JEE Main 2024 Jan 30 (Shift 1) Question Paper

Mathematics Section A

1. A line passing through the point $A(9,0)$ makes an angle of 30° with the positive direction of the x-axis. If this line is rotated about A through an angle of 15° in the clockwise direction, then its equation in the new position is:

(1) $\frac{y}{\sqrt{3}-2}+x=9$

(2) $\frac{x}{\sqrt{3}-2}+y=9$

(3) $\frac{x}{\sqrt{3}+2}+y=9$

(4) $\frac{y}{\sqrt{3}+2}+x=9$

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2. Let S_n denote the sum of the first n terms in an arithmetic progression. If $S_{20}=790$ and $S_{10}=145$, then $S_{15}-S_5$ is:

(1) 395

(2) 390

(3) 405

(4) 410

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3. If $z=x+iy$, $xy\neq 0$, satisfies the equation $z^2+i\overline{z}=0$, then $|z|^2$ is equal to:

(1) 9

(2) 1

(3) 4

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

---

4. Let $\vec{a}=a_1\hat{i}+a_2\hat{j}+a_3\hat{k}$ and $\vec{b}=b_1\hat{i}+b_2\hat{j}+b_3\hat{k}$ be two vectors such that $|\vec{a}|=1$, $\vec{a}\times\vec{b}=2$, and $|\vec{b}|=4$. If $\vec{c}=2(\vec{a}\times\vec{b})-3\vec{b}$, then the angle between $\vec{b}$ and $\vec{c}$ is equal to:

(1) $\cos^{-1}\left(\frac{2}{\sqrt{3}}\right)$

(2) $\cos^{-1}\left(-\frac{1}{\sqrt{3}}\right)$

(3) $\cos^{-1}\left(-\frac{\sqrt{3}}{2}\right)$

(4) $\cos^{-1}\left(\frac{2}{3}\right)$

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5. The maximum area of a triangle whose one vertex is at $(0, 0)$ and the other two vertices lie on the curve $y = -2x^2 + 54$ at points (x, y) and $(-x, y)$ where $y > 0$ is:

(1) 88

(2) 122

(3) 92

(4) 108

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6. The value of $\lim_{n\to\infty} \sum_{k=1}^{n} \frac{n^3}{(n^2+k^2)(n^2+3k^2)}$ is:

(1) $\frac{(2\sqrt{3}+3)\pi}{24}$

(2) $\frac{13\pi}{8(4\sqrt{3}+3)}$

(3) $\frac{13(2\sqrt{3}-3)\pi}{8}$

(4) $\frac{\pi}{8(2\sqrt{3}+3)}$

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7. Let $g : \mathbb{R} \to \mathbb{R}$ be a non-constant twice differentiable function such that $g'\left(\frac{1}{2}\right) = g'\left(\frac{3}{2}\right)$. If a real-valued function f is defined as $f(x) = \frac{1}{2}\left[g(x) + g(2 - x)\right]$, then:

(1) $f''(x) = 0$ for at least two x in $(0, 2)$

(2) $f''(x) = 0$ for exactly one x in $(0, 1)$

(3) $f''(x) = 0$ for no x in $(0, 1)$

(4) $f'\left(\frac{3}{2}\right) + f'\left(\frac{1}{2}\right) = 1$

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8. The area (in square units) of the region bounded by the parabola $y^2 = 4(x-2)$ and the line $y = 2x - 8$ is:

(1) 8

(2) 9

(3) 6

(4) 7

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9. Let $y = y(x)$ be the solution of the differential equation $\sec x\, dy + \{2(1-x)\tan x + x(2-x)\}\, dx = 0$ such that $y(0) = 2$. Then $y(2)$ is equal to:

(1) 2

(2) $2\{1 - \sin(2)\}$

(3) $2\{\sin(2) + 1\}$

(4) 1

---

10. Let (α, β, γ) be the foot of the perpendicular from the point $(1, 2, 3)$ on the line $\frac{x+3}{5} = \frac{y-1}{2} = \frac{z+4}{3}$. Then $19(\alpha + \beta + \gamma)$ is equal to:

(1) 102

(2) 101

(3) 99

(4) 100

---

11. Two integers x and y are chosen with replacement from the set $\{0, 1, 2, \ldots, 10\}$. Then the probability that $|x - y| > 5$ is:

(1) $\frac{30}{121}$

(2) $\frac{62}{121}$

(3) $\frac{60}{121}$

(4) $\frac{31}{121}$

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12. If the domain of the function

$$f(x) = \cos^{-1}\left(\frac{2-|x|}{4}\right) + (\log_e(3-x))^{-1}$$

is $[-\alpha, \beta) - \{\gamma\}$**, then** $\alpha + \beta + \gamma$ **is equal to:**

(1) 12

(2) 9

(3) 11

(4) 8

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13. Consider the system of linear equations

$$x + y + z = 4\mu, \quad x + 2y + 2z = 10\mu, \quad x + 3y + 4\lambda z = \mu^2 + 15$$

where $\lambda, \mu \in \mathbb{R}$**. Which one of the following statements is NOT correct?**

