

JEE Main 2023 Paper 1 (B.E./B.Tech) 24 January 2023 Shift 2 Question Paper



Conducted by the National Testing Agency (NTA)

Time Allowed: 3 Hours

Paper 1: B.E./B.Tech.

Maximum Marks: 300

General Instructions

- (i) This paper is **Paper 1 (B.E./B.Tech.)** of **JEE (Main) 2023 - Session 1**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 24 January 2023, Shift 2. The total duration is **3 hours**.
- (ii) The paper has **90 questions**, of which **75 are to be attempted**, and a maximum of **300 marks**: Mathematics, Physics and Chemistry carry 30 questions (100 marks) each, in that order.
- (iii) Each subject has **two sections**. **Section A** has **20 multiple choice questions** (MCQs) with four options each. Select the most appropriate answer. **Section B** has **10 numerical value questions**; attempt **any 5** of them.
- (iv) **All Section A questions are compulsory**. Attempt only the specified number of Section B questions. For Section B, the answer is an integer value; the answer should be **rounded off to the nearest integer**. Use only the constants given in the question while calculating.
- (v) **Marking scheme** (Sections A and B): **+4** for a correct answer, **-1** for an incorrect answer, and **0** for an unanswered or marked-for-review question.
- (vi) All calculations and rough work are to be done on the rough sheets only. Calculators, log tables, slide rules and electronic gadgets are not allowed.

1. Let $f(x)$ be a function such that
 $f(x+y) = f(x) \cdot f(y)$
 for all $x, y \in \mathbb{N}$. If

$$f(1) = 3$$

and

$$\sum_{k=1}^n f(k) = 3279$$

, then the value of n is

- (A) 9 (B) 7
 (C) 6 (D) 8

2. The number of real solutions of the equation

$$3\left(x^2 + \frac{1}{x^2}\right) - 2\left(x + \frac{1}{x}\right) + 5 = 0$$

, is

- (A) 3 (B) 4
 (C) 0 (D) 2

3. The number of integers, greater than 7000 that can be formed, using the digits 3, 5, 6, 7, 8 without repetition is :

- (A) 48 (B) 120
 (C) 168 (D) 220

4. Let

$$\vec{\alpha} = 4\hat{i} + 3\hat{j} + 5\hat{k}$$

and

$$\vec{\beta} = \hat{i} + 2\hat{j} - 4\hat{k}$$

. Let $\vec{\beta}_1$ be parallel to $\vec{\alpha}$ and $\vec{\beta}_2$ be perpendicular to $\vec{\alpha}$. If

$$\vec{\beta} = \vec{\beta}_1 + \vec{\beta}_2$$

, then the value of $5\vec{\beta}_2 \cdot (\hat{i} + \hat{j} + \hat{k})$ is :

- (A) 9 (B) 7
 (C) 6 (D) 11

5. If the system of equations

$$\begin{aligned} x + 2y + 3z &= 3 \\ 4x + 3y - 4z &= 4 \\ 8x + 4y - \lambda z &= 9 + \mu \end{aligned}$$

has infinitely many solutions, then the ordered pair (λ, μ) is equal to :

- (A) $\left(\frac{72}{5}, \frac{21}{5}\right)$
 (B) $\left(-\frac{72}{5}, -\frac{21}{5}\right)$
 (C) $\left(-\frac{72}{5}, \frac{21}{5}\right)$
 (D) $\left(\frac{72}{5}, -\frac{21}{5}\right)$

6. The set of all values of a for which

$$\lim_{x \rightarrow a} ([x - 5] - [2x + 2]) = 0$$

, where $[\alpha]$ denotes the greatest integer less than or equal to α is equal to

- (A) $[-7.5, -6.5]$
 (B) $(-7.5, -6.5]$
 (C) $[-7.5, -6.5)$
 (D) $(-7.5, -6.5)$

7. The locus of the mid points of the chords of the circle

$$C_1 : (x - 4)^2 + (y - 5)^2 = 4$$

which subtend an angle θ_i at the centre of the circle C_1 , is a circle of radius r_i . If

$$\theta_1 = \frac{\pi}{3}, \theta_3 = \frac{2\pi}{3}$$

and $r_1^2 = r_2^2 + r_3^2$, then θ_2 is equal to :

- (A) $\frac{\pi}{2}$
 (B) $\frac{\pi}{4}$
 (C) $\frac{3\pi}{4}$
 (D) $\frac{\pi}{6}$

8. Let

$y = y(x)$
be the solution of the differential equation
 $(x^2 - 3y^2)dx + 3xy dy = 0, y(1) = 1$
. Then $6y^2(e)$ is equal to

- (A) $\frac{3}{2}e^2$
(B) $3e^2$
(C) e^2
(D) $2e^2$

9. If

$$f(x) = \frac{2^{2x}}{2^{2x} + 2}, x \in \mathbb{R}$$

, then

$$f\left(\frac{1}{2023}\right) + f\left(\frac{2}{2023}\right) + \dots + f\left(\frac{2022}{2023}\right)$$

is equal to

- (A) 2011 (B) 2010
(C) 1010 (D) 1011

10. The number of square matrices of order 5 with entries from the set $\{0, 1\}$, such that the sum of all the elements in each row is 1 and the sum of all the elements in each column is also 1, is :

- (A) 125 (B) 150
(C) 225 (D) 120

11. Let the six numbers $a_1, a_2, a_3, a_4, a_5, a_6$, be in A.P and

$$a_1 + a_3 = 10$$

. If the mean of these six numbers is $\frac{19}{2}$ and their variance is σ^2 , then $8\sigma^2$ is equal to :

