JEE Main 2023 Jan 25 Shift 2 Question Paper

Time Allowed :3 Hours	**Maximum Marks :**300	**Total Questions :**90

MATHEMATICS

Section-A

1. Let the function $f(x) = 2x^3 + (2p - 7)x^2 + 3(2p - 9)x - 6$ **have a maxima for some value of** $x < 0$ **and a minima for some value of** $x > 0$**. Then, the set of all values of** p **is:**

(1) $\left(\frac{9}{2}, \infty\right)$

(2) $\left(0, \frac{9}{2}\right)$

(3) $\left(-\infty, \frac{9}{2}\right)$

(4) $\left(-\frac{9}{2}, \frac{9}{2}\right)$

2. Let z be a complex number such that $\dfrac{|z - 2i|}{|z + i|} = 2$, $z \neq -i$. Then z lies on the circle of radius 2 and centre:

(1) $(2, 0)$

(2) $(0, 0)$

(3) $(0, 2)$

(4) $(0, -2)$

---

3. If the function

$$f(x) = \begin{cases} (1 + |\cos x|)^{\lambda / |\cos x|}, & 0 < x < \dfrac{\pi}{2} \\[2mm] \mu, & x = \dfrac{\pi}{2} \\[2mm] e^{\frac{\cot 6x}{\cot 4x}}, & \dfrac{\pi}{2} < x < \pi \end{cases}$$

is continuous at $x = \dfrac{\pi}{2}$**, then** $9\lambda + 6\log_e \mu + \mu^6 - e^{6\lambda}$ **is equal to:**

(1) 11

(2) 8

(3) $2e^4 + 8$

(4) 10

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4. Let $f(x) = 2x^n + \lambda$**, where** $\lambda \in \mathbb{R}$ **and** $n \in \mathbb{N}$**. Given that** $f(4) = 133$ **and** $f(5) = 255$**, Then the sum of all the positive integer divisors of** $f(3) - f(2)$**?**

(1) 61

(2) 60

(3) 58

(4) 59

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5. If the four points, whose position vectors are $3\hat{i} - 4\hat{j} + 2\hat{k}$**,** $\hat{i} + 2\hat{j} - \hat{k}$**,** $-2\hat{i} - \hat{j} + 3\hat{k}$**, and** $5\hat{i} - 2\alpha\hat{j} + 4\hat{k}$ **are coplanar, then** α **is equal to:**

(1) $\dfrac{73}{17}$

(2) $-\dfrac{107}{17}$

(3) $-\dfrac{73}{17}$

(4) $\dfrac{107}{17}$

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6. Let

$$A = \begin{bmatrix} 1/\sqrt{10} & 3/\sqrt{10} \\ -3/\sqrt{10} & 1/\sqrt{10} \end{bmatrix} /\sqrt{10} \text{ and } B = \begin{bmatrix} 1 & -i \\ 0 & 1 \end{bmatrix}, \text{ where } i = \sqrt{-1}. \text{ If } M = A^T B A,$$

, then the inverse of the matrix $AM^{2023}A^T$ is:

(1) $\begin{bmatrix} 1 & -2023i \\ 0 & 1 \end{bmatrix}$

(2) $\begin{bmatrix} 1 & 0 \\ -2023i & 1 \end{bmatrix}$

(3) $\begin{bmatrix} 1 & 0 \\ 2023i & 1 \end{bmatrix}$

(4) $\begin{bmatrix} 1 & 2023i \\ 0 & 1 \end{bmatrix}$

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7. Let $\triangle$ and $\triangledown \in [\wedge, \vee]$ be such that the expression $(p \to q) \wedge (p \triangledown q)$ is a tautology. Then:

(1) $\triangle = \wedge, \triangledown = \vee$

(2) $\triangle = \vee, \triangledown = \wedge$

(3) $\triangle = \vee, \triangledown = \vee$

(4) $\triangle = \wedge, \triangledown = \wedge$

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8. The number of numbers, strictly between 5000 and 10000, that can be formed using

the digits 1, 3, 5, 7, 9 without repetition, is:

(1) 6

(2) 12

(3) 120

(4) 72

---

9. The number of functions $f : \{1, 2, 3, 4\} \to \{a \in Z : |a| \le 8\}$ satisfying

$f(n) + 1/nf(n+1)$ **=1, for** $\forall n \in \{1, 2, 3\}$ **is:**

(1) 3

(2) 4

(3) 1

(4) 2

---

10. The equations of two sides of a variable triangle are $x = 0$ and $y = 3$, and its third side is a tangent to the parabola $y^2 = 6x$. The locus of its circumcentre is:

(1) $4y^2 - 18y - 3x - 18 = 0$

(2) $4y^2 + 18y + 3x + 18 = 0$

(3) $4y^2 - 18y + 3x + 18 = 0$

(4) $4y^2 - 18y - 3x + 18 = 0$

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11. Let $f : \mathbb{R} \to \mathbb{R}$ be a function defined by $f(x) = \log_{\sqrt{m}} \left(\sqrt{2}(\sin x - \cos x) + m - 2 \right)$, for some m, such that the range of f is [0, 2]. Then the value of m is:

(1) 5

(2) 3

(3) 2

(4) 4

---

12. Let A, B, C be 3×3 matrices such that A is symmetric and B and C are skew-symmetric. Consider the statements:

(S1) $A^{13}B^{26} - B^{26}A^{13}$ is symmetric.

(S2) $A^{26}C^{13} - C^{13}A^{26}$ is symmetric. Then:

(1) Only S2 is true

(2) Only S1 is true

(3) Both S1 and S2 are false

(4) Both S1 and S2 are true

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13. Let y = $y(t)$ be a solution of the differential equation $\frac{dy}{dt} + \alpha y = \gamma e^{-\beta t}$, where

$\alpha, \beta, \gamma > 0$ **. If $\lim_{t \to \infty} y(t)$, then:**

(1) Is 0

(2) does not exist

(3) Is 1

(4) Is -1

---

14. $\sum_{k=0}^{6} {}^{(51-k)}C_3$: is equal to

(1) ${}^{51}C_4 - {}^{45}C_4$

(2) ${}^{51}C_3 - {}^{45}C_3$

(3) ${}^{52}C_4 - {}^{45}C_4$

(4) ${}^{52}C_3 - {}^{45}C_3$

15. The shortest distance between the lines $x + 1 = 2y = -12z$ and $x = y + 2 = 6z - 6$ is:

(1) 2

(2) 3

(3) $\frac{5}{2}$

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

---

16. Let N be the sum of the numbers appeared when two fair dice are rolled and let the probability that $N - 2, \sqrt{3N}, N + 2$ are in geometric progression be $\frac{k}{48}$. Then the value of k is:

(1) 2

(2) 4

(3) 16

(4) 8

---

17. The integral $16 \int_1^2 \frac{dx}{x^3(x^2+2)^2}$ is equal to:

(1) $\frac{11}{6} + \log_e 4$

(2) $\frac{11}{12} + \log_e 4$

(3) $\frac{11}{12} - \log_e 4$

(4) $\frac{11}{6} - \log_e 4$

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18. Let T and C respectively be the transverse and conjugate axes of the hyperbola $16x^2 - y^2 + 64x + 4y + 44 = 0$. Then the area of the region above the parabola $x^2 = y + 4$, below the transverse axis T and on the right of the conjugate axis C is:

(1) $4\sqrt{6} + \frac{44}{3}$

(2) $4\sqrt{6} + \frac{28}{3}$

(3) $4\sqrt{6} - \frac{44}{3}$

(4) $4\sqrt{6} - \frac{28}{3}$

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19. Let $\vec{a} = -\hat{i} - \hat{j} + \hat{k}$, $\vec{a} \cdot \vec{b} = 1$ and $\vec{a} \times \vec{b} = \hat{i} - \hat{j}$. Then $\vec{a} - 6\vec{b}$ is equal to:

(1) $3(\hat{i} - \hat{j} - \hat{k})$

(2) $3(\hat{i} + \hat{j} + \hat{k})$

(3) $3(\hat{i} - \hat{j} + \hat{k})$

(4) $3(\hat{i} + \hat{j} - \hat{k})$

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20. The foot of the perpendicular from the point $(2, 0, 5)$ on the line $\frac{x+1}{2} = \frac{y-1}{5} = \frac{z+1}{-1}$ is (α, β, γ). Then, which of the following is NOT correct?

(1) $\frac{\alpha\beta}{\gamma} = \frac{4}{15}$

(2) $\frac{\alpha}{\beta} = -8$

(3) $\frac{\beta}{\gamma} = -5$

(4) $\frac{\gamma}{\alpha} = \frac{5}{8}$

Section-B

21. For the two positive numbers a, b, if a, b and $\frac{1}{18}$ are in a geometric progression, while $\frac{1}{a}, 10, \frac{1}{b}$ are in an arithmetic progression, then $16a + 12b$ is equal to:

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22. Points $P(-3, 2), Q(9, 10),$ **and** $R(\alpha, 4)$ **lie on a circle** C **with** PR **as its diameter. The tangents to** C **at** Q **and** R **intersect at point** S. **If** S **lies on the line** $2x - ky = 1$, **then** k **is equal to:**

