JEE MAIN 2024 8 April Shift 2 Question Paper

1. If the image of the point $(-4, 5)$ **in the line** $x + 2y = 2$ **lies on the circle** $(x+4)^2 + (y-3)^2 = r^2$**, then** r **is equal to:**

(1) 1

(2) 2

(3) 75

(4) 3

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2. Let $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$**,** $\vec{b} = 2\hat{i} + 3\hat{j} - 5\hat{k}$**, and** $\vec{c} = 3\hat{i} - \hat{j} + \lambda\hat{k}$ **be three vectors. Let** $\vec{r}$ **be a unit vector along** $\vec{b} + \vec{c}$**. If** $\vec{r} \cdot \vec{a} = 3$**, then** 3λ **is equal to:**

(1) 27

(2) 25

(3) 25

(4) 21

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3. If $\alpha \neq a$**,** $\beta \neq b$**,** $\gamma \neq c$ **and**

$$\begin{vmatrix} \alpha & b & c \\ a & \beta & c \\ a & b & \gamma \end{vmatrix} = 0, \text{ then } \frac{a}{\alpha - a} + \frac{b}{\beta - b} + \frac{\gamma}{\gamma - c} \text{ is equal to:}$$

(1) 2

(2) 3

(3) 0

(4) 1

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4. In an increasing geometric progression of positive terms, the sum of the second and sixth terms is $\frac{70}{3}$ and the product of the third and fifth terms is 49. Then the sum of the 4th, 6th, and 8th terms is:

(1) 96

(2) 78

(3) 91

(4) 84

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5. The number of ways five alphabets can be chosen from the alphabets of the word MATHEMATICS, where the chosen alphabets are not necessarily distinct, is equal to:

(1) 175

(2) 181

(3) 177

(4) 179

6: The sum of all possible values of $\theta \in [-\pi, 2\pi]$, for which

$$\frac{1 + i\cos\theta}{1 - 2i\cos\theta}$$

is purely imaginary, is equal to:

Options:

(1) 2π

(2) 3π

(3) 5π

(4) 4π

7. If the system of equations

$$x + 4y - z = \lambda, \quad 7x + 9y + \mu z = -3, \quad 5x + y + 2z = -1$$

has infinitely many solutions, then $2\mu + 3\lambda$ is equal to:

(1) 2

(2) -3

(3) 3

(4) -2

8. If the shortest distance between the lines

$$\frac{x - \lambda}{2} = \frac{y - 4}{3} = \frac{z - 3}{4} \quad \text{and} \quad \frac{x - 2}{4} = \frac{y - 4}{6} = \frac{z - 7}{8}$$

is $\frac{13}{\sqrt{29}}$, then a value of λ is:

(1) $-\frac{13}{25}$

(2) $\frac{13}{25}$

(3) 1

(4) -1

.

9. If the value of

$$\frac{3\cos 36° + 5\sin 18°}{5\cos 36° - 3\sin 18°} = \frac{a\sqrt{5} - b}{c},$$

where a, b, c are natural numbers and $\gcd(a, c) = 1$, then $a + b + c$ is equal to:

(1) 50

(2) 40

(3) 52

(4) 54

10. Let $y = y(x)$ be the solution curve of the differential equation

$$\sec y \frac{dy}{dx} + 2x \sin y = x^3 \cos y,$$

with the condition $y(1) = 0$**. Then** $y(\sqrt{3})$ **is equal to:**

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

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

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

(4) $\frac{\pi}{12}$

11. The area of the region in the first quadrant inside the circle $x^2 + y^2 = 8$ **and outside the parabola** $y^2 = 2x$ **is equal to:**

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

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

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

(4) $\pi - \frac{1}{3}$

12. If the line segment joining the points $(5, 2)$ **and** $(2, a)$ **subtends an angle** $\frac{\pi}{4}$ **at the origin, then the absolute value of the product of all possible values of** a **is:**

(1) 6

(2) 8

(3) 2

(4) 4

13. Let $\vec{a} = 4\hat{i} - \hat{j} + \hat{k}$**,** $\vec{b} = 11\hat{i} - \hat{j} + \hat{k}$**, and** $\vec{c}$ **be a vector such that**

$$(\vec{a} + \vec{b}) \times \vec{c} = \vec{c} \times (-2\vec{a} + 3\vec{b}).$$

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If $(2\vec{a} + 3\vec{b}) \cdot \vec{c} = 1670$, then $|\vec{c}|^2$ is equal to:

(1) 1627

(2) 1618

(3) 1600

(4) 1609

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14. If the function $f(x) = 2x^3 - 9ax^2 + 12a^2x + 1$, $a > 0$, has a local maximum at $x = \alpha$ and a local minimum at $x = \alpha^2$, then α and α^2 are the roots of the equation:

(1) $x^2 - 6x + 8 = 0$

(2) $8x^2 + 6x - 8 = 0$

(3) $8x^2 - 6x + 1 = 0$

(4) $x^2 + 6x + 8 = 0$

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15. There are three bags X, Y, and Z. Bag X contains 5 one-rupee coins and 4 five-rupee coins; Bag Y contains 4 one-rupee coins and 5 five-rupee coins; and Bag Z contains 3 one-rupee coins and 6 five-rupee coins. A bag is selected at random and a coin drawn from it at random is found to be a one-rupee coin. Then the probability that it came from bag Y is:

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

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

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

(4) $\frac{5}{12}$

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16. Let

$$\int_{\alpha}^{\log_e 4} \frac{dx}{\sqrt{e^x - 1}} = \frac{\pi}{6}.$$

5

Then e^{α} and $e^{-\alpha}$ are the roots of the equation:

(1) $2x^2 - 5x + 2 = 0$

(2) $x^2 - 2x - 8 = 0$

(3) $2x^2 - 5x - 2 = 0$

(4) $x^2 + 2x - 8 = 0$

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17. Let

$$f(x) = \begin{cases} -a & \text{if } -a \leq x \leq 0 \\ x + a & \text{if } 0 < x \leq a \end{cases}$$

where $a > 0$ **and** $g(x) = \frac{f(|x|) - |f(x)|}{2}$. **Then the function** $g : [-a, a] \to [-a, a]$ **is:**

(1) neither one-one nor onto

(2) both one-one and onto

(3) one-one

(4) onto

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18. Let $A = \{2, 3, 6, 8, 9, 11\}$ **and** $B = \{1, 4, 5, 10, 15\}$. **Let** R **be a relation on** $A \times B$ **defined by** $(a, b)R(c, d)$ **if and only if** $3ad - 7bc$ **is an even integer. Then the relation** R **is:**

(1) reflexive but not symmetric.

(2) transitive but not symmetric.

(3) reflexive and symmetric but not transitive.

(4) an equivalence relation.

19. For $a, b > 0$**, let**

$$f(x) = \begin{cases} \tan((a+1)x) + b \tan x, & x < 0 \\ \frac{x}{3}, & x = 0 \\ \frac{\sqrt{ax + b^2 x^2} - \sqrt{ax}}{b\sqrt{ax\sqrt{x}}}, & x > 0 \end{cases}$$

be a continuous function at $x = 0$**. Then** $\frac{b}{a}$ **is equal to:**

(1) 5

(2) 4

(3) 8

(4) 6

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20. If the term independent of x **in the expansion of**

$$\left(\sqrt{ax^2} + \frac{1}{2x^3} \right)^{10}$$

is 105**, then** a^2 **is equal to:**

(1) 4

(2) 9

(3) 6

(4) 2

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21. Let A **be the region enclosed by the parabola** $y^2 = 2x$ **and the line** $x = 24$**. Then the maximum area of the rectangle inscribed in the region** A **is** _____.

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22. If $\alpha = \lim_{x \to 0^+} \left(\frac{e^{\sqrt{\tan x}} - e^{\sqrt{x}}}{\sqrt{\tan x} - \sqrt{x}} \right)$ **and** $\beta = \lim_{x \to 0} (1 + \sin x)^{\frac{1}{2 \cot x}}$ **are the roots of the quadratic equation** $ax^2 + bx - \sqrt{e} = 0$**, then** $12 \log_e(a + b)$ **is equal to :**

23. Let S be the focus of the hyperbola $\frac{x^2}{3} - \frac{y^2}{5} = 1$, on the positive x-axis. Let C be the circle with its centre at $A(\sqrt{6}, \sqrt{5})$ and passing through the point S. If O is the origin and SAB is a diameter of C, then the square of the area of the triangle OSB is equal to -

24. Let P(α, β, γ) be the image of the point Q(1, 6, 4) in the line $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$. Then $2\alpha + \beta + \gamma$ is equal to:

25. An arithmetic progression is written in the following way:

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                    2
          5                8
    11          14                17
20          23          26          29
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The sum of all the terms of the 10th row is:

26. The number of distinct real roots of the equation $|x+1||x+3| - 4|x+2| + 5 = 0$ is:

27. Let a ray of light passing through the point (3, 10) reflect on the line $2x + y = 6$ and the reflected ray pass through the point (7, 2). If the equation of the incident ray is $ax + by + 1 = 0$, then $a^2 + b^2 + 3ab$ is equal to:

28. Let $a, b, c \in \mathbb{N}$ and $a < b < c$. Let the mean, the mean deviation about the mean, and the variance of the 5 observations $9, 25, a, b, c$ be $18, 4$ and $\frac{136}{5}$, respectively. Then $2a + b - c$ is equal to:

29. Let $\alpha|x| = |y|e^{xy-\beta}$, $\alpha, \beta \in \mathbb{N}$ **be the solution of the differential equation** $xdy - ydx + xy(xdy + ydx) = 0$, **with** $y(1) = 2$. **Then** $\alpha + \beta$ **is equal to:**

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30. If $\int \frac{1}{\sqrt[5]{(x-1)^4(x+3)^6}}dx = A\left(\frac{\alpha x-1}{\beta x+3}\right)^B + C$, **where** C **is the constant of integration, then the value of** $\alpha + \beta + 20AB$ **is:**
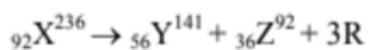
Physics

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31. A block is simply released from the top of an inclined plane as shown in the figure above. The maximum compression in the spring when the block hits the spring is:
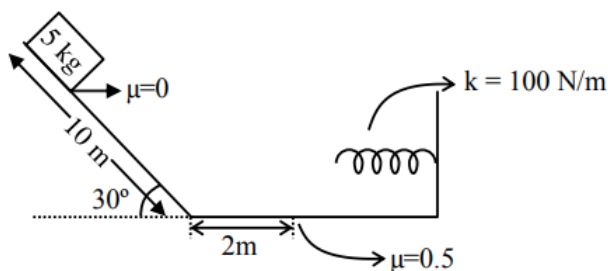
(1) $\sqrt{6}\,\text{m}$

(2) $2\,\text{m}$

(3) $1\,\text{m}$

(4) $\sqrt{5}\,\text{m}$

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32. In a hypothetical fission reaction:

$$_{92}X^{236} \rightarrow \, _{56}Y^{141} + \, _{36}Z^{92} + 3R$$

The identity of emitted particles (R) **is:**

(1) Proton

(2) Electron

(3) Neutron

(4) γ-radiations

33. If ε_0 is the permittivity of free space and E is the electric field, then $\varepsilon_0 E^2$ has the dimensions:

(1) $[M^0 L^{-2} T A]$

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

(3) $[M^{-1} L^{-3} T^4 A^2]$

(4) $[M L^2 T^{-2}]$

34. The position of the image formed by the combination of lenses is:
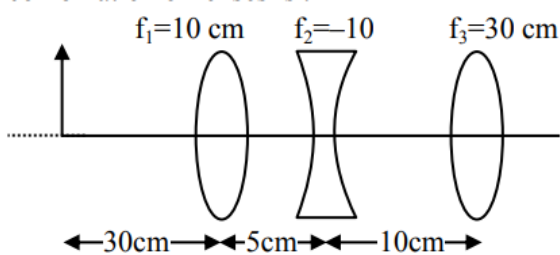
(1) $30\,\text{cm}$ (right of third lens)

(2) $15\,\text{cm}$ (left of second lens)

(3) $30\,\text{cm}$ (left of third lens)

(4) $15\,\text{cm}$ (right of second lens)

35. A plane progressive wave is given by:

$$y = 2\cos 2\pi(330\,t - x)\,\text{m}.$$

The frequency of the wave is:

(1) $165\,\text{Hz}$

(2) $330\,\text{Hz}$

(3) $660\,\text{Hz}$

(4) $340\,\text{Hz}$

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36. A thin circular disc of mass M and radius R is rotating in a horizontal plane about an axis passing through its center and perpendicular to its plane with angular velocity ω. If another disc of same dimensions but of mass $M/2$ is placed gently on the first disc co-axially, then the new angular velocity of the system is:

(1) $\frac{4}{5}\omega$

(2) $\frac{5}{4}\omega$

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

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

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37. A cube of ice floats partly in water and partly in kerosene oil. The ratio of volume of ice immersed in water to that in kerosene oil (specific gravity of kerosene oil $= 0.8$, specific gravity of ice $= 0.9$) is:
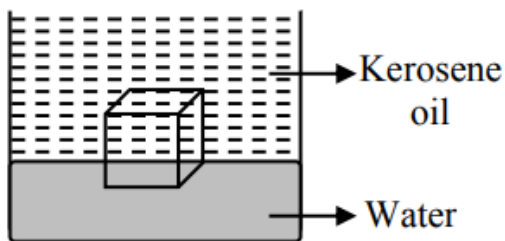
(1) $8 : 9$

(2) $5 : 4$

(3) $9 : 10$

(4) $1 : 1$

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38. Given below are two statements:

Statement (I): The mean free path of gas molecules is inversely proportional to the square of

11

molecular diameter.