- (A) 220 (B) 210
(C) 105 (D) 200

12. The value of

$$\left(\frac{1 + \sin \frac{2\pi}{9} + i \cos \frac{2\pi}{9}}{1 + \sin \frac{2\pi}{9} - i \cos \frac{2\pi}{9}} \right)^3$$

is

- (A) $-\frac{1}{2}(1 - i\sqrt{3})$
(B) $-\frac{1}{2}(\sqrt{3} - i)$
(C) $\frac{1}{2}(1 - i\sqrt{3})$
(D) $\frac{1}{2}(\sqrt{3} + i)$

13. If

$f(x) = x^3 - x^2 f'(1) + x f''(2) - f'''(3), x \in \mathbb{R}$
, then

- (A) $2f(0) - f(1) + f(3) = f(2)$
(B) $f(1) + f(2) + f(3) = f(0)$
(C) $f(3) - f(2) = f(1)$
(D) $3f(1) + f(2) = f(3)$

14.

$$\int_{\frac{3\sqrt{2}}{4}}^{\frac{3\sqrt{3}}{4}} \frac{48}{\sqrt{9-4x^2}} dx$$

is equal to :

- (A) $\frac{\pi}{2}$
(B) $\frac{\pi}{3}$
(C) $\frac{\pi}{6}$
(D) 2π

15. If the foot of the perpendicular drawn from $(1, 9, 7)$ to the line passing through the point $(3, 2, 1)$ and parallel to the planes $x + 2y + z = 0$ and $3y - z = 3$ is (α, β, γ) , then $\alpha + \beta + \gamma$ is equal to :

- (A) 3 (B) 1
(C) -1 (D) 5

16. Let A be a 3×3 matrix such that $|\text{adj}(\text{adj}(\text{adj } A))| = 12^4$. Then $|A^{-1} \text{adj } A|$ is equal to

- (A) 12
(B) $2\sqrt{3}$
(C) 1
(D) $\sqrt{6}$

17. Let the plane containing the line of intersection of the planes

$P_1 :$

$$x + (\lambda + 4)y + z = 1$$

and

$P_2 :$

$$2x + y + z = 2$$

pass through the points $(0, 1, 0)$ and $(1, 0, 1)$. Then the distance of the point $(2\lambda, \lambda, -\lambda)$ from the plane P_2 is :

- (A) $2\sqrt{6}$
(B) $3\sqrt{6}$
(C) $4\sqrt{6}$
(D) $5\sqrt{6}$

18. The equations of the sides AB and AC of a triangle ABC are

$$(\lambda + 1)x + \lambda y = 4$$

and

$$\lambda x + (1 - \lambda)y + \lambda = 0$$

respectively. Its vertex A is on the y-axis and its orthocentre is $(1, 2)$. The length of the tangent from the point C to the part of the parabola $y^2 = 6x$ in the first quadrant is :

- (A) 4
(B) $2\sqrt{2}$
(C) 2
(D) $\sqrt{6}$

19. Let p and q be two statements. Then $\sim (p \wedge (p \Rightarrow \sim q))$ is equivalent to

- (A) $(\sim p) \vee q$
(B) $p \vee (p \wedge (\sim q))$
(C) $p \vee (p \wedge q)$
(D) $p \vee ((\sim p) \wedge q)$

20. If

$$({}^{30}C_1)^2 + 2({}^{30}C_2)^2 + 3({}^{30}C_3)^2 + \dots + 30({}^{30}C_{30})^2 = \frac{\alpha 60!}{(30!)^2}$$

then α is equal to :

- (A) 30 (B) 10
(C) 15 (D) 60

21. The minimum number of elements that must be added to the relation $R = \{(a, b), (b, c), (b, d)\}$ on the set $\{a, b, c, d\}$ so that it is an equivalence relation, is _____.

22. If the shortest between the lines

$$\frac{x + \sqrt{6}}{2} = \frac{y - \sqrt{6}}{3} = \frac{z - \sqrt{6}}{4}$$

and

$$\frac{x - \lambda}{3} = \frac{y - 2\sqrt{6}}{4} = \frac{z + 2\sqrt{6}}{5}$$

is 6, then the square of sum of all possible values of λ is :

23. Let

$$\vec{a} = \hat{i} + 2\hat{j} + \lambda\hat{k}, \vec{b} = 3\hat{i} - 5\hat{j} - \lambda\hat{k}, \vec{a} \cdot \vec{b} = 7, 2\vec{b} \cdot \vec{c} + 43 = 0, \vec{a} \times \vec{c} = \vec{b} \times \vec{c}$$

$$\vec{c} = 7, 2\vec{b} \cdot \vec{c} + 43 = 0, \vec{a} \times \vec{c} = \vec{b} \times \vec{c}$$

. Then $|\vec{a} \cdot \vec{b}|$ is equal to :

24. Let the sum of the coefficients of the first three terms in the expansion of

$$\left(x - \frac{3}{x^2}\right)^n, x \neq 0, n \in \mathbb{N}$$

, be 376. Then the coefficient of x^4 is _____.

25. The equations of the sides AB, BC and CA of a triangle ABC are :

$$2x + y = 0, x + py = 21a, (a \neq 0)$$

and $x - y = 3$ respectively. Let $P(2, a)$ be the centroid of ΔABC . Then $(BC)^2$ is equal to _____.

26. Let f be a differentiable function defined on

$$\left[0, \frac{\pi}{2}\right]$$

such that

$$f(x) > 0$$

and

$$f(x) + \int_0^x f(t) \sqrt{1 - (\log_e f(t))^2} dt = e, \forall x \in [0,$$

$$\frac{\pi}{2}]$$

. Then

$$\left(6 \log_e f\left(\frac{\pi}{6}\right)\right)^2$$

is equal to _____.

