

JEE Main 2024 Paper 1 (B.E./B.Tech) 29 January 2024 Shift 1 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) 2024 - Session 1**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 29 January 2024, Shift 1. 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. Suppose

$$f(x) = \frac{(2^x + 2^{-x}) \tan x \sqrt{\tan^{-1}(x^2 - x + 1)}}{(7x^2 + 3x + 1)^3}$$

. Then the value of $f'(0)$ is equal to

- (A) π
 (B) $\sqrt{\pi}$
 (C) 0
 (D) $\frac{\pi}{2}$

2. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non-zero vectors such that $\vec{b}$ and $\vec{c}$ are non-collinear. If $\vec{a} + 5\vec{b}$ is collinear with $\vec{c}$, $\vec{b} + 6\vec{c}$ is collinear with $\vec{a}$ and

$$\vec{a} + \alpha\vec{b} + \beta\vec{c} = \vec{0}$$

, then $\alpha + \beta$ is equal to

- (A) 30 (B) -30
 (C) -25 (D) 35

3. Let

$$\left(5, \frac{a}{4}\right)$$

be the circumcenter of a triangle with vertices $A(a, -2), B(a, 6)$ and

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

. Let α denote the circumradius, β denote the area and γ denote the perimeter of the triangle. Then $\alpha + \beta + \gamma$ is

- (A) 60 (B) 62
 (C) 53 (D) 30

4. If

$$\alpha, -\frac{\pi}{2} < \alpha < \frac{\pi}{2}$$

is the solution of

$$4 \cos \theta + 5 \sin \theta = 1$$

, then the value of $\tan \alpha$ is

- (A) $\frac{10 - \sqrt{10}}{12}$
 (B) $\frac{\sqrt{10} - 10}{6}$
 (C) $\frac{\sqrt{10} - 10}{12}$
 (D) $\frac{10 - \sqrt{10}}{6}$

5. If in a G.P. of 64 terms, the sum of all the terms is 7 times the sum of the odd terms of the G.P. then the common ratio of the G.P. is equal to

- (A) 7 (B) 6
 (C) 5 (D) 4

6. A fair die is thrown until 2 appears. Then the probability, that 2 appears in even number of throws, is

- (A) $\frac{5}{11}$
 (B) $\frac{5}{6}$
 (C) $\frac{1}{6}$
 (D) $\frac{6}{11}$

7. In an A.P., the sixth term $a_6 = 2$. If the product $a_1 a_4 a_5$ is the greatest, then the common difference of the A.P. is equal to

- (A) $\frac{2}{3}$
 (B) $\frac{5}{8}$
 (C) $\frac{3}{2}$
 (D) $\frac{8}{5}$

8.

$$\text{Let } A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \alpha & \beta \\ 0 & \beta & \alpha \end{bmatrix} \text{ and } |2A|^3 = 2^{21} \text{ where } \alpha,$$

$\beta \in \mathbb{Z}$, Then a value of α is

- (A) 9 (B) 17
 (C) 3 (D) 5

9. Let R be a relation on $Z \times Z$ defined by $(a, b)R(c, d)$ if and only if $ad - bc$ is divisible by 5. Then R is

- | | |
|--|--|
| (A) Reflexive and transitive but not symmetric | (B) Reflexive and symmetric but not transitive |
| (C) Reflexive but neither symmetric nor transitive | (D) Reflexive, symmetric and transitive |

10. If

$$f(x) = \begin{cases} 2 + 2x, & -1 \leq x < 0 \\ 1 - \frac{x}{3}, & 0 \leq x \leq 3 \end{cases};$$

$$g(x) = \begin{cases} -x, & -3 \leq x \leq 0 \\ x, & 0 < x \leq 1 \end{cases}$$

, then range of $(f \circ g)(x)$ is

- | | |
|-----|----------|
| (A) | $[0, 1)$ |
| (B) | $[0, 3)$ |
| (C) | $(0, 1]$ |
| (D) | $[0, 1]$ |

11. Let O be the origin and the position vectors of A and B be $2\hat{i} + 2\hat{j} + \hat{k}$ and $2\hat{i} + 4\hat{j} + 4\hat{k}$ respectively. If the internal bisector of $\angle AOB$ meets the line AB at C , then the length of OC is