Statement (II): Average kinetic energy of gas molecules is directly proportional to absolute temperature of gas.

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

(1) **Statement I is false but Statement II is true.**

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

(3) **Both Statement I and Statement II are false.**

(4) **Both Statement I and Statement II are true.**

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39. Two satellites A and B orbit a planet in circular orbits having radii $4R$ and R, respectively. If the speed of A is $3v$, the speed of B will be:

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

(2) $3v$

(3) $6v$

(4) $12v$

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40. A long straight wire of radius a carries a steady current I. The current is uniformly distributed across its cross section. The ratio of the magnetic field at $\frac{a}{2}$ and $2a$ from the axis of the wire is:

(1) $1 : 4$

(2) $4 : 1$

(3) $1 : 1$

(4) $3 : 4$

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41. The angle of projection for a projectile to have the same horizontal range and maxi-

mum height is:

(1) $\tan^{-1}(1)$

(2) $\tan^{-1}(4)$

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

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

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42. Water boils in an electric kettle in 20 minutes after being switched on. Using the same main supply, the length of the heating element should be ... to ... times of its initial length if the water is to be boiled in 15 minutes.

(1) Increased, $\frac{3}{4}$

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

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

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

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43. A capacitor has air as dielectric medium and two conducting plates of area $12\,\text{cm}^2$, and they are $0.6\,\text{cm}$ apart. When a slab of dielectric having area $12\,\text{cm}^2$ and $0.6\,\text{cm}$ thickness is inserted between the plates, one of the conducting plates has to be moved by $0.2\,\text{cm}$ to keep the capacitance the same as in the previous case. The dielectric constant of the slab is: (Given $\varepsilon_0 = 8.834 \times 10^{-12}\,\text{F/m}$).

(1) 1.50

(2) 1.33

(3) 0.66

(4) 1

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44. A given object takes n times the time to slide down a $45°$ rough inclined plane as it takes to slide down an identical perfectly smooth $45°$ inclined plane. The coefficient of

kinetic friction between the object and the surface of the inclined plane is:

(1) $1 - \frac{1}{n^2}$

(2) $1 - n^2$

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

(4) $\sqrt{1 - n^2}$

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45. A coil of negligible resistance is connected in series with a $90\,\Omega$ resistor across $120\,\text{V}$, $60\,\text{Hz}$ supply. A voltmeter reads $36\,\text{V}$ across the resistor. The inductance of the coil is:

(1) $0.76\,\text{H}$

(2) $2.86\,\text{H}$

(3) $0.286\,\text{H}$

(4) $0.91\,\text{H}$

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46. There are 100 divisions on the circular scale of a screw gauge of pitch $1\,\text{mm}$. With no measuring quantity in between the jaws, the zero of the circular scale lies 5 divisions below the reference line. The diameter of a wire is then measured using this screw gauge. It is found that 4 linear scale divisions are clearly visible while 60 divisions on the circular scale coincide with the reference line. The diameter of the wire is:

(1) $4.65\,\text{mm}$

(2) $4.55\,\text{mm}$

(3) $4.60\,\text{mm}$

(4) $3.35\,\text{mm}$

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47. A proton and an electron have the same de Broglie wavelength. If K_p and K_e are the kinetic energies of the proton and electron respectively, then choose the correct relation:

(1) $K_p > K_e$

(2) $K_p = K_e$

(3) $K_p = K_e^2$

(4) $K_p < K_e$

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48. The least count of a vernier caliper is $\frac{1}{20N}$ cm. The value of one division on the main scale is $1\,\mathrm{mm}$. Then the number of divisions of the main scale that coincide with N divisions of the vernier scale is:

(1) $\frac{2N-1}{20N}$

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

(3) $(2N-1)$

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

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49. If M_0 is the mass of isotope $^{12}_{5}B$, M_p and M_n are the masses of proton and neutron, then nuclear binding energy of the isotope is:

(1) $(5M_p + 7M_n - M_0)c^2$

(2) $(M_0 - 5M_p)c^2$

(3) $(M_0 - 12M_n)c^2$

(4) $(M_0 - 5M_p - 7M_n)c^2$


50. A diatomic gas ($\gamma = 1.4$) does $100\,\mathrm{J}$ of work in an isobaric expansion. The heat given to the gas is:

(1) $350\,\mathrm{J}$

(2) $490\,\mathrm{J}$

(3) $150\,\mathrm{J}$

(4) $250\,\mathrm{J}$

51. The coercivity of a magnet is $5 \times 10^3 \, \text{A/m}$. The amount of current required to be passed in a solenoid of length $30 \, \text{cm}$ and number of turns 150, so that the magnet gets demagnetised when inside the solenoid, is ... A.