(1) The system has a unique solution if $\lambda \neq \frac{1}{2}$ and $\mu \neq 1, 15$

(2) The system is inconsistent if $\lambda = \frac{1}{2}$ and $\mu \neq 1$

(3) The system has an infinite number of solutions if $\lambda = \frac{1}{2}$ and $\mu = 15$

(4) The system is consistent if $\lambda \neq \frac{1}{2}$

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14. If the circles $(x+1)^2 + (y+2)^2 = r^2$ **and** $x^2 + y^2 - 4x - 4y + 4 = 0$ **intersect at exactly two distinct points, then:**

(1) $5 < r < 9$

(2) $0 < r < 7$

(3) $3 < r < 7$

(4) $\frac{1}{2} < r < 7$

15. If the length of the minor axis of an ellipse is equal to half of the distance between the foci, then the eccentricity of the ellipse is:

(1) $\frac{\sqrt{5}}{3}$

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

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

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

---

16. Let M denote the median of the following frequency distribution.

Class	Frequency
0-4	3
4-8	9
8-12	10
12-16	8
16-20	6

Then $20M$ is equal to:

(1) 416

(2) 104

(3) 52

(4) 208

---

17. If $f(x) = \begin{vmatrix} 2\cos^4 x & 2\sin^4 x & 3+\sin^2 2x \\ 3+2\cos^4 x & 2\sin^4 x & \sin^2 2x \\ 2\cos^4 x & 3+2\sin^2 4x & \sin^2 2x \end{vmatrix}$**, then** $\frac{1}{5}f'(0)$ **is equal to:**

(1) 0

(2) 1

(3) 2

(4) 6

---

18. Let $A(2,3,5)$ and $C(-3,4,-2)$ be opposite vertices of a parallelogram $ABCD$. If the diagonal $\overrightarrow{BD} = i + 2j + 3k$, then the area of the parallelogram is equal to:

(1) $\frac{1}{2}\sqrt{410}$

(2) $\frac{1}{2}\sqrt{474}$

(3) $\frac{1}{2}\sqrt{586}$

(4) $\frac{1}{2}\sqrt{306}$

19: If $2\sin^3 x + \sin 2x \cos x + 4\sin x - 4 = 0$ has exactly 3 solutions in the interval $\left[0, \frac{\pi}{2}\right]$, $n \in \mathbb{N}$, then the roots of the equation $x^2 + nx + (n-3) = 0$ belong to:

1. $(0, \infty)$
2. $(-\infty, 0)$
3. $\left(-\frac{\sqrt{17}}{2}, \frac{\sqrt{17}}{2}\right)$
4. $\mathbb{Z}$

---

20. Let $f : \left[-\frac{\pi}{2}, \frac{\pi}{2}\right] \to \mathbb{R}$ be a differentiable function such that $f(0) = \frac{1}{2}$. If the limit

$$\lim_{x \to 0} \frac{\int_0^x f(t)\,dt}{e^{x^2} - 1} = \alpha,$$

then $8\alpha^2$ is equal to:

(1) 16

(2) 2

(3) 1

(4) 4

Section B

21. A group of 40 students appeared in an examination of 3 subjects – Mathematics, Physics Chemistry. It was found that all students passed in at least one of the subjects, 20 students passed in Mathematics, 25 students passed in Physics, 16 students passed in Chemistry, at most 11 students passed in both Mathematics and Physics, at most 15 students passed in both Physics and Chemistry, and at most 10 students passed in both Mathematics and Chemistry. The maximum number of students passed in all the three subjects is _____

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22. If d_1 is the shortest distance between the lines

$$x + 1 = 2y = -12z, \quad x = y + 2 = 6z - 6$$

and d_2 is the shortest distance between the lines

$$\frac{x-1}{2} = \frac{y+8}{-7} = \frac{z-4}{5}, \quad \frac{x-1}{2} = \frac{y-2}{1} = \frac{z-6}{-3},$$

then the value of

$$\frac{32\sqrt{3}d_1}{d_2}$$

is:

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23. Let the latus rectum of the hyperbola $\frac{x^2}{9} - \frac{y^2}{b^2} = 1$ subtend an angle of $\frac{\pi}{3}$ at the center of the hyperbola. If b^2 is equal to $\frac{1}{m}(1 + \sqrt{n})$, where l and m are co-prime numbers, then $l^2 + m^2 + n^2$ is equal to _____.

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24. Let $A = \{1, 2, 3, \ldots, 7\}$ and let $P(1)$ denote the power set of A. If the number of functions $f : A \to P(A)$ such that $a \in f(a), \forall a \in A$ is m^n, and m and n are least, then $m+n$ is equal to _____.