27. If the area of the region bounded by the curves

$$y^2 - 2y = -x, x + y = 0$$

is A, then $8A$ is equal to _____.

28. Three urns A, B and C contain 4 red, 6 black; 5 red, 5 black; and λ red, 4 black balls respectively. One of the urns is selected at random and a ball is drawn. If the ball drawn is red and the probability that it is drawn from urn C is 0.4 then the square of the length of the side of the largest equilateral triangle, inscribed in the parabola

$$y^2 = \lambda x$$

with one vertex at the vertex of the parabola, is :

29. Let

$$S = \{\theta \in [0, 2\pi) : \tan(\pi \cos \theta) + \tan(\pi \sin \theta) = 0\}$$

. Then

$$\sum_{\theta \in S} \sin^2\left(\theta + \frac{\pi}{4}\right)$$

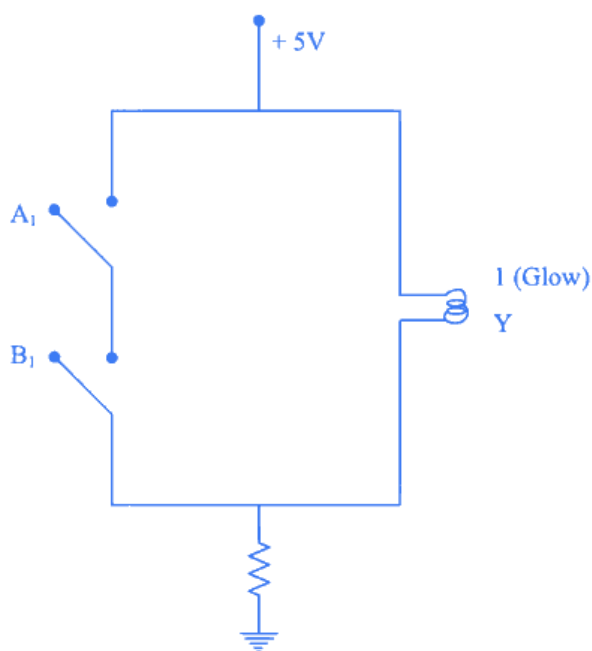
is equal to _____.

30. If

$$\frac{1^3 + 2^3 + 3^3 + \dots \text{up to } n \text{ terms}}{1 \cdot 3 + 2 \cdot 5 + 3 \cdot 7 + \dots \text{up to } n \text{ terms}} = \frac{9}{5}$$

, then the value of n is _____.

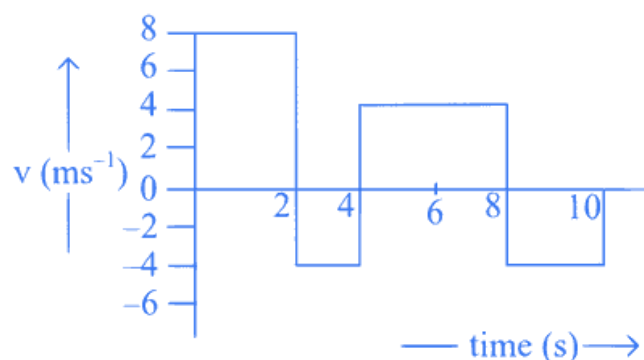
31.



The logic gate equivalent to the given circuit diagram is :

- (A) NOR (B) OR
(C) NAND (D) AND

32. The velocity time graph of a body moving in a straight line is shown in the figure.



The ratio of displacement to distance travelled by the body in time 0 to 10s is :

- (A) 1 : 1 (B) 1 : 3
(C) 1 : 4 (D) 1 : 2

33. A long solenoid is formed by winding 70 turns cm^{-1} . If 2.0 A current flows, then the magnetic field produced inside the solenoid is _____ (

$$\mu_0 = 4\pi \times 10^{-7}$$

TmA^{-1})

- (A) $88 \times 10^{-4} \text{ T}$ (B) $1232 \times 10^{-4} \text{ T}$
(C) $176 \times 10^{-4} \text{ T}$ (D) $352 \times 10^{-4} \text{ T}$

34. A cell of emf 90 V is connected across series combination of two resistors each of 100Ω resistance. A voltmeter of resistance 400Ω is used to measure the potential difference across each resistor. The reading of the voltmeter will be :

- (A) 40 V (B) 90 V
(C) 45 V (D) 80 V

35. An α -particle, a proton and an electron have the same kinetic energy. Which one of the following is correct in case of their de-Broglie wavelength:

- (A) $\lambda_\alpha > \lambda_p < \lambda_e$
(B) $\lambda_\alpha > \lambda_p > \lambda_e$
(C) $\lambda_\alpha = \lambda_p = \lambda_e$
(D) $\lambda_\alpha < \lambda_p < \lambda_e$

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

Assertion A : A pendulum clock when taken to Mount Everest becomes fast.

Reason R : The value of g (acceleration due to gravity) is less at Mount Everest than its value on the surface of earth.