52. Small water droplets of radius $0.01 \, \text{mm}$ are formed in the upper atmosphere and fall with a terminal velocity of $10 \, \text{cm/s}$. Due to condensation, if 8 such droplets are coalesced and form a larger drop, the new terminal velocity will be ... cm/s.

53. If the net electric field at point P along the Y-axis is zero, then the ratio of $\left| \frac{q_2}{q_3} \right|$ is $\frac{8}{5\sqrt{x}}$, where $x = \, ...$
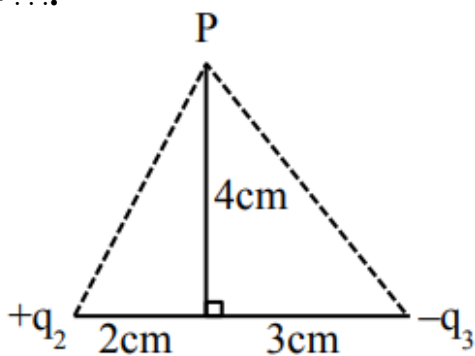
54. A heater is designed to operate with a power of $1000 \, \text{W}$ in a $100 \, \text{V}$ line. It is connected in combination with a resistance of $10 \, \Omega$ and a resistance R, to a $100 \, \text{V}$ mains as shown in the figure. For the heater to operate at $62.5 \, \text{W}$, the value of R should be ... Ω.
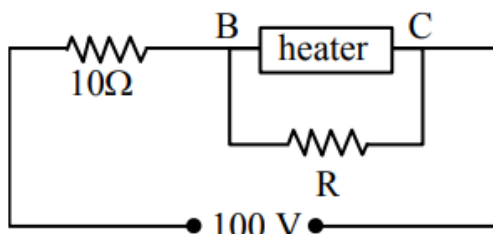
55. An alternating emf $E = 110\sqrt{2}\sin(100t)$ V is applied to a capacitor of $2\,\mu\text{F}$. The RMS value of current in the circuit is ...mA.

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56. Two slits are $1\,\text{mm}$ apart, and the screen is located $1\,\text{m}$ away from the slits. A light wavelength $500\,\text{nm}$ is used. The width of each slit to obtain 10 maxima of the double-slit pattern within the central maximum of the single-slit pattern is $\ldots \times 10^{-4}\,\text{m}$.

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57. An object of mass $0.2\,\text{kg}$ executes simple harmonic motion along the x-axis with a frequency of $\left(\frac{25}{\pi}\right)$ Hz. At the position $x = 0.04\,\text{m}$, the object has kinetic energy $0.5\,\text{J}$ and potential energy $0.4\,\text{J}$. The amplitude of oscillation is ...cm.

**58.** A potential divider circuit is connected with a DC source of $20\,\text{V}$, a light-emitting diode (LED) with a glow voltage of $1.8\,\text{V}$, and a zener diode with a breakdown voltage of $3.2\,\text{V}$. The length (PR) of the resistive wire is $20\,\text{cm}$. The minimum length of PQ to just glow the LED is ...cm.

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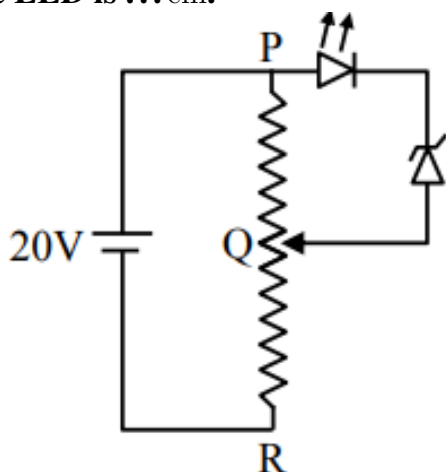
59. A body of mass M thrown horizontally with velocity v from the top of a tower of height H touches the ground at a distance of $100\,\text{m}$ from the foot of the tower. A body of mass $2M$ thrown at a velocity $\frac{v}{2}$ from the top of a tower of height $4H$ will touch the

ground at a distance of . . . m.