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25. The value of

$$9\int_0^9 \left\lfloor \sqrt{\frac{10x}{x+1}} \right\rfloor dx,$$

where $[t]$ denotes the greatest integer less than or equal to t, is ____

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26. Number of integral terms in the expansion of

$$\left(7^{1/2}+11^{1/6}\right)^{824}$$

is equal to __

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

$$(1-x^2)\frac{dy}{=}\left[xy+(x^3+2)\sqrt{3(1-x^2)}\right]dx,$$

for $-1<x<1$ and $y(0)=0$. If $y\left(\frac{1}{2}\right)=\frac{m}{n}$, where m and n are co-prime numbers, then $m+n$ is equal to ____

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28. Let $\alpha,\beta\in\mathbb{N}$ be roots of the equation

$$x^2-70x+\lambda=0,$$

where $\frac{\lambda}{2},\frac{\lambda}{3}\notin\mathbb{N}$. If λ assumes the minimum possible value, then

$$\frac{\left(\sqrt{\alpha-1}+\sqrt{\beta-1}\right)(\lambda+35)}{|\alpha-\beta|}$$

is equal to:

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29. If the function $f(x)=\begin{cases}\frac{1}{|x|}, & |x|\geq 2\\ ax^2+2b, & |x|<2\end{cases}$ is differentiable on $\mathbb{R}$, then $48(a+b)$ is equal to _____.

30. Let $\alpha = 1^2 + 4^2 + 8^2 + 13^2 + 19^2 + 26^2 + \ldots$ up to 10 terms and $\beta = \sum_{n=1}^{10} n^4$. If $4\alpha - \beta = 55k + 40$, then k is equal to _____.

Physics Section A

31. Match List-I with List-II.

List-I		List-II
A. Coefficient of viscosity	I.	$[ML^{-1}T^{-1}]$
B. Surface Tension	II.	$[ML^0T^{-2}]$
C. Angular momentum	III.	$[ML^2T^{-1}]$
D. Rotational kinetic energy	IV.	$[ML^2T^{-2}]$

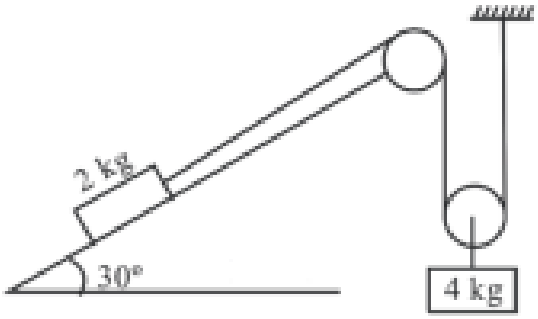
(1) A-I, B-II, C-III, D-IV

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

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

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

32. All surfaces shown in the figure are assumed to be frictionless, and the pulleys and the string are light. The acceleration of the block of mass 2 kg is:



(1) g

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

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

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

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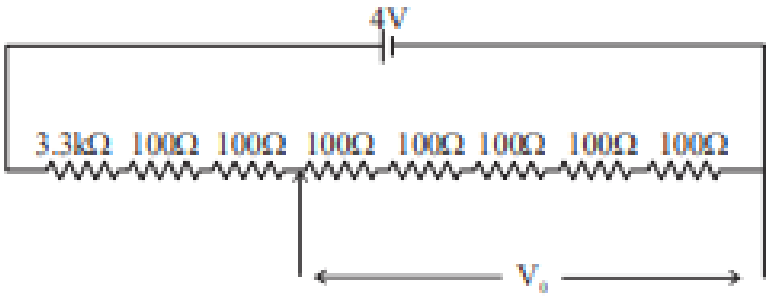
33. A potential divider circuit is shown in the figure. The output voltage V_0 is:



(1) 4V

(2) 2 mV

(3) 0.5 V

(4) 12 mV

---

34. Young's modulus of material of a wire of length L and cross-sectional area A is Y. If the length of the wire is doubled and cross-sectional area is halved, then Young's modulus will be:

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

(2) Y

(3) $4Y$

(4) $2Y$

---

35. The work function of a substance is 3.0 eV. The longest wavelength of light that can cause the emission of photoelectrons from this substance is approximately:

(1) 215 nm

(2) 414 nm

(3) 400 nm

(4) 200 nm

---

36. The ratio of the magnitude of the kinetic energy to the potential energy of an electron in the 5th excited state of a hydrogen atom is:

(1) 4

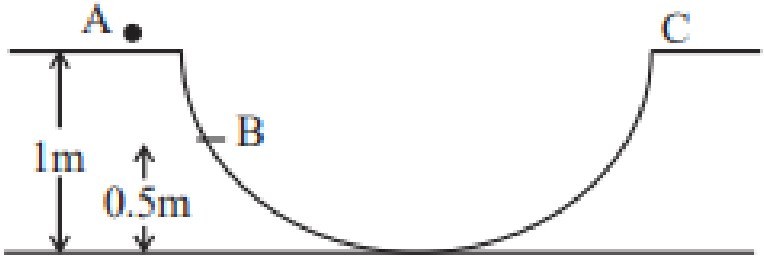
(2) $\frac{1}{4}$

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

(4) 1

---

37. A particle is placed at the point A of a frictionless track ABC as shown in the figure. It is gently pushed toward the right. The speed of the particle when it reaches the point B is: (Take $g = 10$ m/s^2).