- | | |
|-----|------------------------|
| (A) | $\frac{3}{2}\sqrt{34}$ |
| (B) | $\frac{2}{3}\sqrt{31}$ |
| (C) | $\frac{2}{3}\sqrt{34}$ |
| (D) | $\frac{3}{2}\sqrt{31}$ |

12. In a $\triangle ABC$, suppose $y = x$ is the equation of the bisector of the angle B and the equation of the side AC is $2x - y = 2$. If $2AB = BC$ and the points A and B are respectively $(4, 6)$ and (α, β) , then $\alpha + 2\beta$ is equal to

- | | |
|--------|--------|
| (A) 42 | (B) 39 |
| (C) 48 | (D) 45 |

13. For

$$x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$$

, if

$$y(x) = \int \frac{\operatorname{cosec} x + \sin x}{\operatorname{cosec} x \sec x + \tan x \sin^2 x} dx$$

, and

$$\lim_{x \rightarrow \left(\frac{\pi}{2}\right)^-} y(x) = 0$$

then

$$y\left(\frac{\pi}{4}\right)$$

is equal to

- | | |
|-----|--|
| (A) | $-\frac{1}{\sqrt{2}} \tan^{-1}\left(\frac{1}{\sqrt{2}}\right)$ |
| (B) | $\tan^{-1}\left(\frac{1}{\sqrt{2}}\right)$ |
| (C) | $\frac{1}{2} \tan^{-1}\left(\frac{1}{\sqrt{2}}\right)$ |
| (D) | $\frac{1}{\sqrt{2}} \tan^{-1}\left(-\frac{1}{2}\right)$ |

14. Let A be a square matrix such that

$$AA^T = I$$

. Then

$$\frac{1}{2}A \left[(A + A^T)^2 + (A - A^T)^2 \right]$$

is equal to

- | | |
|-----|-------------|
| (A) | $A^2 + A^T$ |
| (B) | $A^3 + I$ |
| (C) | $A^3 + A^T$ |
| (D) | $A^2 + I$ |

15. If

$$z = \frac{1}{2} - 2i$$

is such that

$$|z + 1| = \alpha z + \beta(1 + i), i = \sqrt{-1}$$

and $\alpha, \beta \in \mathbb{R}$, then $\alpha + \beta$ is equal to

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

16. Consider the function

$$f: \left[\frac{1}{2}, 1 \right] \rightarrow \mathbb{R}$$

defined by

$$f(x) = 4\sqrt{2} x^3 - 3\sqrt{2} x - 1$$

. Consider the statements

(I) The curve

$$y = f(x)$$

intersects the x -axis exactly at one point.

(II) The curve

$$y = f(x)$$

intersects the x -axis at

$$x = \cos \frac{\pi}{12}$$

Then

(A) Both (I) and (II) are correct. (B) Only (I) is correct.

(C) Both (I) and (II) are incorrect. (D) Only (II) is correct.

17. Let PQR be a triangle with $R(-1, 4, 2)$. Suppose $M(2, 1, 2)$ is the mid point of PQ . The distance of the centroid of $\triangle PQR$ from the point of intersection of the lines

$$\frac{x-2}{0} = \frac{y}{2} = \frac{z+3}{-1}$$

and

$$\frac{x-1}{1} = \frac{y+3}{-3} = \frac{z+1}{1}$$

is

(A) 69

(B) $\sqrt{99}$

(C) $\sqrt{69}$

(D) 9

18.

$$\lim_{x \rightarrow \frac{\pi}{2}} \left(\frac{1}{\left(x - \frac{\pi}{2}\right)^2} \int_{x^3}^{\left(\frac{\pi}{2}\right)^3} \cos\left(t^{\frac{1}{3}}\right) dt \right)$$

is equal to

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

(B) $\frac{3\pi^2}{8}$

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

(D) $\frac{3\pi}{8}$

19. A function

$$y = f(x)$$

satisfies

$$f(x)\sin 2x + \sin x - (1 + \cos^2 x) f'(x) = 0$$

with condition

$$f(0) = 0$$

. Then,

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

is equal to

(A) 2 (B) 1

(C) -1 (D) 0

20. If the value of the integral

$$\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \left(\frac{x^2 \cos x}{1 + \pi^x} + \frac{1 + \sin^2 x}{1 + e^{\sin x^{2123}}} \right) dx = \frac{\pi}{4}(\pi + a) - 2$$