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60. A circular table is rotating with an angular velocity of $\omega\,\mathrm{rad/s}$ about its axis (see figure). There is a smooth groove along a radial direction on the table. A steel ball is gently placed at a distance of $1\,\mathrm{m}$ on the groove. All surfaces are smooth. If the radius of the table is $3\,\mathrm{m}$, the radial velocity of the ball with respect to the table at the time the ball leaves the table is $x\sqrt{2}\omega\,\mathrm{m/s}$, where the value of x is . . . .
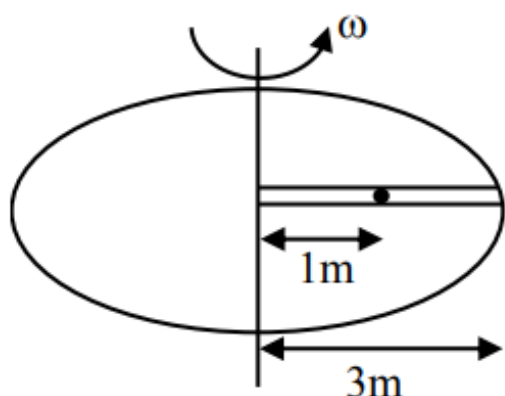
Chemistry

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61. In qualitative tests for the identification of the presence of phosphorus, the compound is heated with an oxidizing agent. It is then treated with nitric acid and ammonium molybdate, respectively. The yellow-colored precipitate obtained is:

(1) $Na_3PO_4 \cdot 12MoO_3$

(2) $(NH_4)_3PO_4 \cdot 12(NH_4)_2MoO_4$

(3) $(NH_4)_3PO_4 \cdot 12MoO_3$

(4) $MoPO_4 \cdot 21NH_4NO_3$

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62. For a reaction $A \xrightarrow{k_1} B \xrightarrow{k_2} C$, if the rate of formation of B is set to zero, then the

concentration of B **is given by:**

(1) $k_1 k_2 [A]$

(2) $(k_1 - k_2)[A]$

(3) $(k_1 + k_2)[A]$

(4) $\left(\frac{k_1}{k_2}\right)[A]$

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63. When ψ_A and ψ_B are the wave functions of atomic orbitals, then σ^* is represented by:

(1) $\psi_A - 2\psi_B$

(2) $\psi_A - \psi_B$

(3) $\psi_A + 2\psi_B$

(4) $\psi_A + \psi_B$

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64. Which one of the following compounds will readily react with dilute $NaOH$?

(1) $C_6H_5CH_2OH$

(2) C_2H_5OH

(3) $(CH_3)_3COH$

(4) C_6H_5OH

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65. The shape of a carbocation is:

(1) Trigonal planar

(2) Diagonal pyramidal

(3) Tetrahedral

(4) Diagonal

66. Given below are two statements:

- **Statement I:** S_N2 reactions are 'stereospecific', indicating that they result in the formation of only one stereoisomer as the product.

- **Statement II:** S_N1 reactions generally result in the formation of products as racemic mixtures.

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

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

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

(3) Both Statement I and Statement II are true

(4) Both Statement I and Statement II are false

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67. Match List-I with List-II.
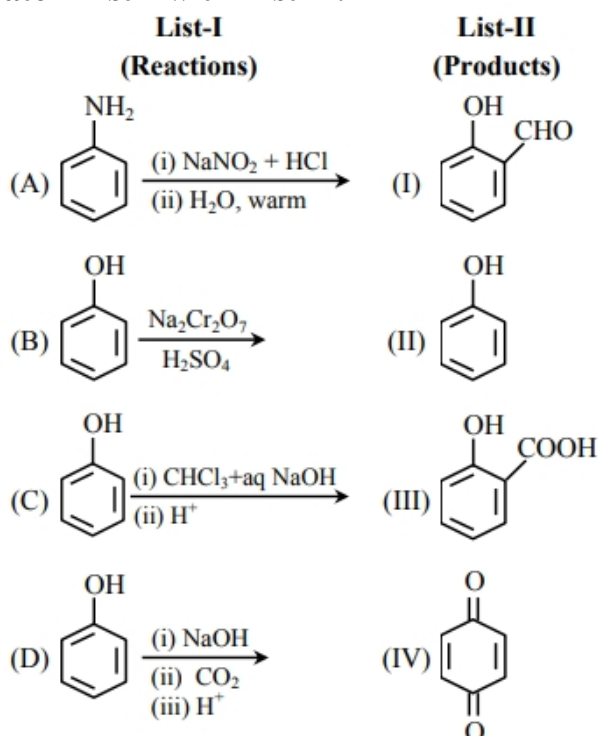
Choose the correct answer from the options given below :

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

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

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

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

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68. Match List-I with List-II.