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

- | | |
|--|---------------------------------------|
| (A) Both A and R are correct but R is NOT the correct explanation of A | (B) A is correct but R is not correct |
| (C) Both A and R are correct and R is the correct explanation of A | (D) A is not correct but R is correct |

37. Let γ_1 be the ratio of molar specific heat at constant pressure and molar specific heat at constant volume of a monoatomic gas and γ_2 be the similar ratio of diatomic gas. Considering the diatomic gas molecule as a rigid rotator, the ratio,

$$\frac{\gamma_1}{\gamma_2}$$

is :

- | | |
|-----|-----------------|
| (A) | $\frac{35}{27}$ |
| (B) | $\frac{25}{21}$ |
| (C) | $\frac{21}{25}$ |
| (D) | $\frac{27}{35}$ |

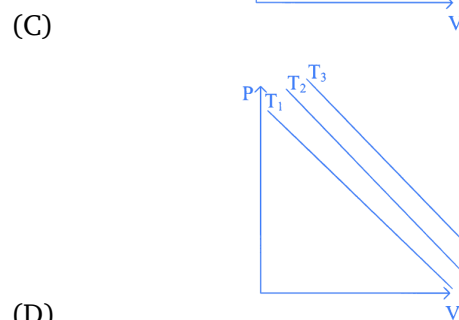
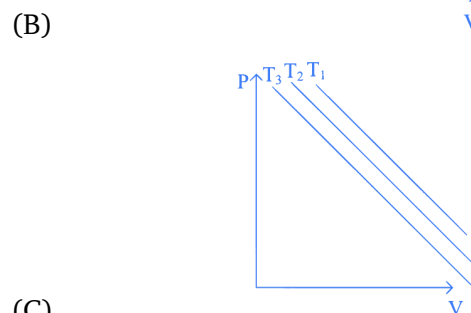
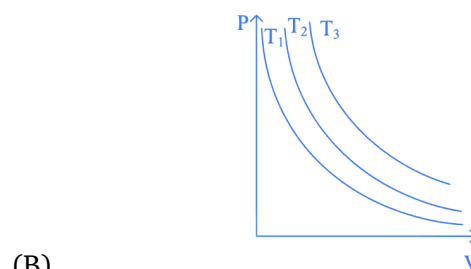
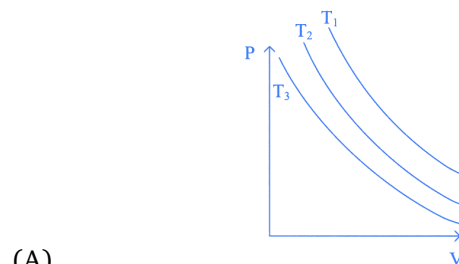
38. When a beam of white light is allowed to pass through convex lens parallel to principal axis, the different colours of light converge at different point on the principle axis after refraction. This is called :

- | | |
|--------------------------|--------------------------|
| (A) Spherical aberration | (B) Scattering |
| (C) Polarisation | (D) Chromatic aberration |

39. In an Isothermal change, the change in pressure and volume of a gas can be represented for three different temperature;

$$T_3 > T_2 > T_1$$

as :



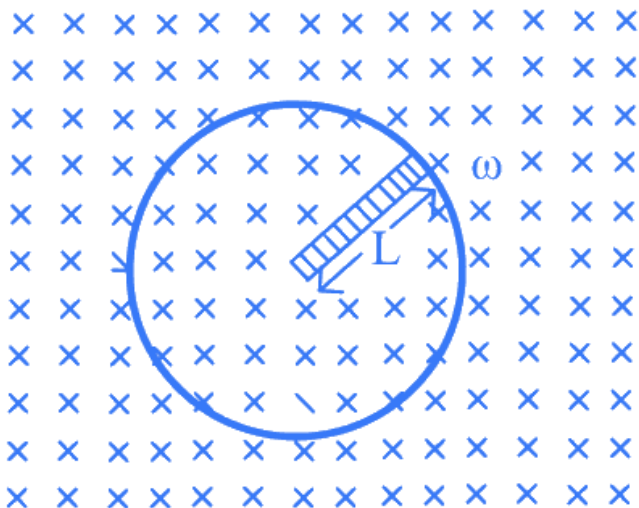
40. The electric field and magnetic field components of an electromagnetic wave going through vacuum is described by

$$\begin{aligned} E_x &= E_0 \sin(kz - \omega t) \\ B_y &= B_0 \sin(kz - \omega t) \end{aligned}$$

Then the correct relation between E_0 and B_0 is given by

- (A) $E_0 B_0 = \omega k$
 (B) $E_0 = k B_0$
 (C) $k E_0 = \omega B_0$
 (D) $\omega E_0 = k B_0$

41. A metallic rod of length 'L' is rotated with an angular speed of ' ω ' normal to a uniform magnetic field 'B' about an axis passing through one end of rod as shown in figure. The induced emf will be :



- (A) $\frac{1}{2} B^2 L^2 \omega$
 (B) $\frac{1}{2} B L^2 \omega$
 (C) $\frac{1}{4} B L^2 \omega$
 (D) $\frac{1}{4} B^2 L \omega$

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

Assertion A : Steel is used in the construction of buildings and bridges.

Reason R : Steel is more elastic and its elastic limit is high.

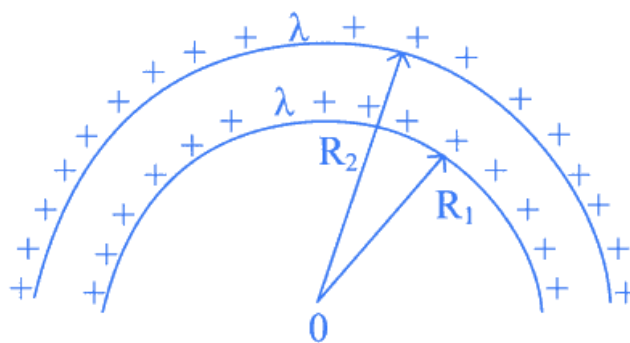
In the light of above statements, choose the most appropriate answer from the options given below

- (A) Both A and R are correct and R is the correct explanation of A
 (B) A is correct but R is not correct
 (C) Both A and R are correct but R is NOT the correct explanation of A
 (D) A is not correct but R is correct

43. If the distance of the earth from Sun is 1.5×10^6 km. Then the distance of an imaginary planet from Sun, if its period of revolution is 2.83 years is :

- (A) 6×10^6 km
 (B) 3×10^7 km
 (C) 6×10^7 km
 (D) 3×10^6 km

44. The electric potential at the centre of two concentric half rings of radii R_1 and R_2 , having same linear charge density λ is :



- (A) $\frac{\lambda}{2 \epsilon_0}$
 (B) $\frac{\lambda}{\epsilon_0}$
 (C) $\frac{2\lambda}{\epsilon_0}$
 (D) $\frac{\lambda}{4 \epsilon_0}$

45. Given below are two statements:

Statement I : Acceleration due to earth's gravity decreases as you go 'up' or 'down' from earth's surface.

