JEE Main 5 April Shift 1 Question Paper

1. **Let d be the distance of the point of intersection of the lines**

$$\frac{x+6}{3}=\frac{y}{2}=\frac{z+1}{1} \quad \text{and} \quad \frac{x-7}{4}=\frac{y-9}{3}=\frac{z-4}{2}$$

from the point $(7,8,9)$. Then d^2+6 is equal to:

1. 72
2. 69
3. 75
4. 78

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2. **Let a rectangle $ABCD$ of sides 2 and 4 be inscribed in another rectangle $PQRS$ such that the vertices of the rectangle $ABCD$ lie on the sides of the rectangle $PQRS$. Let a and b be the sides of the rectangle $PQRS$ when its area is maximum. Then $(a+b)^2$ is equal to:**

1. **72**
2. **60**
3. **80**
4. **64**

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3. **Let two straight lines drawn from the origin O intersect the line $3x+4y=12$ at the points P and Q such that $\triangle OPQ$ is an isosceles triangle and $\angle POQ=90^\circ$. If $\ell=OP^2+PQ^2+OQ^2$, then the greatest integer less than or equal to ℓ is:**

1. **44**
2. **48**
3. **46**
4. **42**

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4. **If $y=y(x)$ is the solution of the differential equation $\frac{dy}{dx}+2y=\sin(2x)$, $y(0)=\frac{3}{4}$, then $y\left(\frac{\pi}{8}\right)$ is equal to:**

1. $\mathbf{e}^{-\pi/8}$
2. $\mathbf{e}^{-\pi/4}$
3. $\mathbf{e}^{\pi/4}$

4. $\mathbf{e^{\pi/8}}$

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5. For the function $f(x) = \sin x + 3x - \frac{2}{\pi}(x^2 + x)$, where $x \in \left[0, \frac{\pi}{2}\right]$, consider the following two statements:

(I) f is increasing in $\left(0, \frac{\pi}{2}\right)$.

(II) f is decreasing in $\left(0, \frac{\pi}{2}\right)$.

Between the above two statements,

1. **only (I) is true.**
2. **only (II) is true.**
3. **neither (I) nor (II) is true.**
4. **both (I) and (II) are true.**

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6. If the system of equations

$$11x + y + \lambda z = -5$$

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

$$8x - 19y - 39z = \mu$$

has infinitely many solutions, then $\lambda^4 - \mu$ is equal to:

1. **49**
2. **45**
3. **47**
4. **51**

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7. Let $A = \{1, 3, 7, 9, 11\}$ and $B = \{2, 4, 5, 7, 8, 10, 12\}$. Then the total number of one-one maps $f : A \to B$, such that $f(1) + f(3) = 14$, is:

1. **180**
2. **120**
3. **480**
4. **240**

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8. If the function $f(x) = \frac{\sin 3x + \alpha \sin x - \beta \cos 3x}{x^3}$, $x \in R$, is continuous at $x = 0$, then $f(0)$ is equal to:

1. **2**
2. **-2**
3. **4**

4. **-4**

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9. The integral $\int_0^{\pi/4} \frac{136 \sin x}{3 \sin x + 5 \cos x}\, dx$ is equal to:

1. $\mathbf{3}\pi - 50 \log_e 2 + 20 \log_e 5$
2. $\mathbf{3}\pi - 25 \log_e 2 + 10 \log_e 5$
3. $\mathbf{3}\pi - 10 \log_e (2\sqrt{2}) + 10 \log_e 5$
4. $\mathbf{3}\pi - 30 \log_e 2 + 20 \log_e 5$

10: The coefficients a, b, c in the quadratic equation

$$ax^2 + bx + c = 0$$

are chosen from the set $\{1, 2, 3, 4, 5, 6, 7, 8\}$. The probability of this equation having repeated roots is:

1. $\frac{3}{256}$
2. $\frac{1}{128}$
3. $\frac{1}{64}$
4. $\frac{3}{128}$

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11. Let A and B be two square matrices of order 3 such that $|A| = 3$ and $|B| = 2$. Then $|A^T A(\mathbf{adj}(2A))^{-1}(\mathbf{adj}(4B))(\mathbf{adj}(AB))^{-1}AA^T|$ is equal to: **(1)** 64
(2) 81
(3) 32
(4) 108

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12. Let a circle C of radius 1 and closer to the origin be such that the lines passing through the point $(3, 2)$ and parallel to the coordinate axes touch it. Then the shortest distance of the circle C from the point $(5, 5)$ is:

(1) $2\sqrt{2}$
(2) 5
(3) $4\sqrt{2}$
(4) 4

---

13. Let the line $2x + 3y - k = 0$, $k > 0$, intersect the x-axis and y-axis at the points A and B, respectively. If the equation of the circle having the line segment AB as a diameter is $x^2 + y^2 - 3x - 2y = 0$ and the length of the latus rectum of the ellipse $x^2 + 9y^2 = k^2$ is $\frac{m}{n}$, where m and n are coprime, then $2m + n$ is equal to:

(1) 10

(2) 11

(3) 13

(4) 12

---

14. Consider the following two statements:

Statement I: For any two non-zero complex numbers z_1, z_2,

$$(|z_1| + |z_2|)\left|\frac{z_1}{|z_1|} + \frac{z_2}{|z_2|}\right| \leq 2\,(|z_1| + |z_2|)$$

Statement II: If x, y, z are three distinct complex numbers and a, b, c are three positive real numbers such that

$$\frac{a}{|y-z|} = \frac{b}{|z-x|} = \frac{c}{|x-y|}$$

then

$$\frac{a^2}{y-z} + \frac{b^2}{z-x} + \frac{c^2}{x-y} = 1$$

Between the above two statements,

(1) both Statement I and Statement II are incorrect.

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

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

(4) both Statement I and Statement II are correct.

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15. Suppose $\theta \in \left[0, \frac{\pi}{4}\right]$ is a solution of $4\cos\theta - 3\sin\theta = 1$.

Then $\cos\theta$ is equal to:

(1) $\frac{4}{3\sqrt{6}-2}$

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

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

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

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16. If

$$\frac{1}{\sqrt{1}+\sqrt{2}} + \frac{1}{\sqrt{2}+\sqrt{3}} + \cdots + \frac{1}{\sqrt{99}+\sqrt{100}} = m$$

and

$$\frac{1}{1\cdot 2} + \frac{1}{2\cdot 3} + \cdots + \frac{1}{99\cdot 100} = n$$

then the point (m, n) lies on the line:

(1) $11(x-1) - 100(y-2) = 0$

(2) $11(x-2) - 100(y-1) = 0$

(3) $11(x-1) - 100y = 0$

(4) $11x - 100y = 0$

17. Let $f(x) = x^5 + 2x^3 + 3x + 1$, $x \in R$,and $g(x)$ be a function such that $g(f(x)) = x$ for all $x \in R$. Then

$$\frac{g(7)}{g'(7)}$$

is equal to:

(1) 7
(2) 42
(3) 1
(4) 14

---

18. If $A(1, -1, 2)$, $B(5, 7, -6)$, $C(3, 4, -10)$, and $D(-1, -4, -2)$ are the vertices of a quadrilateral $ABCD$, then its area is:

(1) $12\sqrt{29}$
(2) $24\sqrt{29}$
(3) $24\sqrt{7}$
(4) $48\sqrt{7}$

---

19. The value of $\int_{-\pi}^{\pi} \frac{2y(1+\sin y)}{1+\cos^2 y}\, dy$ is:

(1) π^2
(2) $\frac{\pi^2}{2}$
(3) $\frac{\pi}{2}$
(4) $2\pi^2$

---

20. If the line $\frac{2-x}{3} = \frac{3y-2}{4\lambda+1} = 4 - z$ makes a right angle with the line $\frac{x+3}{3\mu} = \frac{1-2y}{6} = \frac{5-z}{7}$, then $4\lambda + 9\mu$ is equal to:

(1) 13
(2) 4
(3) 5
(4) 6

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21. From a lot of 10 items, which include 3 defective items, a sample of 5 items is drawn at random. Let the random variable X denote the number of defective items in the sample. If the variance of X is σ^2, then $96\sigma^2$ is equal to _____.

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22. If the constant term in the expansion of

$$(1+2x-3x^3)\left(\frac{3}{2}x^2-\frac{1}{3x}\right)^9$$

is p, then $108p$ is equal to

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23. The area of the region enclosed by the parabolas

$$y=x^2-5x \quad \textbf{and} \quad y=7x-x^2$$

is

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24. The number of ways of getting a sum 16 on throwing a dice four times is.

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25. If $S=\{a\in R:|2a-1|=3[a]+2\{a\}\}$, where $[t]$ denotes the greatest integer less than or equal to t and $\{t\}$ represents the fractional part of t, then

$$72\sum_{a\in S} a \textbf{ is equal to.}$$

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26. Let f be a differentiable function in the interval $(0,\infty)$ such that $f(1)=1$ and

$$\lim_{t\to x}\frac{t^2f(x)-x^2f(t)}{t-x}=1$$

for each $x>0$. Then $2f(2)+3f(3)$ is equal to _____.