List-I (Test)	List-II (Identification)
(A) Bayer's test	(I) Phenol
(B) Ceric ammonium nitrate test	(II) Aldehyde
(C) Phthalein dye test	(III) Alcoholic-OH group
(D) Schiff's test	(IV) Unsaturation

Choose the correct answer from the options given below:

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

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

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

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

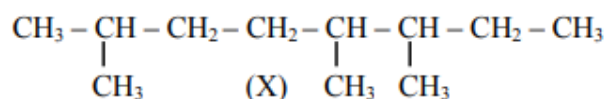**69. Identify the incorrect statements about Group 15 elements:**

(A) Dinitrogen is a diatomic gas that acts like an inert gas at room temperature.

(B) The common oxidation states of these elements are -3, $+3$, and $+5$.

(C) Nitrogen has a unique ability to form $p\pi$-$p\pi$ multiple bonds.

(D) The stability of $+5$ oxidation state increases down the group.

(E) Nitrogen shows a maximum covalency of 6.

   Choose the correct answer from the options given below:

(1) (A), (B), (D) only

(2) (A), (C), (E) only

(3) (B), (D), (E) only

(4) (D) and (E) only

---

70. The IUPAC name of the following hydrocarbon (X) is:

$$CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - CH_2 - \underset{\underset{(X) \quad CH_3}{|}}{CH} - \underset{\underset{CH_3}{|}}{CH} - CH_2 - CH_3$$

(1) 2-Ethyl-3,6-dimethylheptane

(2) 2-Ethyl-2,6-diethylheptane

(3) 2,5,6-Trimethyloctane

(4) 3,4,7-Trimethyloctane

---

71. The equilibrium $Cr_2O_7^{2-} \rightleftharpoons 2CrO_4^{2-}$ is shifted to the right in:

(1) an acidic medium

(2) a basic medium

(3) a weakly acidic medium

(4) a neutral medium

---

72. Given below are two statements:

- **Statement I:** A buffer solution is the mixture of a salt and an acid or a base mixed in any particular quantities.

- **Statement II:** Blood is a naturally occurring buffer solution whose pH is maintained by H_2CO_3/HCO_3^- concentrations.

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

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

(2) Both Statement I and Statement II are true

(3) Both Statement I and Statement II are false
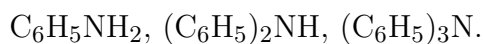
(4) Statement I is true but Statement II is false

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73. The correct sequence of acidic strength of the following aliphatic acids in their decreasing order is:

$$CH_3CH_2COOH, \; CH_3COOH, \; CH_3CH_2CH_2COOH, \; HCOOH$$

(1) $HCOOH > CH_3COOH > CH_3CH_2COOH > CH_3CH_2CH_2COOH$

(2) $HCOOH > CH_3CH_2CH_2COOH > CH_3CH_2COOH > CH_3COOH$

(3) $CH_3CH_2CH_2COOH > CH_3CH_2COOH > CH_3COOH > HCOOH$

(4) $CH_3COOH > CH_3CH_2COOH > CH_3CH_2CH_2COOH > HCOOH$

---

74. Given below are two statements:

- **Statement I:** All the following compounds react with p-toluenesulfonyl chloride:

$$C_6H_5NH_2, \; (C_6H_5)_2NH, \; (C_6H_5)_3N.$$

- **Statement II:** Their products in the above reaction are soluble in aqueous $NaOH$.

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

(1) Both Statement I and Statement II are false

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

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

(4) Both Statement I and Statement II are true

---

75. The emf of the cell:

$$Tl \,|\, Tl^+ \,(0.001\,M) \,||\, Cu^{2+} \,(0.01\,M) \,|\, Cu$$

is $0.83\,\text{V}$ at $298\,\text{K}$. It could be increased by:

(1) increasing concentration of Tl^+ ions

(2) increasing concentration of both Tl^+ and Cu^{2+} ions

(3) decreasing concentration of both Tl^+ and Cu^{2+} ions

(4) increasing concentration of Cu^{2+} ions

---

76. Identify the correct statements about p-block elements and their compounds:

(A) Non-metals have higher electronegativity than metals.

(B) Non-metals have lower ionization enthalpy than metals.

(C) Compounds formed between highly reactive non-metals and highly reactive metals are generally ionic.

(D) The non-metal oxides are generally basic in nature.

(E) The metal oxides are generally acidic or neutral in nature.