, then the value of a is

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

(B) 3

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

(D) 2

21. The area (in sq. units) of the part of the circle $x^2 + y^2 = 169$ which is below the line $5x - y = 13$ is

$$\frac{\pi\alpha}{2\beta} - \frac{65}{2} + \frac{\alpha}{\beta} \sin^{-1}\left(\frac{12}{13}\right)$$

, where α, β are coprime numbers. Then $\alpha + \beta$ is equal to _____.

22. If the mean and variance of the data 65, 68, 58, 44, 48, 45, 60, $\alpha, \beta, 60$ where $\alpha > \beta$, are 56 and 66.2 respectively, then $\alpha^2 + \beta^2$ is equal to _____.

23. Equations of two diameters of a circle are $2x - 3y = 5$ and $3x - 4y = 7$. The line joining the points

$$\left(-\frac{22}{7}, -4\right)$$

and

$$\left(-\frac{1}{7}, 3\right)$$

intersects the circle at only one point $P(\alpha, \beta)$. Then, $17\beta - \alpha$ is equal to _____.

24. A line with direction ratios 2, 1, 2 meets the lines $x = y + 2 = z$ and $x + 2 = 2y = 2z$ respectively at the points P and Q. If the length of the perpendicular from the point (1, 2, 12) to the line PQ is l , then l^2 is _____.

25.

$$\text{If } \frac{{}^{11}C_1}{2} + \frac{{}^{11}C_2}{3} + \dots + \frac{{}^{11}C_9}{10} = \frac{n}{m} \text{ with } \gcd(n, m) = 1, \text{ then } n + m \text{ is equal to}$$

_____.

26. If the points of intersection of two distinct conics $x^2 + y^2 = 4b$ and

$$\frac{x^2}{16} + \frac{y^2}{b^2} = 1$$

lie on the curve $y^2 = 3x^2$, then $3\sqrt{3}$ times the area of the rectangle formed by the intersection points is _____.

27. All the letters of the word "GTWENTY" are written in all possible ways with or without meaning and these words are written as in a dictionary. The serial number of the word "GTWENTY" is _____.

28. Let α, β be the roots of the equation $x^2 - x + 2 = 0$ with

. Then $\frac{\text{Im}(\alpha) > \text{Im}(\beta)}{\alpha^6 + \alpha^4 + \beta^4 - 5\alpha^2}$ is equal to _____.

29. Let

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

. If m and n are respectively the number of points at which the curves

$$y = f(x)$$

and

$$y = f'(x)$$

intersect the x -axis, then the value of $m + n$ is _____.

30. If the solution curve

$$y = y(x)$$

of the differential equation

$$(1 + y^2)(1 + \log_e x)dx + xdy = 0, x > 0$$

passes through the point (1, 1) and

$$y(e) = \frac{\alpha - \tan\left(\frac{3}{2}\right)}{\beta + \tan\left(\frac{3}{2}\right)}$$

, then $\alpha + 2\beta$ is _____.

31. The resistance

$$R = \frac{V}{I}$$

where

$$V = (200 \pm 5)V$$

and

$$I = (20 \pm 0.2)A$$

, the percentage error in the measurement of R is :

- (A) 5.5% (B) 3%
(C) 7% (D) 3.5%

32. The de-Broglie wavelength of an electron is the same as that of a photon. If velocity of electron is 25% of the velocity of light, then the ratio of K.E. of electron and K.E. of photon will be:

- (A) $\frac{1}{4}$
(B) $\frac{8}{1}$
(C) $\frac{1}{8}$
(D) $\frac{1}{1}$

33. A convex mirror of radius of curvature 30 cm forms an image that is half the size of the object. The object distance is :

- (A) -45 cm (B) -15 cm
(C) 45 cm (D) 15 cm

34. The deflection in moving coil galvanometer falls from 25 divisions to 5 division when a shunt of 24Ω is applied. The resistance of galvanometer coil will be :

