and trans-2-butene are not interconvertible at room temperature.

(2) cis-2-butene has less dipole moment than trans-2-butene.

(3) trans-2-butene is more stable than cis-2-butene.

(4) cis-2-butene and trans-2-butene are stereoisomers.

71. Given below are two statements:

Statement I: PF_5 and BrF_5 both exhibit sp^3d hybridisation.

Statement II: Both SF_6 and $[Co(NH_3)_6]^{3+}$ exhibit sp^3d^2 hybridisation.

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) Both Statement I and Statement II are true
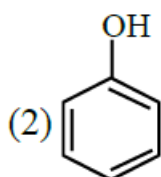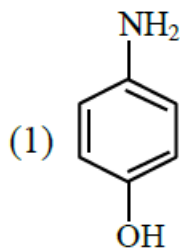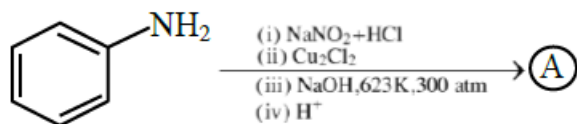
(3) Both Statement I and Statement II are false

(4) Statement I is false but Statement II is true

72. The number of ions from the following that are expected to behave as oxidising agents is:

Sn^{4+}, Sn^{2+}, Pb^{2+}, Tl^{3+}, Pb^{4+}, Tl^{+}

(1) 3

(2) 4

(3) 1

(4) 2

73. Identify the product A in the following reaction.

(1)

(2)

(3)

(4)
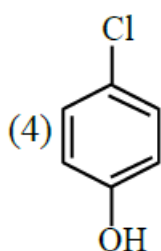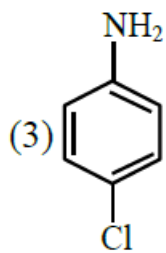
74. The correct statements among the following, for a "chromatography" purification method is:

(1) Organic compounds run faster than solvent in the thin layer chromatographic plate.

(2) Non-polar compounds are retained at top and polar compounds come down in column chromatography.

(3) R_f of a polar compound is smaller than that of a non-polar compound.

(4) R_f is an integral value.

75. Evaluate the following statements related to group 14 elements for their correctness.

(A) Covalent radius decreases down the group from C to Pb in a regular manner.

(B) Electronegativity decreases from C to Pb down the group gradually.

(C) Maximum covalence of C is 4 whereas other elements can expand their covalence due to presence of d orbitals.

(D) Heavier elements do not form π-π bonds.

(E) Carbon can exhibit negative oxidation states.

   Choose the correct answer from the options given below:

(1) (C), (D) and (E) Only

(2) (A) and (B) Only
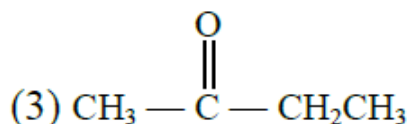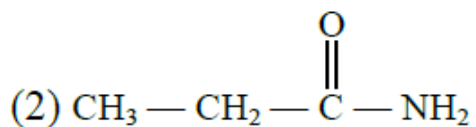
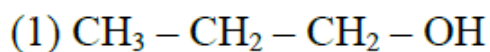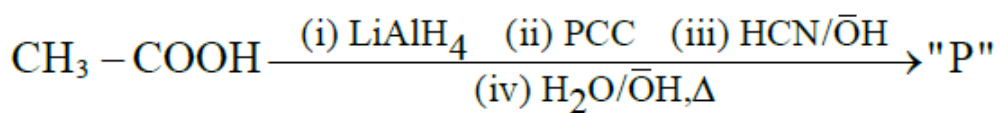(3) (A), (B) and (C) Only

(4) (C) and (D) Only

76. Match List-I with the List-II

List-I (Reaction)	List-II (Type of redox reaction)
(A) $N_2(g) + O_2(g) \rightarrow 2NO(g)$	(I) Decomposition
(B) $2Pb(NO_3)_{2(s)} \rightarrow 2PbO_{(s)} + 4NO_{2(g)} + O_{2(g)}$	(II) Displacement
(C) $2Na(s) + 2H_2O \rightarrow 2NaOH_{(aq)} + H_2(g)$	(III) Disproportionation
(D) $2NO_2(g) + 2^-OH_{(aq)} \rightarrow NO_{2(aq)}^- + NO_{3(aq)}^- + H_2O_{(l)}$	(IV) Combination

   Choose the correct answer from the options given below:

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

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

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

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

77. Consider the given reaction, identify the major product P.

$CH_3 - COOH \xrightarrow[\text{(iv) } H_2O/\bar{O}H, \Delta]{\text{(i) LiAlH}_4 \quad \text{(ii) PCC} \quad \text{(iii) HCN}/\bar{O}H}$ "P"

(1) $CH_3 - CH_2 - CH_2 - OH$

(2) $CH_3 - CH_2 - \overset{\overset{\displaystyle O}{\|}}{C} - NH_2$

(3) $CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - CH_2CH_3$

(4) $CH_3 - \overset{\overset{\displaystyle OH}{|}}{CH} - COOH$
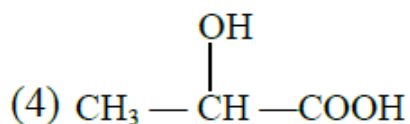
78. The correct IUPAC name of $[PtBr_2(PMe_3)_2]$ is:

1. bis(trimethylphosphine)dibromoplatinum(II)

2. bis[bromo(trimethylphosphine)]platinum(II)

3. dibromobis(trimethylphosphine)platinum(II)

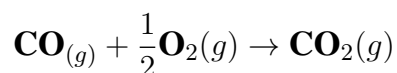4. dibromodi(trimethylphosphine)platinum(II)

79. Match List-I with List-II

List-I	List-II
Tetrahedral Complex	Electronic configuration
(A) $TiCl_4$	(I) e^2, t_2^1
(B) $[FeO_4]^{2-}$	(II) e^4, t_2^2
(C) $[FeCl_4]^-$	(III) e^0, t_2^0
(D) $[CoCl_4]^{2-}$	(IV) e^2, t_2^2

80. The ratio $\frac{K_P}{K_C}$ for the reaction:

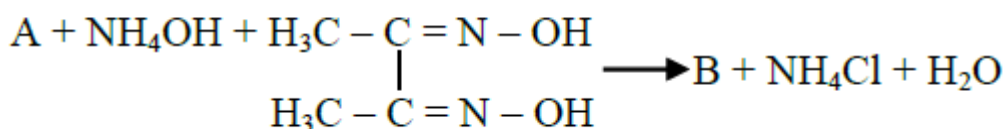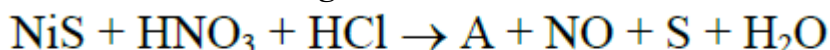$$CO_{(g)} + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$$

is:

1. $(RT)^{1/2}$

2. RT

3. 1

4. $\frac{1}{\sqrt{RT}}$

81. An amine (X) is prepared by ammonolysis of benzyl chloride. On adding p-toluenesulphonyl chloride to it, the solution remains clear. Molar mass of the amine (X) formed is _____ g mol^{-1}.
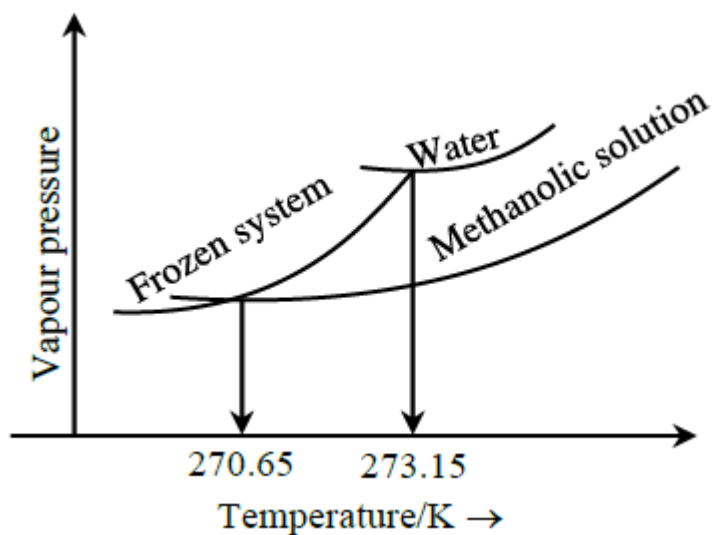
(Given molar mass in g mol^{-1} C: 12, H: 1, O: 16, N: 14)

82. Consider the following reactions

$$NiS + HNO_3 + HCl \rightarrow A + NO + S + H_2O$$

$$A + NH_4OH + \underset{H_3C-C=N-OH}{\overset{H_3C-C=N-OH}{\mid}} \longrightarrow B + NH_4Cl + H_2O$$