Statement II : Acceleration due to earth's gravity is same at a height 'h' and depth 'd' from earth's surface, if $h = d$.

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

- (A) Statement I is correct but statement II is incorrect
(B) Both Statement I and II are correct
(C) Statement I is incorrect but statement II is correct
(D) Both Statement I and Statement II are incorrect

46. A photon is emitted in transition from $n = 4$ to $n = 1$ level in hydrogen atom. The corresponding wavelength for this transition is (given, $h = 4 \times 10^{-15}$ eVs) :

- (A) 99.3 nm
(B) 94.1 nm
(C) 974 nm
(D) 941 nm

47. The frequency (ν) of an oscillating liquid drop may depend upon radius (r) of the drop, density (ρ) of liquid and the surface tension (s) of the liquid as

$$\nu = r^a \rho^b s^c$$

. The values of a, b and c respectively are

- (A) $\left(\frac{3}{2}, \frac{1}{2}, -\frac{1}{2}\right)$
(B) $\left(-\frac{3}{2}, -\frac{1}{2}, \frac{1}{2}\right)$
(C) $\left(\frac{3}{2}, -\frac{1}{2}, \frac{1}{2}\right)$
(D) $\left(-\frac{3}{2}, \frac{1}{2}, \frac{1}{2}\right)$

48. If two vectors

$$\vec{P} = \hat{i} + 2m\hat{j} + m\hat{k}$$

and

$$\vec{Q} = 4\hat{i} - 2\hat{j} + m\hat{k}$$

are perpendicular to each other. Then, the value of m will be :

- (A) -1
(B) 3
(C) 1
(D) 2

49. A body of mass 200g is tied to a spring of spring constant 12.5 N/m, while the other end of spring is fixed at point O. If the body moves about O in a circular path on a smooth horizontal surface with constant angular speed 5 rad/s. Then the ratio of extension in the spring to its natural length will be :

- (A) 1 : 2
(B) 2 : 3
(C) 2 : 5
(D) 1 : 1

50. Match List I with List II

	List-I		List-II
A.	AM Broadcast	I.	88-108 MHz
B.	FM Broadcast	II.	540-1600 kHz
C.	Television	III.	3.7-4.2 GHz
D.	Satellite Communication	IV.	54MHz - 890MHz

Choose the correct answer from the options given below :

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

51. A convex lens of refractive index 1.5 and focal length 18cm in air is immersed in water. The change in focal length of the lens will be _____ cm.

(Given refractive index of water

$$= \frac{4}{3}$$

)

52. A body of mass 1kg begins to move under the action of a time dependent force

$$\vec{F} = (t\hat{i} + 3t^2\hat{j})$$

N, where $\hat{i}$ and $\hat{j}$ are the unit vectors along x and y axis. The power developed by above force, at the time $t = 2s$, will be _____ W.

53. The energy released per fission of nucleus of ^{240}X is 200 MeV. The energy released if all the atoms in 120g of pure ^{240}X undergo fission is _____ $\times 10^{25}$ MeV.

(Given

$$N_A = 6 \times 10^{23}$$

)

54. A uniform solid cylinder with radius R and length L has moment of inertia I_1 , about the axis of the cylinder. A concentric solid cylinder of radius

$$R' = \frac{R}{2}$$

and length

$$L' = \frac{L}{2}$$

is carved out of the original cylinder. If I_2 is the moment of inertia of the carved out portion of the cylinder then

$$\frac{I_1}{I_2} =$$

_____.

(Both I_1 and I_2 are about the axis of the cylinder)

55. If a copper wire is stretched to increase its length by 20%. The percentage increase in resistance of the wire is _____ %.

56. A parallel plate capacitor with air between the plate has a capacitance of 15pF. The separation between the plate becomes twice and the space between them is filled with a medium of dielectric constant 3.5. Then the capacitance becomes $\frac{x}{4}$ pF. The value of x is _____.

57. A single turn current loop in the shape of a right angle triangle with sides 5 cm, 12 cm, 13 cm is carrying a current of 2 A. The loop is in a uniform magnetic field of magnitude 0.75 T whose direction is parallel to the current in the 13 cm side of the loop. The magnitude of the magnetic force on the 5 cm side will be $\frac{x}{130}$ N. The value of x is _____.

58. A Spherical ball of radius 1mm and density 10.5 g/cc is dropped in glycerine of coefficient of viscosity 9.8 poise and density 1.5 g/cc. Viscous force on the ball when it attains constant velocity is 3696×10^{-x} N. The value of x is _____.