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27. Let $a_1,a_2,a_3,\ldots$ be in an arithmetic progression of positive terms. Let $A_k=a_1^2-a_2^2+a_3^2-a_4^2+\ldots+a_{2k-1}^2-a_{2k}^2$. If $A_3=-153$, $A_5=-435$ and $a_1^2+a_2^2+a_3^2=66$, then a_7-A_7 is equal to _____.

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28. Let $\vec{a}=\hat{i}-3\hat{j}+7\hat{k}$, $\vec{b}=2\hat{i}-\hat{j}+\hat{k}$ and $\vec{c}$ be a vector such that $(\vec{a}+2\vec{b})\times\vec{c}=3(\vec{c}\times\vec{a})$. If $\vec{a}\cdot\vec{c}=130$, then $\vec{b}\cdot\vec{c}$ is equal to _____.

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29. The number of distinct real roots of the equation $|x|x+2|-5x+1|-1=0$ is _____.

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30. Suppose AB is a focal chord of the parabola $y^2=12x$ of length l and slope $m<\sqrt{3}$. If the distance of the chord AB from the origin is d, then ld^2 is equal to _____.

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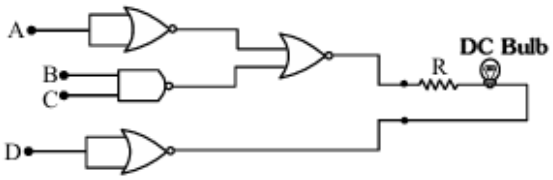
31. Light emerges out of a convex lens when a source of light is kept at its focus. The shape of the wavefront of the light is:

(1) Both spherical and cylindrical

(2) Cylindrical

(3) Spherical

(4) Plane



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32. The following gates section is connected in a complete suitable circuit.
For which of the following combinations will the bulb glow (ON):

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

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33. If G be the gravitational constant and u be the energy density, then which of the following quantities has the dimension as that of $\sqrt{uG}$:

(1) Pressure gradient per unit mass
(2) Force per unit mass
(3) Gravitational potential
(4) Energy per unit mass

---

34. Given below are two statements:
Statement-I: When a capillary tube is dipped into a liquid, the liquid neither rises nor falls in the capillary. The contact angle may be 0°.
Statement-II: The contact angle between a solid and a liquid is a property of the material of the solid and liquid as well.
In 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 true.
(3) Both Statement-I and Statement-II are false.
(4) Statement-I is true and Statement-II is false.

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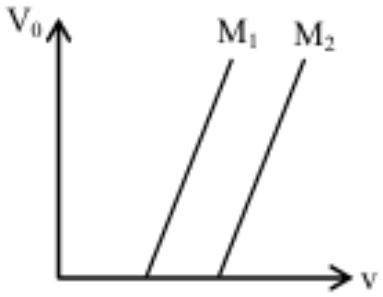
35. Given below are two statements:
Statement-I: Figure shows the variation of stopping potential with frequency (ν) for the two photosensitive materials M_1 and M_2. The slope gives the value of $\frac{h}{e}$, where h is Planck's constant and e is the charge of an electron.
Statement-II: M_2 will emit photoelectrons of greater kinetic energy for the incident radiation having the same frequency.
In the light of the above statements, choose the most appropriate answer from the options given below:



(1) Statement-I is correct and 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.

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36. The angle between vector $\vec{Q}$ and the resultant of $(2\vec{Q}+2\vec{P})$ and $(2\vec{Q}-2\vec{P})$ is:

(1) 0°

(2) $\tan^{-1}\left(\frac{2\vec{Q}-2\vec{P}}{2\vec{Q}+2\vec{P}}\right)$

(3) $\tan^{-1}\left(\frac{P}{Q}\right)$

(4) $\tan^{-1}\left(\frac{2Q}{P}\right)$

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37. In a hydrogen-like system, the ratio of the coulombian force and gravitational force between an electron and a proton is in the order of:

(1) 10^{39}

(2) 10^{19}

(3) 10^{29}

(4) 10^{46}

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38. In a co-axial straight cable, the central conductor and the outer conductor carry equal currents in opposite directions. The magnetic field is zero.