(1) 20 m/s

(2) $\sqrt{10}$ m/s

(3) $2\sqrt{10}$ m/s

(4) 10 m/s

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38. The electric field of an electromagnetic wave in free space is represented as $\vec{E} = E_0 \cos(\omega t - kx)\hat{i}$. The corresponding magnetic induction vector will be:

(1) $\vec{B} = E_0 C \cos(\omega t - kx)\hat{j}$

(2) $\vec{B} = \frac{E_0}{C} \cos(\omega t - kx)\hat{j}$

(3) $\vec{B} = E_0 C \cos(\omega t + kx)\hat{j}$

(4) $\vec{B} = \frac{E_0}{C} \cos(\omega t + kx)\hat{j}$

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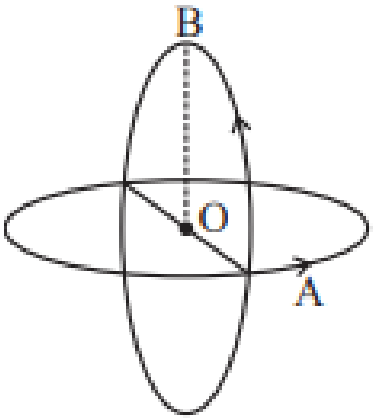
39. Two insulated circular loops A and B of radius $'a'$ carrying a current $'I'$ in the anti-clockwise direction as shown in the figure. The magnitude of the magnetic induction at the centre will be:



(1) $\frac{\sqrt{2}\mu_0 I}{a}$

(2) $\frac{\mu_0 I}{2a}$

(3) $\frac{\mu_0 I}{\sqrt{2}a}$

(4) $\frac{2\mu_0 I}{a}$

---

40. The diffraction pattern of a light of wavelength 400 nm diffracting from a slit of width 0.2 mm is focused on the focal plane of a convex lens of focal length 100 cm. The width of the 1st secondary maxima will be:

(1) 2 mm

(2) 2 cm

(3) 0.02 mm

(4) 0.2 mm

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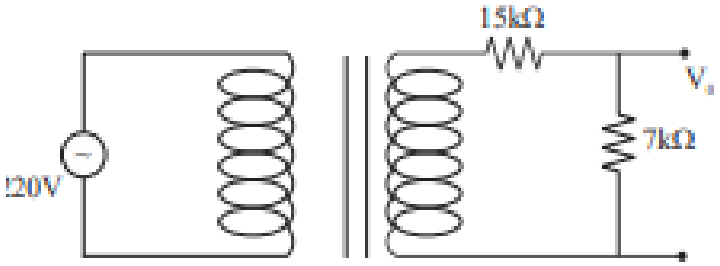
41. Primary coil of a transformer is connected to 220 V ac. Primary and secondary turns of the transformer are 100 and 10 respectively. The secondary coil of the transformer is connected to two series resistances shown in the figure. The output voltage V_0 is:



(1) 7 V

(2) 15 V

(3) 44 V

(4) 22 V

---

42. The gravitational potential at a point above the surface of Earth is -5.12×10^7 J/kg and the acceleration due to gravity at that point is 6.4 m/s^2. Assume that the mean radius of Earth to be 6400 km. The height of this point above the Earth's surface is:

(1) 1600 km

(2) 540 km

(3) 1200 km

(4) 1000 km

---

43. An electric toaster has resistance of 60 Ω at room temperature (27°C). The toaster is connected to a 220 V supply. If the current flowing through it reaches 2.75 A, the temperature attained by toaster is around: (if $\alpha = 2 \times 10^{-4}\,^\circ\text{C}^{-1}$)

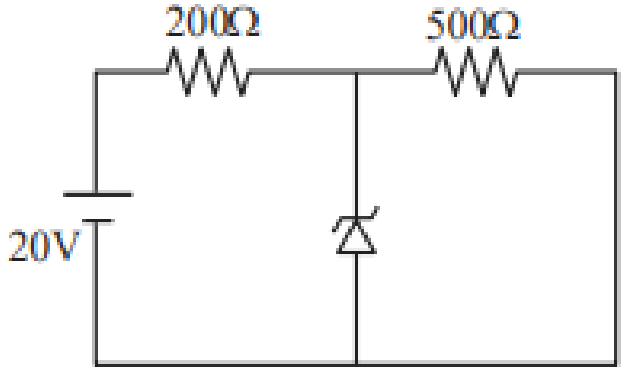
(1) 694°C

(2) 1235°C

(3) 1694°C

(4) 1667°C

44. A Zener diode of breakdown voltage 10V is used as a voltage regulator as shown in the figure. The current through the Zener diode is:



(1) 50 mA

(2) 0

(3) 30 mA

(4) 20 mA

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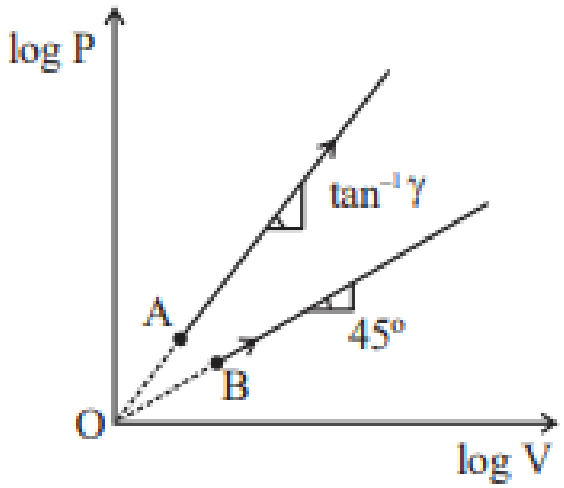
45. Two thermodynamical processes are shown in the figure. The molar heat capacity for process A and B are C_A and C_B. The molar heat capacity at constant pressure and constant volume are represented by C_P and C_V, respectively. Choose the correct statement.