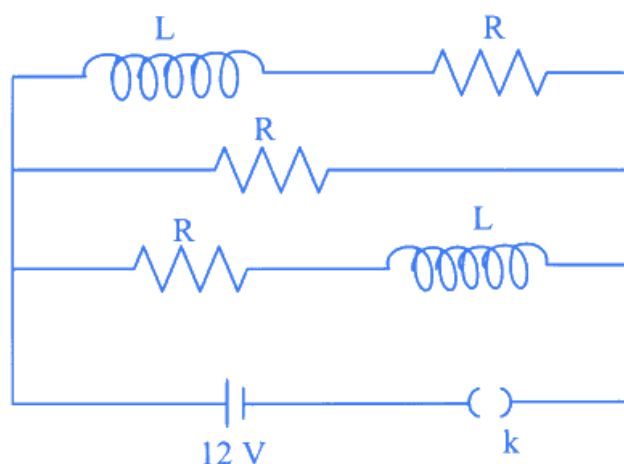
(Given, $g = 9.8 \text{ m/s}^2$ and

$$\pi = \frac{22}{7}$$

)

59. A mass m attached to free end of a spring executes SHM with a period of 1s. If the mass is increased by 3 kg the period of the oscillation increases by one second, the value of mass m is _____ kg.

60. Three identical resistors with resistance $R = 12\Omega$ and two identical inductors with self inductance $L = 5 \text{ mH}$ are connected to an ideal battery with emf of 12 V as shown in figure. The current through the battery long after the switch has been closed will be _____ A.



Chemistry - Section A · Multiple Choice Questions

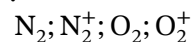
61. The number of s-electrons present in an ion with 55 protons in its unipositive state is

- (A) 10 (B) 9
(C) 12 (D) 8

62. Find out the major products from the following reactions.



63. What is the number of unpaired electron(s) in the highest occupied molecular orbital of the following species :



?

- (A) 0, 1, 0, 1 (B) 2, 1, 0, 1
(C) 0, 1, 2, 1 (D) 2, 1, 2, 1

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

Assertion A : Benzene is more stable than hypothetical cyclohexatriene

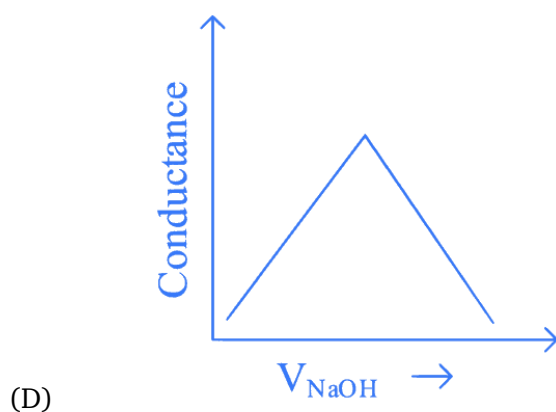
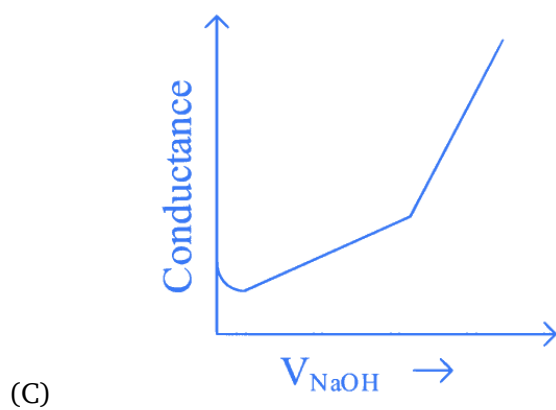
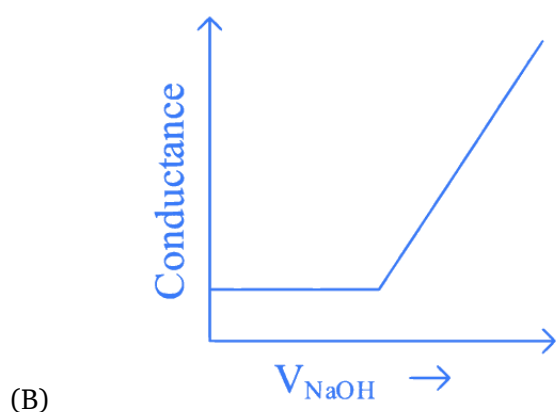
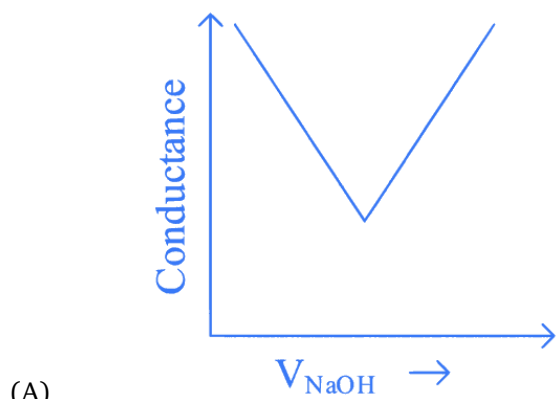
Reason R : The delocalised π electron cloud is attracted more strongly by nuclei of carbon atoms.

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

- (A) A is true but R is false (B) Both A and R are correct and R is the correct explanation of A
(C) Both A and R are correct but R is NOT the correct explanation of A (D) A is false but R is true

65. Choose the correct representation of conductometric titration of benzoic acid vs sodium hydroxide.

65. (continued)



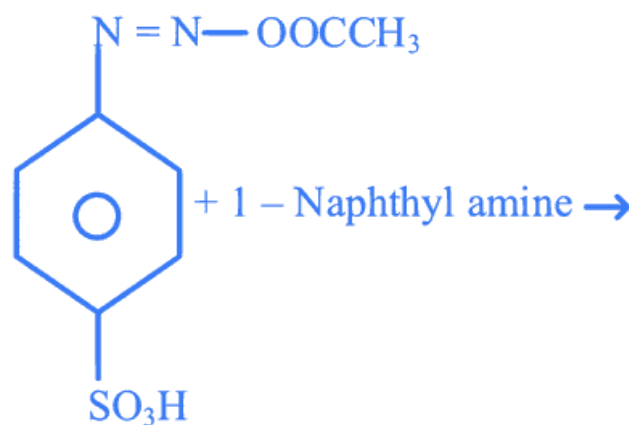
66. Given below are two statements :