(1) inside the outer conductor

(2) in between the two conductors

(3) outside the cable

(4) inside the inner conductor

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39. An electron rotates in a circle around a nucleus having positive charge Ze. Correct relation between total energy (E) of electron and its potential energy (U) is:

(1) $E = 2U$

(2) $2E = 3U$

(3) $E = U$

(4) $2E = U$

---

40. If the collision frequency of hydrogen molecules in a closed chamber at 27°C is Z, then the collision frequency of the same system at 127°C is:

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

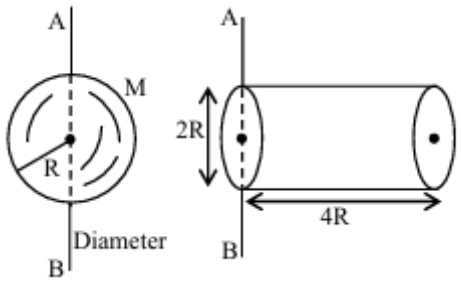
(2) $\frac{4}{3}Z$

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

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

---

41. The ratio of the radius of gyration of a hollow sphere to that of a solid cylinder of equal mass, for the moment of inertia about their diameter axis AB as shown in the figure is $\frac{\sqrt{8}}{\sqrt{x}}$. The value of x is:



(1) 34

(2) 17

(3) 67

(4) 51

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42. Two conducting circular loops A and B are placed in the same plane with their centers coinciding as shown in the figure. The mutual inductance between them is:

(1) $\frac{\mu_0 \pi a^2}{2b}$

(2) $\frac{\mu_0 b^2}{2\pi a}$

(3) $\frac{\mu_0 \pi b^2}{2a}$

(4) $\frac{\mu_0 a^2}{2\pi b}$

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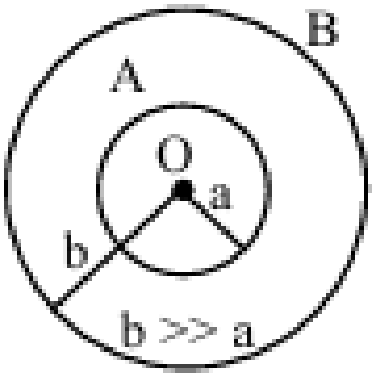
43. Match *List-I* with *List-II*:

Choose the correct answer from the options given below:



	List-I		List-II
(A)	Kinetic energy of planet	(I)	$-\frac{GMm}{a}$
(B)	Gravitation Potential energy of Sun-planet system.	(II)	$\frac{GMm}{2a}$
(C)	Total mechanical energy of planet	(III)	$\frac{Gm}{r}$
(D)	Escape energy at the surface of planet for unit mass object	(IV)	$-\frac{GMm}{2a}$

(1) **(A) – II, (B) – I, (C) – IV, (D) – III**
(2) **(A) – III, (B) – IV, (C) – I, (D) – II**
(3) **(A) – I, (B) – IV, (C) – II, (D) – III**
(4) **(A) – I, (B) – II, (C) – III, (D) – IV**

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44. A wooden block of mass $5\,\text{kg}$ rests on a soft horizontal floor. When an iron cylinder of mass $25\,\text{kg}$ is placed on top of the block, the floor yields and the block and the cylinder together go down with an acceleration of $0.1\,\text{m/s}^2$. The action force of the system on the floor is equal to:

(1) $297\,\text{N}$
(2) $294\,\text{N}$
(3) $291\,\text{N}$
(4) $196\,\text{N}$

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45. A simple pendulum doing small oscillations at a place R height above the earth's surface has a time period of $T_1 = 4\,s$. T_2 would be its time period if it is brought to a point which is at a height $2R$ from the earth's surface. Choose the correct relation [R = radius of Earth]:

(1) $T_1 = T_2$
(2) $2T_1 = 3T_2$
(3) $3T_1 = 2T_2$
(4) $2T_1 = T_2$

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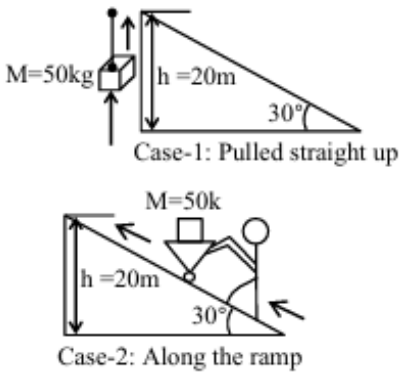
46. A body of mass $50\,$kg is lifted to a height of $20\,$m from the ground in two different ways as shown in the figures. The ratio of work done against gravity in both respective cases will be:



(1) $1:1$
(2) $2:1$
(3) $\sqrt{3}:2$
(4) $1:2$

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47. Time periods of oscillation of the same simple pendulum measured using four different measuring clocks were recorded as $4.62\,s, 4.632\,s, 4.6\,s$ and $4.64\,s$. The arithmetic mean of these readings in the correct significant figure is:

(1) $4.623\,s$
(2) $4.62\,s$
(3) $4.6\,s$
(4) $5\,s$

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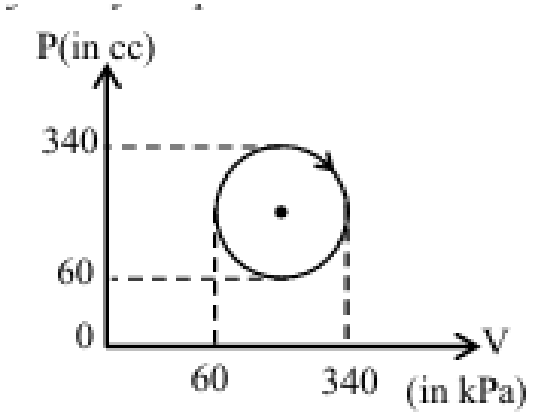
48. The heat absorbed by a system in going through the given cyclic process is:



(1) $61.6\,J$
(2) $431.2\,J$
(3) $616\,J$
(4) $419.6\,J$

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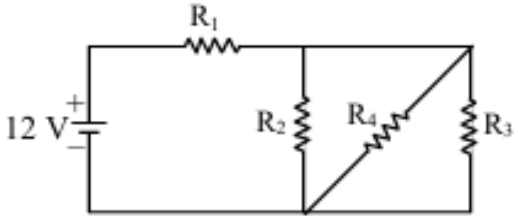
49. In the given figure, $R_1 = 10\,\Omega$, $R_2 = 8\,\Omega$, $R_3 = 4\,\Omega$, and $R_4 = 8\,\Omega$. The battery is ideal with emf $12\,V$. The equivalent resistance of the circuit and current supplied by the battery are respectively:



(1) $12\,\Omega$ **and** $1.14\,A$
(2) $10.5\,\Omega$ **and** $1.14\,A$
(3) $10.5\,\Omega$ **and** $1\,A$
(4) $12\,\Omega$ **and** $1\,A$

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50. An alternating voltage of amplitude $40\,V$ and frequency $4\,$kHz is applied directly across a capacitor of $12\,\mu F$. The maximum displacement current between the plates of the capacitor is nearly:

(1) $13\,A$
(2) $8\,A$
(3) $10\,A$
(4) $12\,A$

51. In Young's double slit experiment, carried out with light of wavelength 5000Å, the distance between the slits is 0.3 mm and the screen is at 200 cm from the slits. The central maximum is at $x = 0$ cm. The value of x for third maxima is ..... mm.

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52. A 2A current carrying straight metal wire of resistance 1 Ω, resistivity $2 \times 10^{-6}\,\Omega$m, area of cross-section $10\,\text{mm}^2$ and mass 500 g is suspended horizontally in mid air by applying a uniform magnetic field $\vec{B}$. The magnitude of B is ..... $\times 10^{-1}$ T (given, $g = 10\,\text{m/s}^2$).

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53. The electric field between the two parallel plates of a capacitor of $1.5\,\mu$F capacitance drops to one third of its initial value in $6.6\,\mu$s when the plates are connected by a thin wire. The resistance of this wire is ..... Ω. (Given, $\log 3 = 1.1$)

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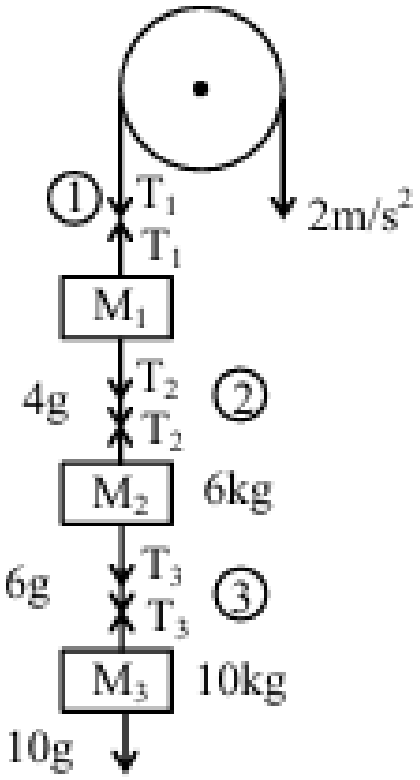
54. Three blocks M_1, M_2, M_3 having masses 4 kg, 6 kg, and 10 kg respectively are hanging from a smooth pulley using rope 1, 2, and 3 as shown in the figure. The tension in the rope 1, T_1, when they are moving upward with an acceleration of $2\,\text{m/s}^2$ is ..... N (if $g = 10\,\text{m/s}^2$).