(1) $C_B = \infty, C_A = 0$

(2) $C_A = 0$ and $C_B = \infty$

(3) $C_P > C_A = C_B = C_V$

(4) $C_A > C_P > C_V > C_B$

---

46. The electrostatic potential due to an electric dipole at a distance r varies as:

(1) r

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

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

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

---

47. A spherical body of mass 100 g is dropped from a height of 10 m from the ground. After hitting the ground, the body rebounds to a height of 5 m. The impulse of force imparted by the ground to the body is given by: (given $g = 9.8\,\text{m/s}^2$).

(1) 4.32 kg m/s

(2) 4.2 kg m/s

(3) 2.39 kg m/s

(4) 2.39 kg m/s

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48. A particle of mass m projected with a velocity u making an angle of 30° with the horizontal. The magnitude of angular momentum of the projectile about the point of projection when the particle is at its maximum height is:

(1) $\frac{\sqrt{3}mu^2}{16\,g}$

(2) $\frac{\sqrt{3}mu^2}{2\,g}$

(3) $\frac{mu^3}{\sqrt{2}\,g}$

(4) zero

49. At which temperature the r.m.s. velocity of a hydrogen molecule equal to that of an oxygen molecule at 47°C?

(1) 80 K

(2) -73 K

(3) 4 K

(4) 20 K

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50. A series L, R circuit connected with an ac source $E = (25\sin(1000\,t))\,V$ has a power factor of $\frac{1}{\sqrt{2}}$. If the source of emf is changed to $E = (20\sin(2000\,t))\,V$, the new power factor of the circuit will be:

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

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

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

(4) $\frac{1}{\sqrt{7}}$

Section B

51. The horizontal component of earth's magnetic field at a place is $3.5 \times 10^{-5}\,T$. A very long straight conductor carrying current of $\sqrt{2}\,A$ in the direction from South East to North West is placed. The force per unit length experienced by the conductor is:

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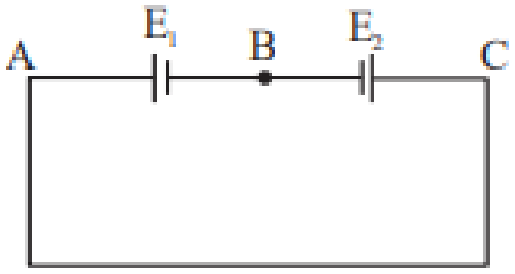
52. Two cells are connected in opposition as shown. Cell E_1 is of 8 V emf and 2 Ω internal resistance; the cell E_2 is of 2 V emf and 4 Ω internal resistance. The terminal potential difference of cell E_2 is:



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53. An electron of hydrogen atom on an excited state is having energy $E_n = -0.85$ eV. The maximum number of allowed transitions to lower energy level is:

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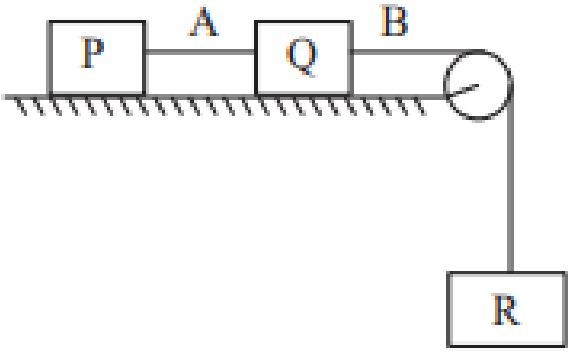
54. Each of three blocks $P, Q,$ and R shown in figure has a mass of 3 kg. Each of the wire A and B has cross-sectional area 0.005 cm^2 and Young's modulus 2×10^{11} N/m^2. Neglecting friction, the longitudinal strain on wire B is $\times 10^{-4}$.



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55. The distance between object and its two times magnified real image as produced by a convex lens is 45 cm. The focal length of the lens used is _____ cm.

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56. The displacement and the increase in the velocity of a moving particle in the time interval of t to $(t+1)$ seconds are 125 m and 50 m/s, respectively. The distance travelled by the particle in $(t+2)^{th}$ second is _____ m.

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57. A capacitor of capacitance C and potential V has energy E. It is connected to another

capacitor of capacitance $2C$ and potential $2V$. Then the loss of energy is $\frac{x}{3}E$, where x is _____.