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

- | | |
|---|---|
| (A) Both Statement I and Statement II are true | (B) Statement I is false but Statement II is true |
| (C) Statement I is true but Statement II is false | (D) Both Statement I and Statement II are false |

67. Choose the correct colour of the product for the following reaction.



- | | |
|-----------|------------|
| (A) White | (B) Yellow |
| (C) Red | (D) Blue |

68. Which one amongst the following are good oxidizing agents?

- A. Sm^{2+}
 B. Ce^{2+}
 C. Ce^{4+}
 D. Tb^{4+}

Choose the most appropriate answer from the options given below :

- (A) C and D only (B) A and B only
 (C) D only (D) C only

69. A student has studied the decomposition of a gas AB_3 at 25°C . He obtained the following data.

p (mm Hg)	50	100	200	400
relative $t_{1/2}$ (s)	4	2	1	0.5

The order of the reaction is

- (A) 2 (B) 0.5
 (C) 1 (D) 0 (zero)

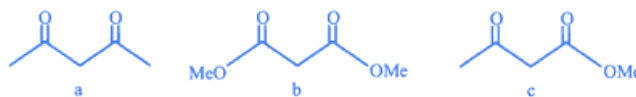
70. The hybridization and magnetic behaviour of cobalt ion in $[\text{Co}(\text{NH}_3)_6]^{3+}$ complex, respectively is :

- (A) sp^3d^2 and paramagnetic (B) sp^3d^2 and diamagnetic
 (C) d^2sp^3 and diamagnetic (D) d^2sp^3 and paramagnetic

71. $\text{K}_2\text{Cr}_2\text{O}_7$ paper acidified with dilute H_2SO_4 turns green when exposed to :

- (A) Sulphur dioxide (B) Sulphur trioxide
 (C) Hydrogen sulphide (D) Carbon dioxide

72. Which will undergo deprotonation most readily in the basic medium?



- (A) a only (B) Both a and c
 (C) c only (D) b only

73. Which of the following cannot be explained by crystal field theory?

- (A) The order of spectrochemical series (B) Stability of metal complexes
 (C) Magnetic properties of transition metal complexes (D) Colour of metal complexes

74. Given below are two statements:

Statement I : Pure Aniline and other arylamines are usually colourless.

Statement II : Arylamines get coloured on storage due to atmospheric reduction.

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

- (A) Both Statement I and Statement II are correct (B) Statement I is correct but Statement II is incorrect
 (C) Both Statement I and Statement II are incorrect (D) Statement I is incorrect but Statement II is correct

75. In which of the following reactions the hydrogen peroxide acts as a reducing agent?

- (A) $\text{Mn}^{2+} + \text{H}_2\text{O}_2 \rightarrow \text{Mn}^{4+} + 2\text{OH}^-$
 (B) $\text{HOCl} + \text{H}_2\text{O}_2 \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^- + \text{O}_2$
 (C) $\text{PbS} + 4\text{H}_2\text{O}_2 \rightarrow \text{PbSO}_4 + 4\text{H}_2\text{O}$
 (D) $2\text{Fe}^{2+} + \text{H}_2\text{O}_2 \rightarrow 2\text{Fe}^{3+} + 2\text{OH}^-$

76. The metal which is extracted by oxidation and subsequent reduction from its ore is :

- (A) Al (B) Cu
 (C) Ag (D) Fe

77. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R

Assertion A : Beryllium has less negative value of reduction potential compared to the other alkaline earth metals.

Reason R : Beryllium has large hydration energy due to small size of Be^{2+} but relatively large value of atomization enthalpy

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

- (A) Both A and R are correct but R is NOT the correct explanation of A
 (B) Both A and R are correct and R is the correct explanation of A
 (C) A is correct but R is not correct
 (D) A is not correct but R is correct

78. Correct statement is :

- (A) An average human being consumes more food than air
 (B) An average human being consumes 100 times more air than food
 (C) An average human being consumes nearly 15 times more air than food
 (D) An average human being consumes equal amount of food and air

79. Identify the correct statements about alkali metals.

- A. The order of standard reduction potential ($M^+ | M$) for alkali metal ions is $\text{Na} > \text{Rb} > \text{Li}$.
 B. CsI is highly soluble in water.
 C. Lithium carbonate is highly stable to heat.
 D. Potassium dissolved in concentrated liquid ammonia is blue in colour and paramagnetic.
 E. All the alkali metal hydrides are ionic solids.

Choose the correct answer from the options given below :

- (A) C and E only (B) A and E only
 (C) A, B, D only (D) A, B and E only

80. Match List I with List II

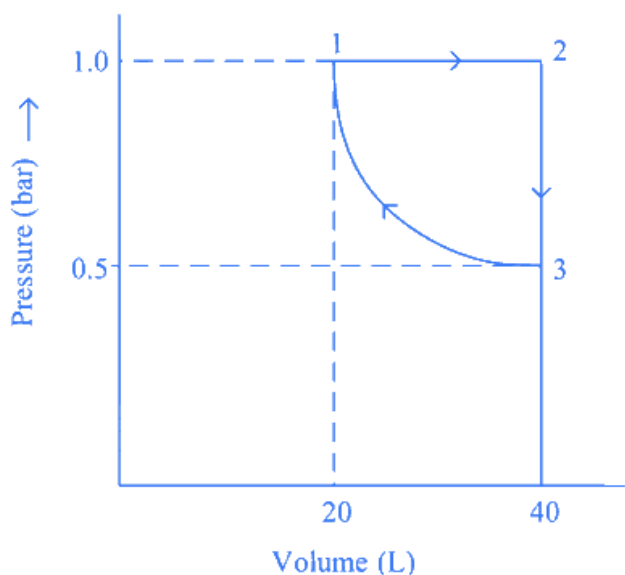
	List-I Type		List-II Name
A.	Antifertility drug	i)	Norethindrone
B.	Tranquilizer	ii)	Meprobamate
C.	Antihistamine	iii)	Seldane
D.	Antibiotic	iv)	Ampicillin