- (A) 48Ω
(B) 100Ω
(C) 96Ω
(D) 12Ω

35. A capacitor of capacitance $100\mu F$ is charged to a potential of 12 V and connected to a 6.4 mH inductor to produce oscillations. The maximum current in the circuit would be :

- (A) 2.0 A (B) 3.2 A
(C) 1.5 A (D) 1.2 A

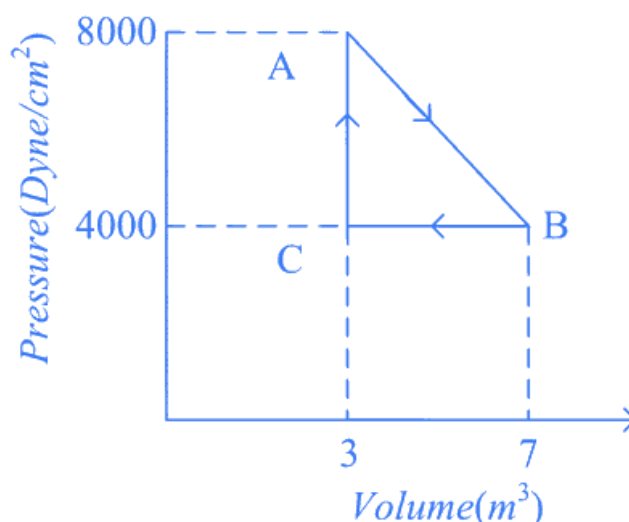
36. At what distance above and below the surface of the earth a body will have same weight. (take radius of earth as R .)

- (A) $\frac{\sqrt{3} R - R}{2}$
(B) $\frac{R}{2}$
(C) $\frac{\sqrt{5} R - R}{2}$
(D) $\sqrt{5} R - R$

37. A galvanometer having coil resistance 10Ω shows a full scale deflection for a current of 3 mA. For it to measure a current of 8 A, the value of the shunt should be:

- (A) $3.75 \times 10^{-3}\Omega$
(B) $3 \times 10^{-3}\Omega$
(C) $4.85 \times 10^{-3}\Omega$
(D) $2.75 \times 10^{-3}\Omega$

38. A thermodynamic system is taken from an original state A to an intermediate state B by a linear process as shown in the figure. It's volume is then reduced to the original value from B to C by an isobaric process. The total work done by the gas from A to B and B to C would be :



- (A) 800 J (B) 2200 J
(C) 33800 J (D) 1200 J

39. Two charges of $5Q$ and $-2Q$ are situated at the points $(3a, 0)$ and $(-5a, 0)$ respectively. The electric flux through a sphere of radius ' $4a$ ' having center at origin is :

- (A) $\frac{2Q}{\epsilon_0}$
 (B) $\frac{7Q}{\epsilon_0}$
 (C) $\frac{3Q}{\epsilon_0}$
 (D) $\frac{5Q}{\epsilon_0}$

40. A biconvex lens of refractive index 1.5 has a focal length of 20 cm in air. Its focal length when immersed in a liquid of refractive index 1.6 will be:

- (A) -16 cm (B) +16 cm
 (C) +160 cm (D) -160 cm

41. A block of mass 100 kg slides over a distance of 10 m on a horizontal surface. If the co-efficient of friction between the surfaces is 0.4, then the work done against friction (in J) is :

- (A) 3900 (B) 4500
 (C) 4200 (D) 4000

42. Given below are two statements:

Statement I : If a capillary tube is immersed first in cold water and then in hot water, the height of capillary rise will be smaller in hot water.

Statement II : If a capillary tube is immersed first in cold water and then in hot water, the height of capillary rise will be smaller in cold water.

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

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

43. If the radius of curvature of the path of two particles of same mass are in the ratio 3 : 4, then in order to have constant centripetal force, their velocities will be in the ratio of :

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

44. Match List I with List II

	List - I		List - II
(A)	$\oint \vec{B} \cdot d\vec{l} = \mu_o i_c + \mu_o \epsilon_o \frac{d\phi_E}{dt}$	(I)	Gauss' law for electricity
(B)	$\oint \vec{E} \cdot d\vec{l} = \frac{d\phi_B}{dt}$	(II)	Gauss' law for magnetism
(C)	$\oint \vec{E} \cdot d\vec{A} = \frac{Q}{\epsilon_o}$	(III)	Faraday law
(D)	$\oint \vec{B} \cdot d\vec{A} = 0$	(IV)	Ampere - Maxwell law