23. Let $a \in \mathbb{R}$ **and let** α, β **be the roots of the equation** $x^2 + 60^{\frac{1}{4}}x + a = 0$. **If** $\alpha^4 + \beta^4 = -30$, **then the product of all possible values of** a **is:**

24. Suppose Anil's mother wants to give 5 whole fruits to Anil from a basket of 7 red apples, 5 white apples, and 8 oranges. If in the selected 5 fruits, at least 2 oranges, at least one red apple, and at least one white apple must be given, then the number of ways Anil's mother can offer 5 fruits to Anil is:

25. If m **and** n **respectively are the numbers of positive and negative values of** θ **in the interval** $[-\pi, \pi]$ **that satisfy the equation** $\cos 2\theta \cdot \cos \frac{\theta}{2} = \cos 3\theta \cdot \cos \frac{9\theta}{2}$, **then** mn **is equal to:**

26. If
$\int_{\frac{1}{3}}^{3} |\log_e x| \, dx = \frac{m}{n} \log_e \left(\frac{n^2}{e} \right)$, **where m and n are coprime natural numbers, then** $m^2 + n^2 - 5$ **is equal to ____.**

27. The remainder when $(2023)^{2023}$ **is divided by 35 is:**

28. If the shortest distance between the line joining the points $(1, 2, 3)$ **and** $(2, 3, 4)$, **and the line** $\frac{x-1}{2} = \frac{y+1}{-1} = \frac{z-2}{0}$ **is** α, **then** $28\alpha^2$ **is equal to:**

29. 25% of the population are smokers. A smoker has 27 times more chances to develop lung cancer than a non-smoker. If a person is diagnosed with lung cancer, and the probability that this person is a smoker is $\frac{k}{10}$, **then the value of** k **is:**

30. A triangle is formed by the X**-axis,** Y**-axis, and the line** $3x + 4y = 60$. **Then the number of points** $P(a, b)$, **where** a **is an integer and** b **is a multiple of** a, **which lie strictly inside the triangle, is: ____**

Physics

Section-A

31. Match List I with List II:

List I	List II
A. Young's Modulus (Y)	I. $[ML^{-1}T^{-1}]$
B. Co-efficient of Viscosity (η)	II. $[ML^2T^{-1}]$
C. Planck's Constant (h)	III. $[ML^{-1}T^{-2}]$
D. Work Function (Φ)	IV. $[ML^2T^{-2}]$

Choose the correct answer from the options given below:

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

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

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

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

32. According to the law of equipartition of energy, the molar specific heat of a diatomic gas at constant volume where the molecule has one additional vibrational mode is:

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

(2) $\frac{5}{2}R$

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

(4) $\frac{7}{2}R$

33. The light rays from an object have been reflected towards an observer from a standard flat mirror. The image observed by the observer is:

A. Real

B. Erect

C. Smaller in size than the object

D. Laterally inverted

Choose the most appropriate answer from the options given below:

(1) B and D only

(2) B and C only

(3) A and D only

(4) A, C, and D only

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34. For a moving coil galvanometer, the deflection in the coil is 0.05 rad when a current of 10 mA is passed through it. If the torsional constant of the suspension wire is 4.0×10^{-5} Nm/rad, the magnetic field is 0.01 T, and the number of turns in the coil is 200, the area of each turn (in cm^2) is:

(1) 2.0

(2) 1.0

(3) 1.5

(4) 0.5

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35. The graph between two temperature scales P and Q is shown in the figure. Between the upper fixed point and lower fixed point, there are 150 equal divisions of scale P and 100 divisions on scale Q. The relationship for conversion between the two scales is given by:
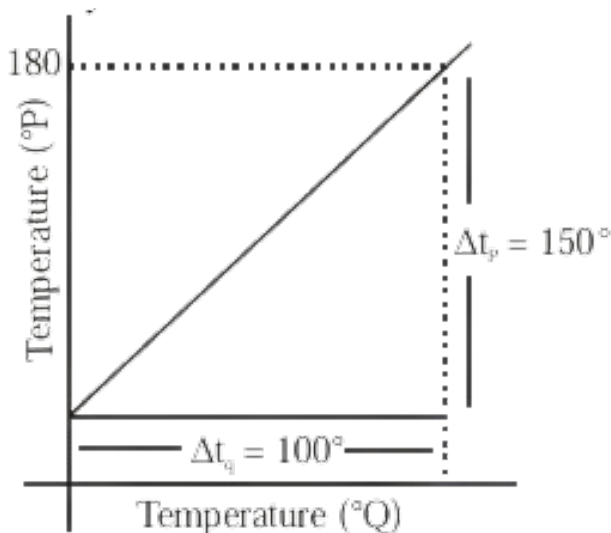
(1) $t_q/150 = \frac{t_p - 180}{100}$