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55. The density and breaking stress of a wire are $6 \times 10^4\,\text{kg/m}^3$ and $1.2 \times 10^8\,\text{N/m}^2$ respectively. The wire is suspended from a rigid support on a planet where acceleration due to gravity is $\frac{1}{3}$ of the value on the surface of Earth. The maximum length of the wire with breaking is ..... m (take, $g = 10\,\text{m/s}^2$).

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56. A body moves on a frictionless plane starting from rest. If S_n is the distance moved between $t = n - 1$ and $t = n$ and S_{n-1} is the distance moved between $t = n - 2$ and $t = n - 1$, then the ratio $\frac{S_{n-1}}{S_n}$ is $\left(1 - \frac{2}{x}\right)$ for $n = 10$. The value of x is .....

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57. If three helium nuclei combine to form a carbon nucleus, then the energy released in this reaction is ..... $\times 10^{-2}$ MeV. (Given $1\,u = 931$ MeV/c^2, atomic mass of helium = 4.002603 u)

Correct Answer: (727)

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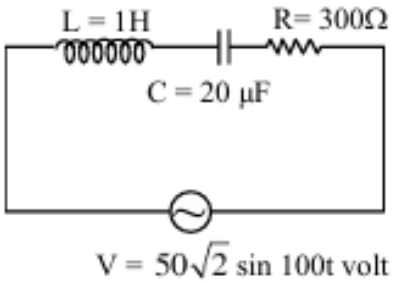
58. An AC source is connected in the given series LCR circuit. The rms potential difference across the capacitor of $20\,\mu F$ is ..... V.



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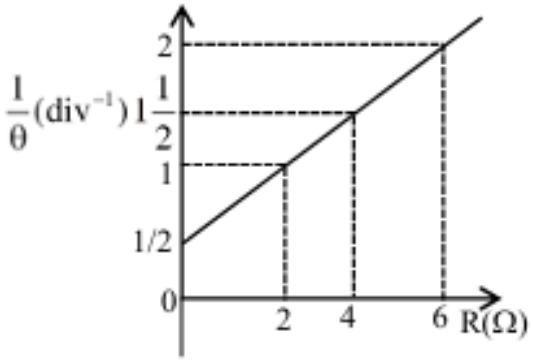
59. In the experiment to determine the galvanometer resistance by the half-deflection method, the plot of $\frac{1}{\theta}$ vs the resistance (R) of the resistance box is shown in the figure. The figure of merit of the galvanometer is ..... $\times 10^{-1}$ A/division. [The source has emf 2V.]



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60. Three capacitors of capacitances $25\,\mu F$, $30\,\mu F$, and $45\,\mu F$ are connected in parallel to a supply of $100\,V$. The energy stored in the above combination is E. When these capacitors are connected in series to the same supply, the stored energy is $\frac{9E}{x}$. The value of x is .....

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61. The incorrect postulates of Dalton's atomic theory are:

(A) Atoms of different elements differ in mass.
(B) Matter consists of divisible atoms.
(C) Compounds are formed when atoms of different elements combine in a fixed ratio.
(D) All the atoms of a given element have different properties, including mass.
(E) Chemical reactions involve reorganization of atoms.

Choose the correct answer from the options given below:

1. **(B), (D), (E) only**
2. **(A), (B), (D) only**
3. **(C), (D), (E) only**
4. **(B), (D) only**

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62. The following reaction occurs in the Blast furnace where iron ore is reduced to iron metal:

$$Fe_2O_3(s) + 3CO(g) \rightleftharpoons 2Fe(l) + 3CO_2(g)$$

Using Le-Chatelier's principle, predict which one of the following will not disturb the equilibrium:

1. **Addition of Fe_2O_3**
2. **Addition of CO_2**
3. **Removal of CO**
4. **Removal of CO_2**

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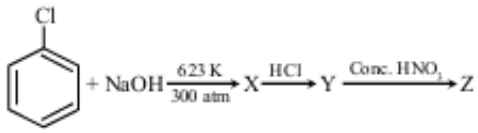
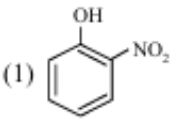
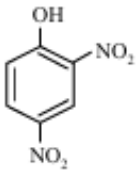
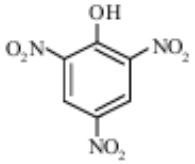
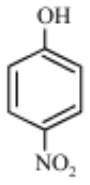
63. Identify compound (Z) in the following reaction sequence.