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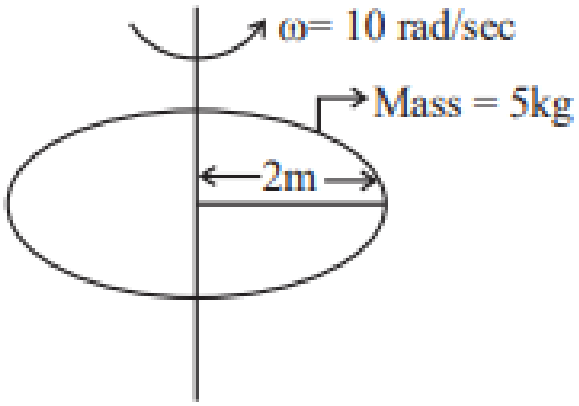
58. Consider a disc of mass 5 kg, radius 2 m, rotating with angular velocity of 10 rad/s about an axis perpendicular to the plane of rotation. An identical disc is kept gently over the rotating disc along the same axis. The energy dissipated so that both discs continue to rotate together without slipping is _____ J.



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59. In a closed organ pipe, the frequency of the fundamental note is 30 Hz. A certain amount of water is now poured in the organ pipe so that the fundamental frequency is increased to 110 Hz. If the organ pipe has a cross-sectional area of $2\,cm^2$, the amount of water poured in the organ tube is _____g. (Take speed of sound in air as 330 m/s)

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60. A ceiling fan having 3 blades of length 80 cm each is rotating with an angular velocity of 1200 rpm. The magnetic field of earth in that region is 0.5 G and angle of dip is $30°$. The emf induced across the blades is $N\pi \times 10^{-5}\,V$. The value of N is _____.

Chemistry Section A

61. Given below are two statements:

Statement-I: The gas liberated on warming a salt with dilute H_2SO_4, turns a piece of paper dipped in lead acetate into black; it is a confirmatory test for sulphide ion.

Statement-II: In statement-I the colour of paper turns black because of formation of lead sulphide.

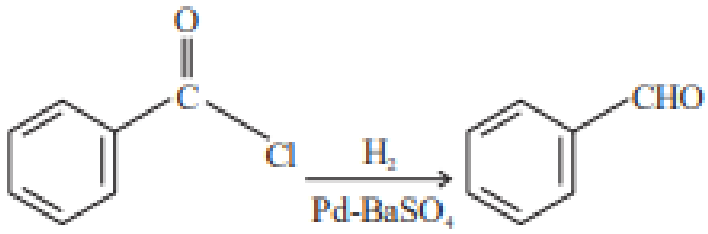
In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both Statement-I and Statement-II are false

(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 true



62. This reduction reaction is known as:

(1) Rosenmund reduction

(2) Wolff-Kishner reduction

(3) Stephen reduction

(4) Etard reduction

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63. Sugar which does not give reddish brown precipitate with Fehling's reagent is:

(1) Sucrose

(2) Lactose

(3) Glucose

(4) Maltose

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64. Given below are the two statements: one is labeled as Assertion (A) and the other is

labeled as Reason (R).

Assertion (A): There is a considerable increase in covalent radius from N to P. However, from As to Bi only a small increase in covalent radius is observed.

Reason (R): Covalent and ionic radii in a particular oxidation state increases down the group.

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

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

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

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

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

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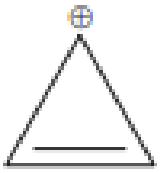
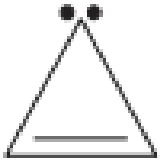
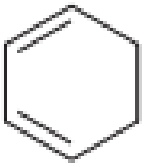
65. Which of the following molecule/species is most stable?

(1) 

(2) 

(3) 

(4) 

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66. Diamagnetic Lanthanoid ions are:

(1) Nd^{3+} and Eu^{3+}

(2) La^{3+} and Ce^{4+}

(3) Nd^{3+} and Ce^{4+}

(4) Lu^{3+} and Eu^{3+}

---

67. Aluminium chloride in acidified aqueous solution forms an ion having geometry:

(1) Octahedral

(2) Square Planar

(3) Tetrahedral

(4) Trigonal bipyramidal

---

68. Given below are two statements:

Statement-I: The orbitals having same energy are called as degenerate orbitals.

Statement-II: In hydrogen atom, 3p and 3d orbitals are not degenerate orbitals.

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

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

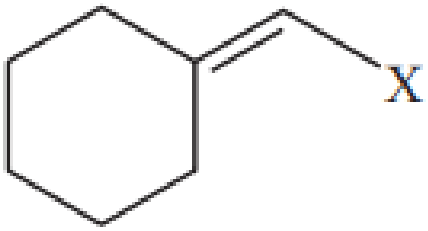
(2) Both Statement-I and Statement-II are true

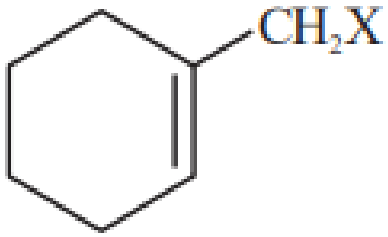
(3) Both Statement-I and Statement-II are false

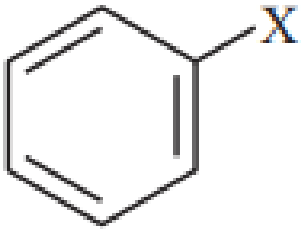
(4) Statement-I is false but Statement-II is true