   Choose the correct answer:

(1) (D) and (E) only

(2) (A) and (C) only

(3) (B) and (E) only

(4) (B) and (D) only

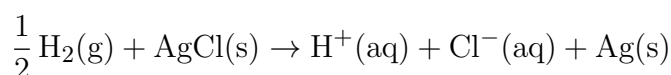## 77. Given below are two statements:

Statement I: Kjeldahl method is applicable to estimate nitrogen in pyridine.

Statement II: The nitrogen present in pyridine can easily be converted into ammonium sulfate in Kjeldahl method.

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

(1) Both Statement I and Statement II are false

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

(3) Both Statement I and Statement II are true

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

---

78. The reaction:

$$\frac{1}{2}\,H_2(g) + AgCl(s) \rightarrow H^+(aq) + Cl^-(aq) + Ag(s)$$

occurs in which of the following galvanic cells?

(1) $Pt|H_2(g)|HCl(soln.)|AgCl(s)|Ag$

(2) $Pt|H_2(g)|HCl(soln.)|AgNO_3(aq)|Ag$

(3) $Pt|H_2(g)|KCl(soln.)|AgCl(s)|Ag$

(4) $Ag|AgCl(s)|KCl(soln.)|AgNO_3(aq)|Ag$

---

79. Given below are two statements:

- **Statement I:** Fusion of MnO_2 with KOH and an oxidizing agent gives dark green K_2MnO_4.

- **Statement II:** Manganate ion on electrolytic oxidation in alkaline medium gives permanganate ion.

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

(1) Both Statement I and Statement II is true

(2) Both Statement I and Statement II is false

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

(4) Statement I is false but Statement II is true
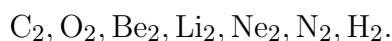
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80. Match List-I with List-II:

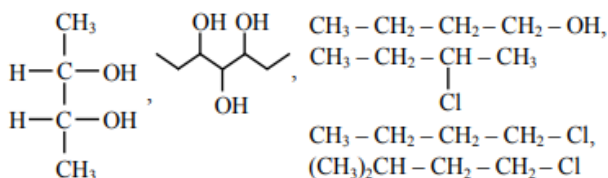| List-I (Complex ion)	List-II (Spin only magnetic moment in B.M.)
(A) $[Cr(NH_3)_6]^{3+}$	(I) 4.90
(B) $[NiCl_4]^{2-}$	(II) 3.87
(C) $[CoF_6]^{3-}$	(III) 0.0
(D) $[Ni(CN)_4]^{2-}$	(IV) 2.83

Choose the correct answer from the options given below:

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

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

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

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

---

81. $\Delta_{vap}H^\circ$ for water is $+40.49\,\text{kJ}\,\text{mol}^{-1}$ at $1\,\text{bar}$ and $100°C$. Change in internal energy for this vaporization under the same condition is _____ $\text{kJ}\,\text{mol}^{-1}$. (Integer answer)

---

82. Number of molecules having bond order 2 from the following molecules is _____:

$$C_2, O_2, Be_2, Li_2, Ne_2, N_2, H_2.$$

---

83. Total number of optically active compounds from the following is _____:

$CH_3-CH_2-CH_2-CH_2-OH,$

$CH_3-CH_2-CH-CH_3$ with Cl substituent

$CH_3-CH_2-CH_2-CH_2-Cl,$

$(CH_3)_2CH-CH_2-CH_2-Cl$

(along with structures: 2,3-dihydroxy-butane type, CH₃ / H–C–OH / H–C–OH / CH₃; and OH OH ... OH pentane structure)

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84. The total number of carbon atoms present in tyrosine, an amino acid, is _____.

85. Two moles of benzaldehyde and one mole of acetone under alkaline conditions using aqueous NaOH after heating gives x as the major product. The number of π-bonds in the product x is _____.

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86. Total number of aromatic compounds among the following compounds is _____.

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87. Molality of an aqueous solution of urea is $4.44\,\mathrm{m}$. Mole fraction of urea in the solution is $x \times 10^{-3}$. Value of x is _____. (Integer answer)

---

88. Total number of unpaired electrons in the complex ion $[\mathrm{Co(NH_3)_6}]^{3+}$ and $[\mathrm{NiCl_4}]^{2-}$ is _____.

---

89. Wavenumber for a radiation having $5800\,\text{Å}$ wavelength is $x \times 10\,\mathrm{cm}^{-1}$. The value of x is _____.

---

90. A solution is prepared by adding $1\,\mathrm{mole}$ of ethyl alcohol in $9\,\mathrm{mole}$ of water. The mass percent of solute in the solution is _____. (Integer Answer)

(Given: Molar mass in $\mathrm{g\,mol^{-1}}$: Ethyl alcohol = 46, Water = 18)