(2) $t_q/100 = \frac{t_p - 30}{150}$

(3) $t_p/180 = \frac{t_Q - 40}{100}$

(4) $t_p/100 = \frac{t_Q - 180}{150}$

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36. Match List I with List II:

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A.	Gauss's Law in Electrostatics	I.	$\oint \vec{E}.d\vec{l} = -\dfrac{d\phi_B}{dt}$
B.	Faraday's Law	II.	$\oint \vec{B}.d\vec{A} = 0$
C.	Gauss's Law in Magnetism	III.	$\oint \vec{B}.d\vec{l} = \mu_0 i_C + \mu_0 \epsilon_0 \dfrac{d\phi_E}{dt}$
D.	Ampere-Maxwell Law	IV.	$\oint \vec{E}.d\vec{s} = \dfrac{q}{\epsilon_0}$

Choose the correct answer from the options given below:

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

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

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

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

37. Statement I: When a Si sample is doped with Boron, it becomes P type and when doped by Arsenic it becomes N-type semi conductor such that P-type has excess holes and N-type has excess electrons.

Statement II: When such P-type and N-type semi-conductors, are fused to make a junction, a current will automatically flow which can be detected with an externally connected ammeter.

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

(1) Both Statement I and statement II are incorrect

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

(3) Both Statement I and statement II are correct

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

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38. Consider a block kept on an inclined plane (inclined at 45°) as shown in the figure.

If the force required to just push it up the incline is 2 times the force required to just prevent it from sliding down, the coefficient of friction between the block and inclined plane (μ) is equal to
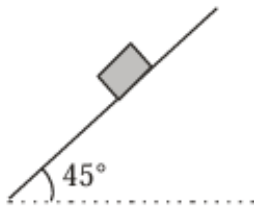

(1) 0.33

(2) 0.60

(3) 0.25

(4) 0.50

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39. A point charge of 10 µC is placed at the origin. At what location on the X-axis should a point charge of 40µC be placed so that the net electric field is zero at x = 2 cm on the X-axis ?

(1) $x = 6\,\text{cm}$

(2) $x = 4\,\text{cm}$

(3) $x = 8\,\text{cm}$

(4) $x = -4\,\text{cm}$

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40. The energy levels of an atom is shown in figure. Which one of these transitions will result in the emission of a photon of wavelength 124.1 nm?

Given (h = 6.626×10^{-34}) JS
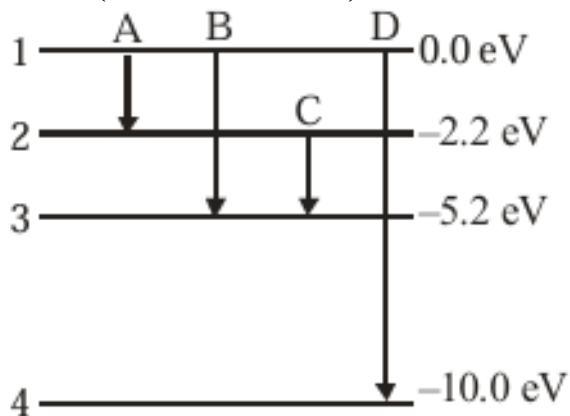
(1) B

(2) A

(3) C

(4) D

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41. A particle executes simple harmonic motion between $x = -A$ and $x = A$. If the time taken by the particle to go from $x = 0$ to $x = A$ is 2 s, then the time taken by particle in going from $x = -A$ to $x = A/2$ is:

(1) 3 s

(2) 2 s

(3) 1.5 s

(4) 4 s

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42. Match List I with List II:

List I	List II
A. Isothermal Process	I. Work done by the gas decreases internal energy
B. Adiabatic Process	II. No change in internal energy
C. Isochoric Process	III. The heat absorbed goes partly to increase internal energy and partly to do work
D. Isobaric Process	IV. No work is done on or by the gas

Choose the correct answer from the options given below :

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

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

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

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

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43. Match List I with List II:

List I	List II
A. Troposphere	I. Approximate 65-75 km over Earth's surface
B. E-Part of Stratosphere	II. Approximate 300 km over Earth's surface
C. F_2-Part of Thermosphere	III. Approximate 10 km over Earth's surface
D. D-Part of Stratosphere	IV. Approximate 100 km over Earth's surface

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Choose the correct answer from the options given below :

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

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

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

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

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44. A body of mass m is taken from earth surface to the height equal to twice the radius of earth (R_e), the increase in potential energy will be:

(g = acceleration due to gravity on the surface of Earth)

(1) $3mgR_e$

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

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

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

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45. A wire of length 1 m moving with velocity 8 m/s at right angles to a magnetic field of 2 T. The magnitude of induced emf between the ends of wire will be:

(1) 20 V

(2) 8 V

(3) 12 V

(4) 16 V

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46. The distance travelled by a particle is related to time t as $x = 4t^2$. The velocity of the particle at $t = 5$ s is:

(1) 40 m/s

(2) 25 m/s

(3) 20 m/s

(4) 8 m/s

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47. Two objects are projected with the same velocity u but at different angles α and β with the horizontal. If $\alpha + \beta = 90°$, the ratio of horizontal range of the first object to the 2nd object will be:

(1) $4 : 1$

(2) $2 : 1$

(3) $1 : 2$

(4) $1 : 1$

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48. The resistance of a wire is 5 Ω. If it's stretched to 5 times of its original length, its new resistance will be:

(1) $625\,\Omega$

(2) $5\,\Omega$

(3) $125\,\Omega$

(4) $25\,\Omega$

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49. Given below are two statements:

Statement I: Stopping potential in photoelectric effect does not depend on the power of the light source.

Statement II: For a given metal, the maximum kinetic energy of the photoelectron depends on the wavelength of the incident light.

In the light of 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 incorrect

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

(4) Both statement I and statement II are correct

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50. Every planet revolves around the sun in an elliptical orbit:

Statements:

A. The force acting on a planet is inversely proportional to the square of the distance from the sun.

B. The force acting on a planet is inversely proportional to the product of the masses of the planet and the sun.

C. The centripetal force acting on the planet is directed away from the sun.

D. The square of the time period of the revolution of a planet around the sun is directly proportional to the cube of the semi-major axis of the elliptical orbit.

Options:

(1) A and D only

(2) C and D only

(3) B and C only

(4) A and C only

Section B

51. A capacitor has a capacitance of 5 μF when its parallel plates are separated by an air medium of thickness d. A slab of material with a dielectric constant of 1.5, having an area equal to that of the plates but with thickness $d/2$, is inserted between the plates. The capacitance of the capacitor in the presence of the slab will be ___ μF :

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52. A train blowing a whistle of frequency 320 Hz approaches an observer standing on the platform at a speed of 66 m/s. The frequency observed by the observer will be (given speed of sound = 330 m/s):

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53. An object is placed on the principal axis of a convex lens of focal length 10 cm as shown. A plane mirror is placed on the other side of the lens at a distance of 20 cm. The image produced by the plane mirror is 5 cm inside the mirror. The distance of the object from the lens is:

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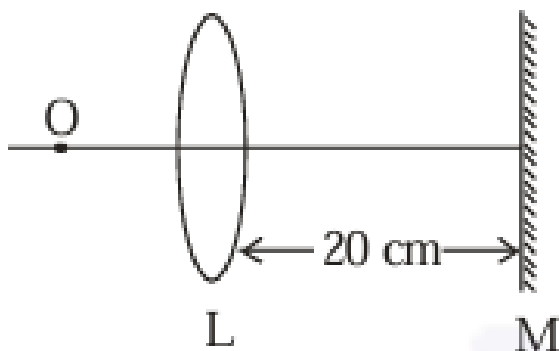
54. Two long parallel wires carrying currents 8A and 15A in opposite directions are placed at a distance of 7 cm from each other. A point P is at equidistant from both the

wires such that the lines joining the point P to the wires are perpendicular to each other. The magnitude of magnetic field at P is ___ $\times 10^{-6}\, T$.

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55. A spherical drop of liquid splits into 1000 identical spherical drops. If u_i is the surface energy of the original drop and u_f is the total surface energy of the resulting drops, the ratio $\frac{u_f}{u_i} = \frac{10}{x}$. Then value of x is ___:

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56. A body of mass 1 kg collides head-on with a stationary body of mass 3 kg. After the collision, the smaller body reverses its direction of motion and moves with a speed of 2 m/s. The initial speed of the smaller body before collision is:

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57. A nucleus disintegrates into two smaller parts, which have their velocities in the ratio 3:2. The ratio of their nuclear sizes will be $\left(\frac{x}{3}\right)^{\frac{1}{3}}$. The value of x is:

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58. Two cells are connected between points A and B as shown. Cell 1 has an emf of 12 V and internal resistance of 3Ω. Cell 2 has an emf of 6 V and internal resistance of 6Ω. An external resistor of 4Ω is connected across A and B. The current flowing through R will be ___ A.