(1) 

(2) 

(3) 

(4) 

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64. Given below are two statements: One is labelled as Assertion (A) and the other as Reason (R):

Assertion (A): Enthalpy of neutralisation of strong monobasic acid with strong monoacidic base is always $-57\,\text{kJ mol}^{-1}$.

Reason (R): Enthalpy of neutralisation is the amount of heat liberated when one mole of H^+ ions furnished by acid combine with one mole of OH^- ions furnished by base to form one mole of water.

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

1. (A) is true but (R) is false

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

3. (A) is false but (R) is true

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

---

65. The statement(s) that are correct about the species O^{2-}, F^-, Na^+, and Mg^{2+} are:

(A) All are isoelectronic.

(B) All have the same nuclear charge.

(C) O^{2-} has the largest ionic radii.

(D) Mg^{2+} has the smallest ionic radii.

Choose the most appropriate answer from the options given below: 1. (B), (C), and (D) only

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

3. (C) and (D) only

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

---

66. For the compounds:

(A) $H_3C - CH_2 - O - CH_2 - CH_2 - CH_3$

(B) $H_3C - CH_2 - CH_2 - CH_2 - CH_3$

(C) $CH_3 - CH_2 - C(=O) - CH_2 - CH_3$

(D) $H_3C - CH(-OH) - CH_2 - CH_2 - CH_3$

The increasing order of boiling points is:

1. (A) < (B) < (C) < (D)
2. (B) < (A) < (C) < (D)
3. (D) < (C) < (A) < (B)
4. (B) < (A) < (D) < (C)

---

67. Given below are two statements:

Statement I: In group 13, the stability of $+1$ oxidation state increases down the group.

Statement II: The atomic size of gallium is greater than that of aluminium.

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**

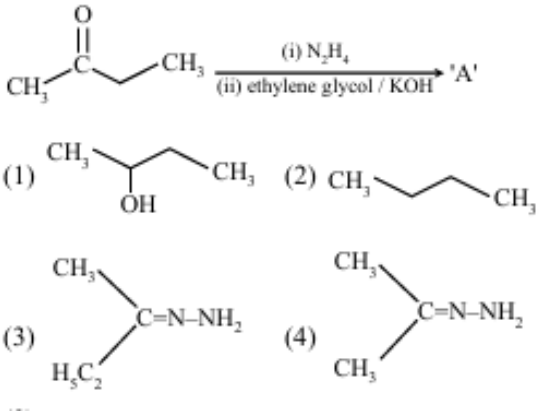
---

68. Number of σ and π bonds present in the ethylene molecule is respectively:

1. **3 and 1**
2. **5 and 2**
3. **4 and 1**
4. **5 and 1**

---

69. Identify 'A' in the following reaction:



$$CH_3 - CO - CH_2 - CH_3 \xrightarrow{N_2H_4} CH_3 - C(NHNH_2) - CH_2 - CH_3.$$

---

70. The reaction at the cathode in the cells commonly used in clocks involves:

1. **reduction of Mn from +4 to +3**
2. **oxidation of Mn from +3 to +4**
3. **reduction of Mn from +7 to +2**
4. **oxidation of Mn from +2 to +7**

---

71. Which one of the following complexes will exhibit the least paramagnetic behaviour?

[Atomic numbers: Cr = 24, Mn = 25, Fe = 26, Co = 27]

1. $[Co(H_2O)_6]^{2+}$
2. $[Fe(H_2O)_6]^{2+}$
3. $[Mn(H_2O)_6]^{2+}$
4. $[Cr(H_2O)_6]^{2+}$

---

72. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R):

Assertion (A): Cis form of alkene is found to be more polar than the trans form.
Reason (R): Dipole moment of the trans isomer of 2-butene is zero.

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

1. **Both (A) and (R) are true but (R) is NOT the correct explanation of (A)**
2. **(A) is true but (R) is false**
3. **Both (A) and (R) are true and (R) is the correct explanation of (A)**
4. **(A) is false but (R) is true**

---

73. Given below are two statements:

Statement I: Nitration of benzene involves the following step:

Statement II: Use of Lewis base promotes the electrophilic substitution of benzene.

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 incorrect**
2. **Statement I is correct but Statement II is incorrect**

3. Both Statement I and Statement II are correct

4. Statement I is incorrect but Statement II is correct

Q.74 The correct order of ligands arranged in increasing field strength:

(1) $Cl^- < OH^- < Br^- < CN^-$

(2) $F^- < Br^- < F^- < NH_3$

(3) $Br^- < F^- < H_2O < NH_3$

(4) $H_2O < OH^- < CN^- < NH_3$

Q.75 Which of the following gives a positive test with ninhydrin?