Choose the correct answer from the options given below :

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

81. Total number of tripeptides possible by mixing of valine and proline is _____

82. One mole of an ideal monoatomic gas is subjected to changes as shown in the graph. The magnitude of the work done (by the system or on the system) is _____ J (nearest integer)



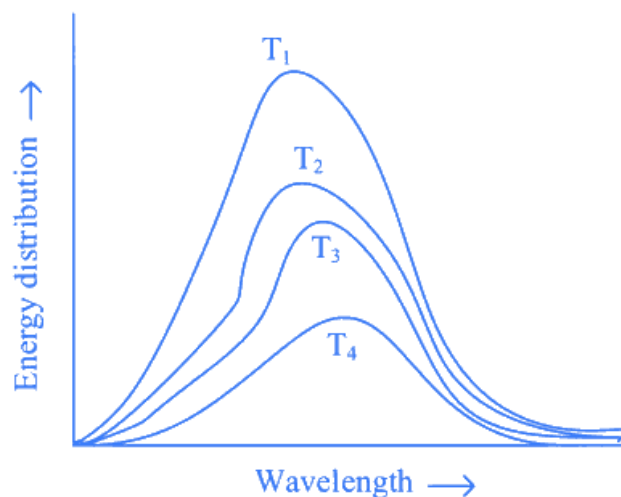
Given ;

$$\log 2 = 0.3$$

$$\ln 10 = 2.3$$

83. Maximum number of isomeric monochloro derivatives which can be obtained from 2,2,5,5-tetramethylhexane by chlorination is _____

84. Following figure shows spectrum of an ideal black body at four different temperatures. The number of correct statement/s from the following is _____.



A.

$$T_4 > T_3 > T_2 > T_1$$

B. The black body consists of particles performing simple harmonic motion.

C. The peak of the spectrum shifts to shorter wavelength as temperature increases.

D.

$$\frac{T_1}{\nu_1} = \frac{T_2}{\nu_2} = \frac{T_3}{\nu_3} \neq$$

constant

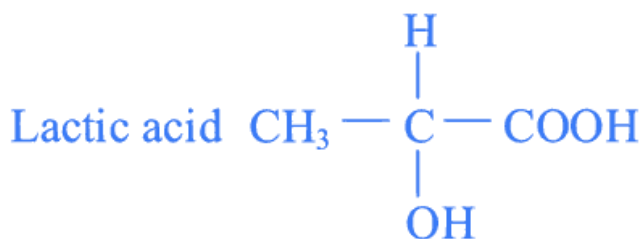
E. The given spectrum could be explained using quantisation of energy.

85. Sum of π -bonds present in peroxodisulphuric acid and pyrosulphuric acid is _____

86. The number of units, which are used to express concentration of solutions from the following is _____
Mass percent, Mole, Mole fraction, Molarity, ppm, Molality

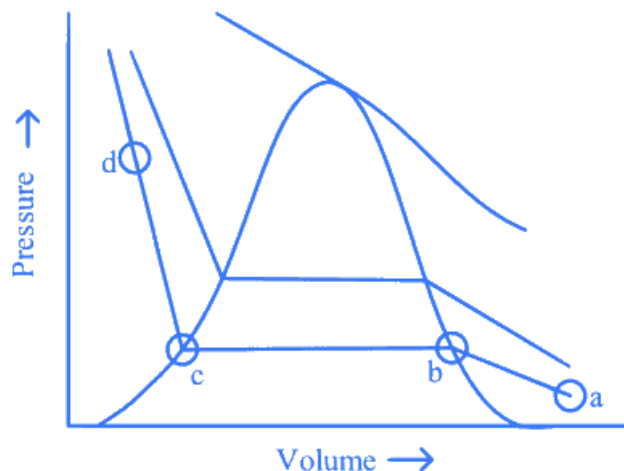
87. The total pressure observed by mixing two liquids A and B is 350 mm Hg when their mole fractions are 0.7 and 0.3 respectively. The total pressure becomes 410 mm Hg if the mole fractions are changed to 0.2 and 0.8 respectively for A and B. The vapour pressure of pure A is _____ mm Hg. (Nearest integer)
Consider the liquids and solutions behave ideally.

88. If the pK_a of lactic acid is 5, then the pH of 0.005 M calcium lactate solution at 25°C is _____ $\times 10^{-1}$ (Nearest integer)



89. The number of statement/s which are the characteristics of physisorption is _____
A. It is highly specific in nature
B. Enthalpy of adsorption is high
C. It decreases with increase in temperature
D. It results into unimolecular layer
E. No activation energy is needed

90. The number of statement/s, which are correct with respect to the compression of carbon dioxide from point (a) in the Andrews isotherm from the following is _____



- A. Carbon dioxide remains as a gas upto point (b)
B. Liquid carbon dioxide appears at point (c)
C. Liquid and gaseous carbon dioxide coexist between points (b) and (c)
D. As the volume decreases from (b) and (c), the amount of liquid decreases

- End of Question Paper -