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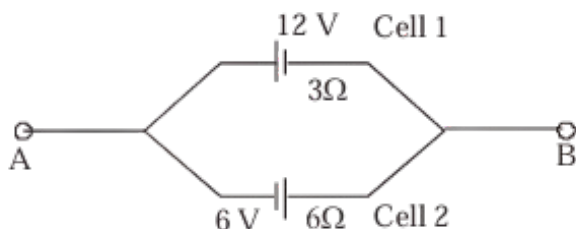
59. A series LCR circuit is connected to an AC source of 220 V, 50 Hz. The circuit contains a resistance $R = 80\,\Omega$, an inductor of inductive reactance $X_L = 70\,\Omega$, and a capacitor of capacitive reactance $X_C = 130\,\Omega$. The power factor of the circuit is $\frac{x}{10}$. The value of x is:

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60. If a solid sphere of mass 5 kg and a disc of mass 4 kg have the same radius. Then the ratio of the moment of inertia of the disc about a tangent in its plane to the moment of inertia of the sphere about its tangent will be $\frac{x}{7}$. The value of x is:

CHEMISTRY

Section-A

61. Match List I with List II:

List I	List II
A. Cobalt catalyst	I. $H_2 + Cl_2$ production
B. Syngas	II. Water gas production
C. Nickel catalyst	III. Coal gasification
D. Brine solution	IV. Methanol production

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

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

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

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

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62. Given are two statements:

Statement I: In froth flotation method a rotating paddle agitates the mixture to drive air out of it.

Statement II: Iron pyrites are generally avoided for extraction of iron due to environmental reasons.

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

(1) Both Statement I and Statement II are true

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

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

(4) Both Statement I and Statement II are false

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63. Which of the following represents the correct order of metallic character of the given elements?

(1) $Si < Be < Mg < K$

(2) $Be < Si < Mg < K$

(3) $K < Mg < Be < Si$

(4) $Be < Si < K < Mg$

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64. Given below are two statements, one labeled as Assertion A and the other as Reason R:

Assertion A: The alkali metals and their salts impart characteristic color to reducing flame.

Reason R: Alkali metals can be detected using flame tests.

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

(1) Both A and R are correct but R is NOT the correct explanation of A.

(2) A is correct but R is not correct.

(3) A is not correct but R is correct.

(4) Both A and R are correct and R is the correct explanation of A.

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65. What is the mass ratio of ethylene glycol ($C_2H_6O_2$, molar mass = 62 g/mol) required for making 500 g of 0.25 molar aqueous solution and 250 mL of 0.25 molar aqueous solution?

(1) 1 : 1

(2) 3 : 1

(3) 2 : 1

(4) 1 : 2

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66. Given two statements about dipole moments:

Statement I: Dipole moment is a vector quantity and by convention it is depicted by a small arrow with tail on the negative center and head pointing towards the positive center.

Statement II: The crossed arrow of the dipole moment symbolizes the direction of the shift of charges in the molecules.

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

(1) Both Statement I and Statement II are correct.

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

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

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

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67. Given below are two statements, one labeled as Assertion A and the other as Reason R:

Assertion A: Butylated hydroxyl anisole when added to butter increases its shelf life.

Reason R: Butylated hydroxyl anisole is more reactive towards oxygen than food.

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

(1) Both A and R are correct and R is the correct explanation of A.

(2) A is correct but R is not correct.

(3) A is not correct but R is correct.

(4) Both A and R are correct but R is NOT the correct explanation of A.

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68. Given below are several statements:

A. Ammonium salts produce haze in the atmosphere.

B. Ozone gets produced when atmospheric oxygen reacts with chlorine radicals.

C. Polychlorinated biphenyls act as cleaning solvents.

D. 'Blue baby' syndrome occurs due to the presence of excess sulphate ions in water.

Choose the correct answer from the options given below :-

(1) A, B and C only

(2) B and C only

(3) A and D only

(4) A and C only

---

69. Match List I with List II:

List I (Amines):	List II (pKb):
A. Aniline	I. 3.25
B. Ethylamine	II. 3.00
C. N-Ethylethanamine	III. 9.38
D. N,N-Diethylethanamine	IV. 3.29

Choose the correct answer from the options given below :-

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

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

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

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

---

70. Which one among the following metals is the weakest reducing agent?

(1) K

(2) Rb

(3) Na

(4) Li

---

71. Match List I with List II:

List I (Isomeric pairs)	List II (Type of isomers)
A. Propanamine and N-Methylethanamine	I. Metamers
B. Hexan-2-one and Hexan-3-one	II. Positional isomers
C. Ethanamide and Hydroxyethanamine	III. Functional isomers
D. o-nitrophenol and p-nitrophenol	IV. Tautomers

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

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

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

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

---

72. Match List I with List II (Uses of polymers):

List I (Name of polymer)	List II
A. Glyptal	I. Flexible pipes
B. Neoprene	II. Synthetic wool
C. Acrilan	III. Paints and Lacquers
D. LDP	IV. Gaskets

Choose the correct answer from the options given below :-

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

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

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

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

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73. Given below are two statements, one labeled as Assertion A and the other as Reason R:

Assertion A: Carbon forms two important oxides — CO and CO2. CO is neutral whereas CO2 is acidic in nature.