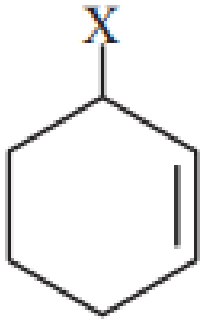
---

69. Example of vinylic halide is:

(1) 

(2) 

(3) 

(4) 

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70. Structure of 4-Methylpent-2-enal is:

(1) $H_2C = C - CH_2 - C = C - H$

(2) $CH_3 - CH_2 - C = CH - C = CH$

(3) $CH_3 - CH_2 - CH = C - CH_3$

(4) $CH_3 - CH = CH - C = C - H$

---

71. Match List-I with List-II

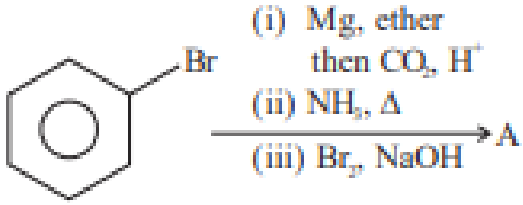
List-I (Molecule)	List-II (Shape)
(A) BrF_5	(I) T-shape
(B) H_2O	(II) See-saw
(C) ClF_3	(III) Bent
(D) SF_4	(IV) Square pyramidal

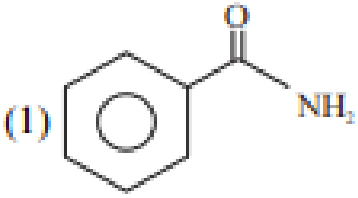
Options:

1. (A) - I, (B) - III, (C) - IV, (D) - II
2. (A) - II, (B) - I, (C) - III, (D) - IV
3. (A) - III, (B) - IV, (C) - I, (D) - II
4. (A) - IV, (B) - III, (C) - I, (D) - II

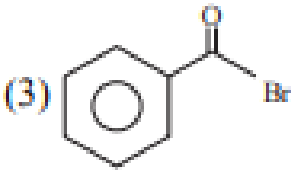
---

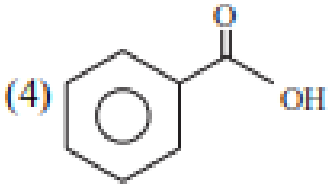
72. The final product A, formed in the following multistep reaction sequence is:



(1) 

(2) 

(3) 

(4) 

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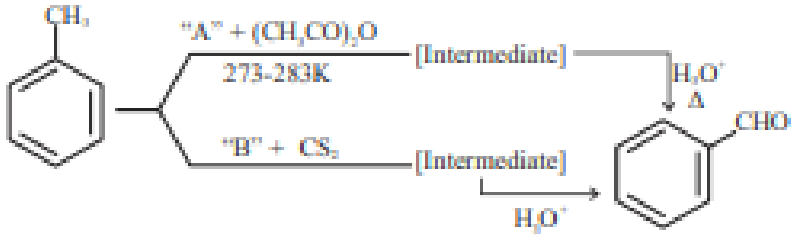
73. In the given reactions, identify the reagent A and reagent B.



(1) A-CrO_3, B-CrO_3

(2) A-CrO_3, B-CrO_2Cl_2

(3) A-CrO_2Cl_2, B-CrO_2Cl_2

(4) A-CrO_2Cl_2, B-CrO_3

---

74. Given below are two statement one is labeled as Assertion (A) and the other is labeled as **Reason (R)**.

Assertion (A): $CH_2 = CH - CH_2 - Cl$ is an example of allyl halide.

Reason (R): Allyl halides are the compounds in which the halogen atom is attached to sp^2 hybridised carbon atom.

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

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

(2) Both **(A)** and **(R)** are true but **(R)** is **not** the correct explanation of **(A)**

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

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

---

75. What happens to freezing point of benzene when small quantity of naphthalene is added to benzene?

(1) Increases

(2) Remains unchanged

(3) First decreases and then increases

(4) Decreases

---

76. Match List-I with List-II

List-I Species	**List-II** Electronic Distribution
(A) Cr^{+2}	(I) $3d^8$
(B) Mn^{+}	(II) $3d^5 4s^1$
(C) Ni^{+2}	(III) $3d^4$
(D) V^{+}	(IV) $3d^3 4s^1$

Choose the correct answer from the options given below:

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

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

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

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

77. Compound A formed in the following reaction reacts with B, giving the product C. Find out A and B.

$$CH_3 - C \equiv CH + Na \rightarrow A \xrightarrow{B} CH_3 - C \equiv C - CH_2 - CH_2 - CH_3 + NaBr\ (C)$$

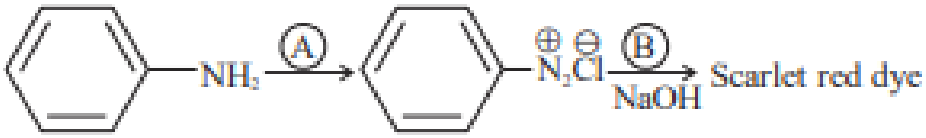
(1) A = CH_3–C≡CNa, B = CH_3–CH_2–CH_2–Br