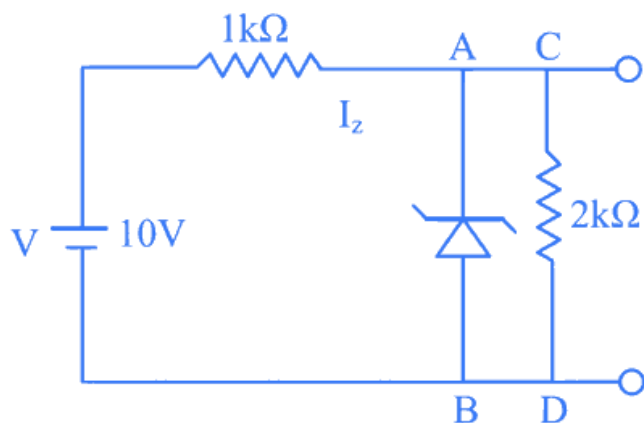
Choose the correct answer from the options given below:

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

45. Two vessels A and B are of the same size and are at same temperature. A contains 1 g of hydrogen and B contains 1 g of oxygen. P_A and P_B are the pressures of the gases in A and B respectively, then $\frac{P_A}{P_B}$ is:

- (A) 4 (B) 32
 (C) 8 (D) 16

46. In the given circuit, the breakdown voltage of the Zener diode is 3.0 V. What is the value of I_z ?



- (A) 3.3 mA (B) 10 mA
(C) 5.5 mA (D) 7 mA

47. A body starts moving from rest with constant acceleration covers displacement S_1 in first $(p - 1)$ seconds and S_2 in first p seconds. The displacement $S_1 + S_2$ will be made in time :

- (A) $(2p + 1)s$
(B) $(2p - 1)s$
(C) $(2p^2 - 2p + 1)s$
(D) $\sqrt{(2p^2 - 2p + 1)} s$

48. The electric current through a wire varies with time as

$$I = I_0 + \beta t$$

, where

$$I_0 = 20 \text{ A}$$

and

$$\beta = 3 \text{ A/s}$$

. The amount of electric charge crossed through a section of the wire in 20 s is :

- (A) 80 C (B) 800 C
(C) 1000 C (D) 1600 C

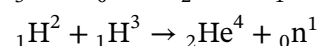
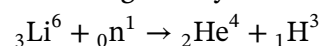
49. The potential energy function (in J) of a particle in a region of space is given as

$$U = (2x^2 + 3y^3 + 2z)$$

. Here x, y and z are in meter. The magnitude of x -component of force (in N) acting on the particle at point $P(1, 2, 3)m$ is :

- (A) 4 (B) 2
(C) 8 (D) 6

50. The explosive in a Hydrogen bomb is a mixture of ${}_1\text{H}^2$, ${}_1\text{H}^3$ and ${}_3\text{Li}^6$ in some condensed form. The chain reaction is given by



During the explosion the energy released is approximately

[Given ;

$$M(\text{Li}) = 6.01690 \text{ amu}, M({}_1\text{H}^2) = 2.01471 \text{ amu},$$

$$M({}_2\text{He}^4) = 4.00388$$

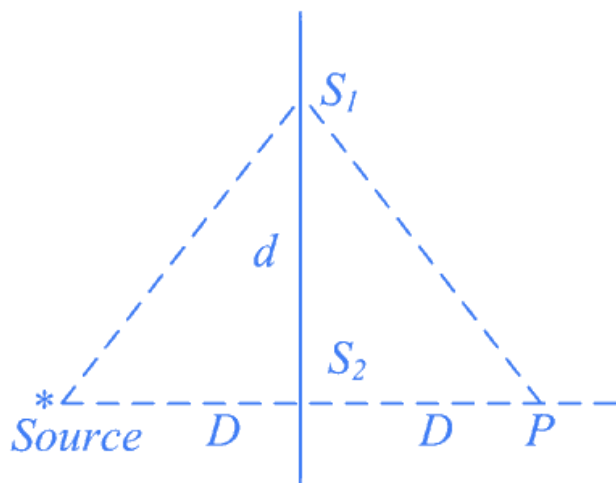
amu, and

$$1 \text{ amu} = 931.5 \text{ MeV}]$$

- (A) 22.22 MeV (B) 28.12 MeV
(C) 16.48 MeV (D) 12.64 MeV

51. In a double slit experiment shown in figure, when light of wavelength 400 nm is used, dark fringe is observed at P . If

$D = 0.2 \text{ m}$, the minimum distance between the slits S_1 and S_2 is _____ mm.