Reason R: CO2 can combine with water in a limited way to form carbonic acid, which is sparingly soluble in water.

(1) Both A and R are correct but R is NOT the correct explanation of A.

(2) Both A and R are correct and R is the correct explanation of A.

(3) A is not correct but R is correct.

(4) A is correct but R is not correct.

---

74. Potassium dichromate acts as a strong oxidizing agent in acidic solution. During this process, the oxidation state changes from:

(1) +3 to +1

(2) +6 to +3

(3) +2 to +1

(4) +6 to +2

---

75. When the hydrogen ion concentration [H$^+$] changes by a factor of 1000, the value of pH of the solution:

(1) increases by 1000 units

(2) decreases by 3 units

(3) decreases by 2 units

(4) increases by 2 units

---

76. Match List I with List II:

List I (Coordination entity):	List II (Wavelength of light absorbed in nm):
A. $[CoCl(NH_3)_5]^{2+}$	I. 310
B. $[Co(NH_3)_6]^{3+}$	II. 475
C. $[Co(CN)_6]^{3-}$	III. 535
D. $[Cu(H_2O)_4]^{2+}$	IV. 600

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

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

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

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

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77. Find out the major product from the following reaction

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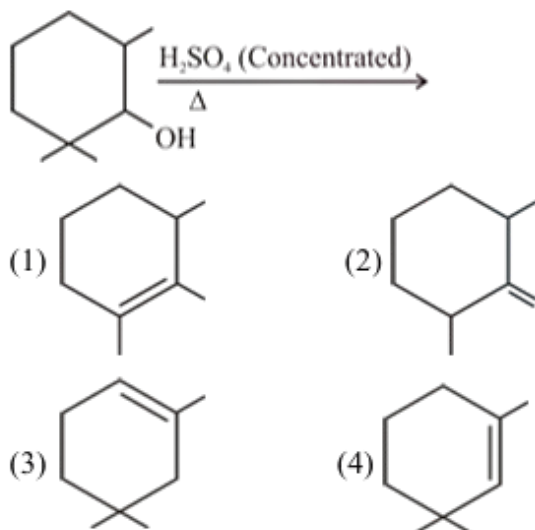
78. Identify 'A' in the given reaction to produce the major product:
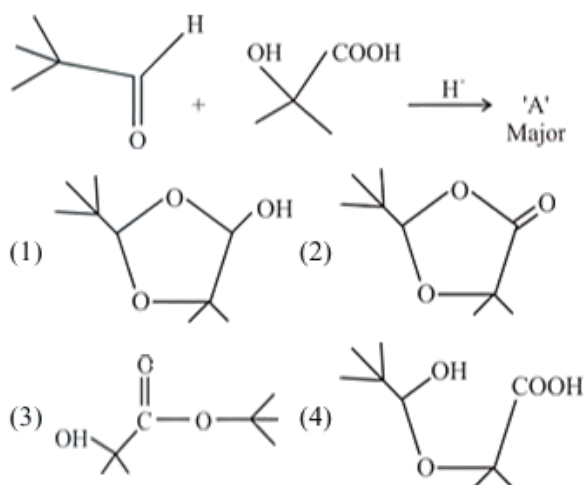
79. The isomeric deuterated bromide with molecular formula C_4H_9DBr having two chiral carbon atoms is:

(1) 2-Bromo-1-deuterobutane

(2) 2-Bromo-2-deuterobutane

(3) 2-Bromo-3-deuterobutane

(4) 2-Bromo-1-deutero-2-methylpropane

80. A chloride salt solution acidified with dil. HNO_3 gives a curdy white precipitate, [A], on addition of $AgNO_3$. [A] on treatment with NH_4OH gives a clear solution, B. The correct products are:
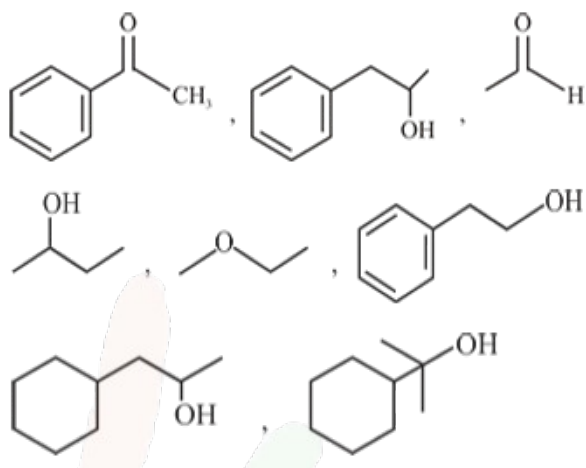
(1) $H[AgCl_3]$ and $[Ag(NH_3)_2]Cl$