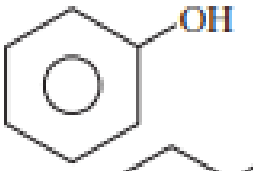
(2) A = CH_3–CH_2–CH_2Br, B = CH_3–C≡C–CH_3

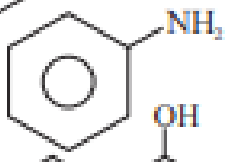
(3) A = CH_3–C≡CNa, B = CH_3–C≡CH

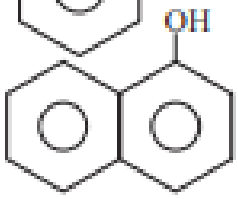
(4) A = CH_3–C≡CNa, B = CH_3–CH_2–CH_3

78. Following is a confirmatory test for aromatic primary amines. Identify reagent (A) and (B).

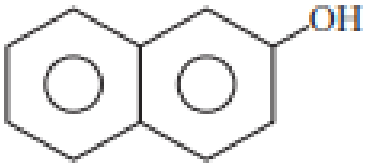


(1) A = HNO_3/H_2SO_4; B = 

(2) A= $NaNO_2$ + HCl, 0 – 5°C; B = 

(3) A=$NaNO_2$ + HCl, 0 – 5°C; B = 

(4) A = $NaNO_2$ + HCl, 0 – 5°C;

B = 

79. The Lassaigne's extract is boiled with dil HNO_3 before testing for halogens because:

(1) AgCN is soluble in HNO_3

(2) Silver halides are soluble in HNO_3

(3) Ag_2S is soluble in HNO_3

(4) Na_2S and NaCN are decomposed by HNO_3

---

80. Choose the correct statements from the following:

(A) Ethane-1,2-diamine is a chelating ligand.

(B) Metallic aluminium is produced by electrolysis of aluminium oxide in presence of cryolite.

(C) Cyanide ion is used as ligand for leaching of silver.

(D) Phosphine acts as a ligand in Wilkinson catalyst.

(E) The stability constants of Ca^{2+} and Mg^{2+} are similar with EDTA complexes.

Choose the correct answer from the options given below:

(1) (B), (C), (E) only

(2) (A), (B), (C) only

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

(4) (A), (B), (C), (D), (E)

Section B

81. The rate of first order reaction is 0.04 mol L^{-1} s^{-1} at 10 minutes and 0.03 mol L^{-1} s^{-1} at 20 minutes after initiation. Half life of the reaction is _____ minutes. (Given log2=0.3010, log3=0.4771)

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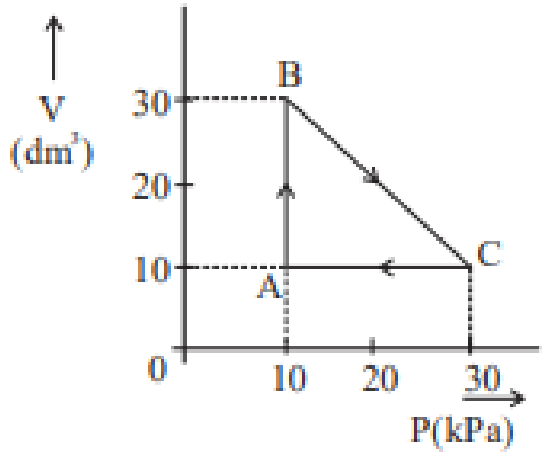
82. The pH at which $Mg(OH)_2$ [K_{sp} = 1 $\times$ 10^{-11}] begins to precipitate from a solution

containing 0.10 M Mg^{2+} ions is _____.



83. An ideal gas undergoes a cyclic transformation starting from the point A and coming back to the same point by tracing the path A $\rightarrow$ B $\rightarrow$ C $\rightarrow$ A as shown in the diagram. The total work done in the process is _____ J.

---

84. If IUPAC name of an element is "Unununnium" then the element belongs to nth group of periodic table. The value of n is _____.

---

85. The total number of molecular orbitals formed from 2s and 2p atomic orbitals of a diatomic molecule is _____.

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86. On a thin layer chromatographic plate, an organic compound moved by 3.5 cm, while the solvent moved by 5 cm. The retardation factor of the organic compound is _____$\times 10^{-1}$.

---

87. The compound formed by the reaction of ethanol with semicarbazide contains _____ number of nitrogen atoms.

---

88. 0.05 cm thick coating of silver is deposited on a plate of 0.05 m^2 area. The number of silver atoms deposited on plate are _____ $\times 10^{23}$. (At mass Ag = 108, d = 7.9 g/cm^3)

---

89. $2MnO4^- + 6I^- + 4H2O- > 3I2 + 2MnO2 + 8OH^-$

If the above equation is balanced with integer coefficients, the value of z is _____.

---

90. The mass of sodium acetate (CH3COONa) required to prepare 250 mL of 0.35 M aqueous solution is _____ g. (Molar mass of CH3COONa is 82.02 g/mol)