The number of protons that do not involve in hydrogen bonding in the product B is_____.
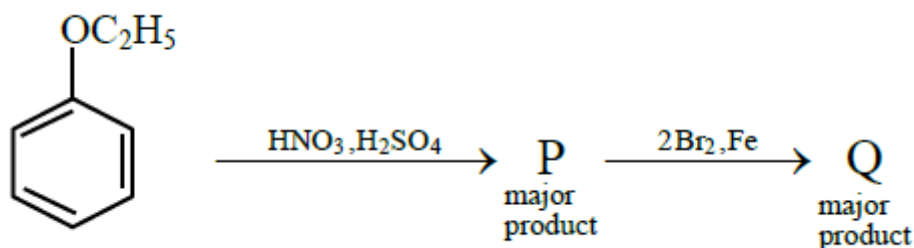
83. When $x \times 10^{-2}$ mL methanol (molar mass = 32 g; density = 0.792 g/cm³) is added to 100 mL water (density = 1 g/cm³), the following diagram is obtained.

x=_____ = (nearest integer)

[Given: Molal freezing point depression constant of water at 273.15 K is 1.86 K kg mol¹.]

84. The compound with OC_2H_5 group undergoes the following reaction sequence:


The ratio of the number of oxygen atoms to bromine atoms in the product Q is ____$\times 10^{-1}$.

85. Number of carbocation from the following that are not stabilized by hyperconjugation is......... .

(tert.-Butyl) (tert.-Butyl)'

$\overset{+}{C}H_3$

$\overset{+}{C}H_2 - OCH_3$,

$N - \overset{+}{C}H_2$
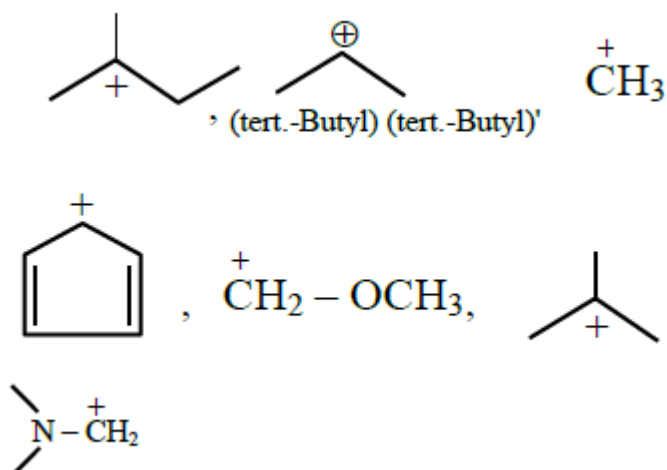
86. For the reaction at 298 K, $2A+B \rightarrow C$. $\Delta H = 400\,\text{kJ mol}^{-1}$ and $\Delta S = 0.2\,\text{kJ mol}^{-1}\,\text{K}^{-1}$. The reaction will become spontaneous above _____ K.

87. Total number of species from the following with central atom utilising sp^2 hybrid orbitals for bonding is ...

NH_3, SO_2, SiO_2, $BeCl_2$, C_2H_2, C_2H_4, BCl_3, $HCHO$, C_6H_6, BF_3, $C_2H_4Cl_2$
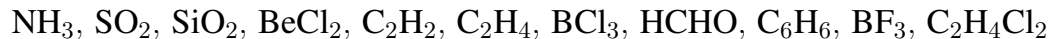
88. Consider the two different first order reactions given below:

A + B $\rightarrow$ C (Reaction 1)

P $\rightarrow$ Q (Reaction 2)

The ratio of the half-life of Reaction 1 : Reaction 2 is **5 : 2**. If t_1 and t_2 represent the time taken to complete $\frac{2}{3}$ and $\frac{4}{5}$ of Reaction 1 and Reaction 2, respectively, then the value of the ratio $t_1 : t_2$ is ___ $\times 10^{-1}$ (nearest integer).

[Given: $\log_{10}(3) = 0.477$ and $\log_{10}(5) = 0.699$]

89. For hydrogen atom, energy of an electron in first excited state is - 3.4 eV, K.E. of the same electron of hydrogen atom is x eV. Value of x is ____ $\times 10^{-1}$ eV. (Nearest integer)

90. Among VO_2^+, MnO_4^- and $Cr_2O_7^{2-}$, the spin-only magnetic moment value of the species

with least oxidising ability is ____ BM (Nearest integer).

[Given atomic number V = 23, Mn = 25, Cr = 24]