(2) $[HAgCl_3]$ and $[NH_4]\,Ag(OH)_2$

(3) $AgCl$ and $[Ag(NH_3)_2]Cl$

(4) $AgCl$ and $[NH_4]\,Ag(OH)_2$

Section-B

81. The number of given orbitals which have electron density along the axis is:

P_x, P_y, P_z, d_{xy}, d_{yz}, d_{xz}, d_{z^2}, $d_{x^2-y^2}$

82. Number of compounds giving (i) red colouration with ceric ammonium nitrate and also (ii) positive iodoform test from the following is:

83. **The number of pairs of the solution having the same value of osmotic pressure from the following is:**

A. 0.500 M C_2H_5OH (aq) and 0.25 M KBr (aq)

B. 0.100 M $K_4[Fe(CN)_6]$ (aq) and 0.100 M $FeSO_4(NH_4)_2SO_4$ (aq)

C. 0.05 M $K_4[Fe(CN)_6]$ (aq) and 0.25 M NaCl (aq)

D. 0.15 M NaCl (aq) and 0.1 M $BaCl_2$ (aq)

E. 0.02 M KCl $MgCl_2.6H_2O$ (aq) and 0.05 M KCl (aq)

---

84. **28.0 L of CO_2 is produced on complete combustion of 16.8 L gaseous mixture of ethene and methane at 25°C and 1 atm. Heat evolved during the combustion process is ___ kJ.**

Given:

$\Delta H_c(CH_4) = -900$ kJ/mol

$\Delta H_c(C_2H_4) = -1400$ kJ/mol

---

85. **Total number of moles of AgCl precipitated on addition of excess of AgNO3 to one mole each of the following complexes:** $[Co(NH_3)_4Cl_2]Cl$, $[Ni(H_2O)_6]Cl_2$, $[Pt(NH_3)_2Cl_2]$, and $[Pd(NH_3)_4]Cl_2$

---

86. **Number of hydrogen atoms per molecule of a hydrocarbon A having 85.8% carbon**

is:

Given: Molar mass of A = 84 g/mol

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87. Pt(s)|H$_2$(g)(1bar)|H$^+$(aq)(1M)||M^{3+}(aq), M^+(aq)|Pt(s)

The E_{cell} for the given cell is 0.1115 V at 298 K when $\frac{[M^+(aq)]}{[M^{3+}(aq)]} = 10^a$.

Given:

$E^0_{M^{3+}/M^+} = 0.2$ V

$2.303\frac{RT}{F} = 0.059$ V

---

88. Based on the given figure, the number of correct statement/s is/are

A. Surface tension is the outcome of equal attractive and repulsion forces acting on the liquid molecule in bulk.

B. Surface tension is due to uneven forces acting on the molecules present on the surface.

C. The molecule in the bulk can never come to the liquid surface.

D. The molecules on the surface are responsible for vapor pressure if the system is a closed system.

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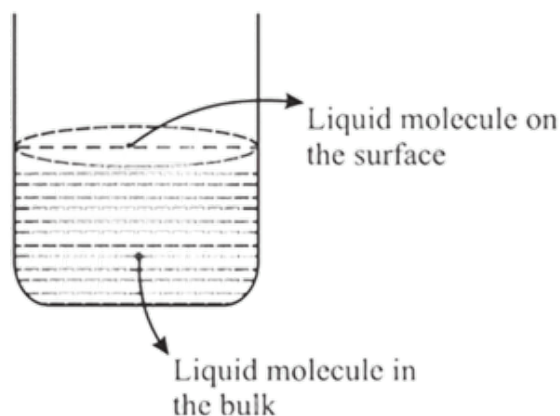
89. A first order reaction has the rate constant, k = 4.6 $\times 10^{-3} s^{-1}$. The number of correct statement/s from the following is/are

A. Reaction completes in 1000 s.

B. The reaction has a half-life of 500 s.

C. The time required for 10% completion is 25 times the time required for 90% completion.

D. The degree of dissociation is equal to $1 - e^{-kt}$.

E. The rate and the rate constant have the same unit.

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90. The number of incorrect statement/s from the following is/are

A. Water vapours are adsorbed by anhydrous calcium chloride.

B. There is a decrease in surface energy during adsorption.

C. As the adsorption proceeds, ΔH becomes more and more negative.

D. Adsorption is accompanied by a decrease in entropy of the system.