(1) Cellulose

(2) Starch

(3) Polyvinyl chloride

(4) Egg albumin

Q.76 The metal that shows the highest and maximum number of oxidation states is:

(1) Fe

(2) Mn

(3) Ti

(4) Co

Q.77 An organic compound has 42.1% carbon, 6.4% hydrogen, and the remainder is oxygen. If its molecular weight is 342, then its molecular formula is:

1. $C_{11}H_{18}O_{12}$
2. $C_{12}H_{20}O_{12}$
3. $C_{14}H_{20}O_{10}$
4. $C_{12}H_{22}O_{11}$

Q.78 Given below are two statements:

Statement I: Bromination of phenol in solvent with low polarity such as $CHCl_3$ or CS_2 requires Lewis acid catalyst.

Statement II: The Lewis acid catalyst polarises the bromine to generate Br^+.

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.

Q.79 Molar ionic conductivities of divalent cation and anion are 57 S cm^2 mol^{-1} and 73 S cm^2 mol^{-1}, respectively. The molar conductivity of a solution of an electrolyte with the above cation and anion will be:

(1) 65 S cm^2 mol^{-1}

(2) 130 S cm^2 mol^{-1}

(3) 187 S cm^2 mol^{-1}

(4) 260 S cm^2 mol^{-1}

Q.80 The number of neutrons present in the more abundant isotope of boron is 'x'. Amorphous boron upon heating with air forms a product, in which the oxidation state of boron is 'y'. The value of $x + y$ is:

(1) 4

(2) 6

(3) 3

(4) 9

Q.81 The value of Rydberg constant (R_H) is 2.18×10^{-18} J. The velocity of electron having mass 9.1×10^{-31} kg in Bohr's first orbit of hydrogen atom is ..... $\times 10^5$ ms^{-1} (nearest integer).

Q.82 In a borax bead test under hot conditions, a metal salt (one from the given) is

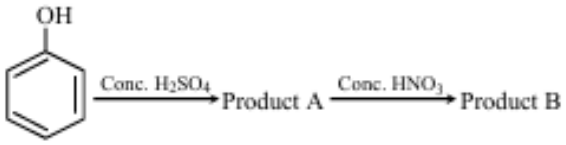
heated at point B of the flame, resulting in a green-colored salt bead. The spin-only magnetic moment value of the salt is ..... BM (Nearest integer).

Q.83 The heat of combustion of solid benzoic acid at constant volume is -321.30 kJ at 27°C. The heat of combustion at constant pressure is $(-321.30 - xR)$ kJ. The value of x is

.....

Correct Answer: (150)

Q.84 Consider the given chemical reaction sequence:



The total sum of oxygen atoms in Product A and Product B is .....

Q.85 The spin-only magnetic moment value of the ion among Ti^{2+}, V^{2+}, Co^{3+}, and Cr^{2+}, that acts as a strong oxidising agent in aqueous solution is ..... BM (Nearest integer).
(Given atomic numbers: Ti: 22, V: 23, Cr: 24, Co: 27)

Q.86 During the kinetic study of the reaction $2A + B \rightarrow C + D$, the following results were obtained:

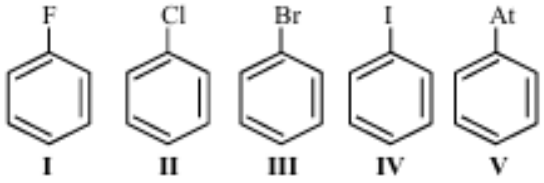
[A](M)	[B](M)	Initial Rate of Formation of D (M/s)
0.1	0.1	6.0×10^{-3}
0.3	0.2	7.2×10^{-2}
0.3	0.4	2.88×10^{-1}
0.4	0.1	2.40×10^{-2}

Based on the data above, the overall order of the reaction is .....

Q.87 An artificial cell is made by encapsulating 0.2 M glucose solution within a semipermeable membrane. The osmotic pressure developed when the artificial cell is placed within a 0.05 M solution of NaCl at 300 K is ..... $\times 10^{-1}$ bar (Nearest integer).
(Given: $R = 0.083\,\text{L bar mol}^{-1}\text{K}^{-1}$)
Assume complete dissociation of NaCl.

Q.88 The number of halobenzenes from the following that can be prepared by Sandmeyer's reaction is .....

Q.89 In the Lewis dot structure for NO_2^-, the total number of valence electrons around nitrogen is .....



Q.90 9.3 g of pure aniline is treated with bromine water at room temperature to give a white precipitate of the product 'P'. The mass of product 'P' obtained is 26.4 g. The percentage yield is ..... %