52. A cylinder is rolling down on an inclined plane of inclination 60° . Its acceleration during rolling down will be

$\frac{x}{\sqrt{3}} \text{ m/s}^2$, where $x = \frac{\text{use}}{g = 10 \text{ m/s}^2}$.

53. An electron is moving under the influence of the electric field of a uniformly charged infinite plane sheet S having surface charge density $+\sigma$. The electron at $t = 0$ is at a distance of 1 m from S and has a speed of 1 m/s . The maximum value of σ if the electron strikes S at $t = 1 \text{ s}$ is

$\alpha \left[\frac{m\epsilon_0}{e} \right] \frac{C}{m^2}$, the value of α is _____.

54. When a hydrogen atom going from $n = 2$ to $n = 1$ emits a photon, its recoil speed is $\frac{x}{5} \text{ m/s}$. Where $x = \text{_____}$. (Use, mass of hydrogen atom

$$= 1.6 \times 10^{-27} \text{ kg}$$

55. A square loop of side 10 cm and resistance 0.7Ω is placed vertically in east-west plane. A uniform magnetic field of 0.20 T is set up across the plane in north east direction. The magnetic field is decreased to zero in 1 s at a steady rate. Then, magnitude of induced emf is $\sqrt{x} \times 10^{-3} \text{ V}$. The value of x is _____.

56. The magnetic potential due to a magnetic dipole at a point on its axis situated at a distance of 20 cm from its center is $1.5 \times 10^{-5} \text{ T m}$. The magnetic moment of the dipole is _____ A m^2 . (Given :

$$\frac{\mu_0}{4\pi} = 10^{-7} \text{ TmA}^{-1}$$

)

57. A 16Ω wire is bend to form a square loop. A 9 V battery with internal resistance 1Ω is connected across one of its sides. If a $4 \mu\text{F}$ capacitor is connected across one of its diagonals, the energy stored by the capacitor will be

$\frac{x}{2} \mu\text{J}$, where $x = \text{_____}$

58. When the displacement of a simple harmonic oscillator is one third of its amplitude, the ratio of total energy to the kinetic energy is $\frac{x}{8}$, where $x = \text{_____}$.

59. A ball rolls off the top of a stairway with horizontal velocity u . The steps are 0.1 m high and 0.1 m wide. The minimum velocity u with which that ball just hits the step 5 of the stairway will be $\sqrt{x} \text{ ms}^{-1}$ where $x = \text{_____}$ [use $g = 10 \text{ m/s}^2$].

60. In a test experiment on a model aeroplane in wind tunnel, the flow speeds on the upper and lower surfaces of the wings are 70 ms^{-1} and 65 ms^{-1} respectively. If the wing area is 2 m^2 , the lift of the wing is _____ N . (Given density of air $= 1.2 \text{ kg m}^{-3}$)

)

61. Identify the incorrect pair from the following :

- (A) Fluoroapatite $-3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaF}_2$
 (B) Carnallite $-\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
 (C) Cryolite $-\text{Na}_3\text{AlF}_6$
 (D) Fluorspar $-\text{BF}_3$

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

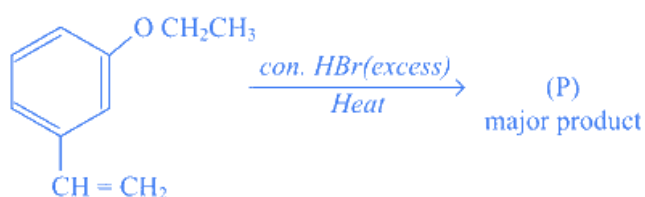
Assertion **A** : The first ionisation enthalpy decreases across a period.

Reason **R** : The increasing nuclear charge outweighs the shielding across the period.

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

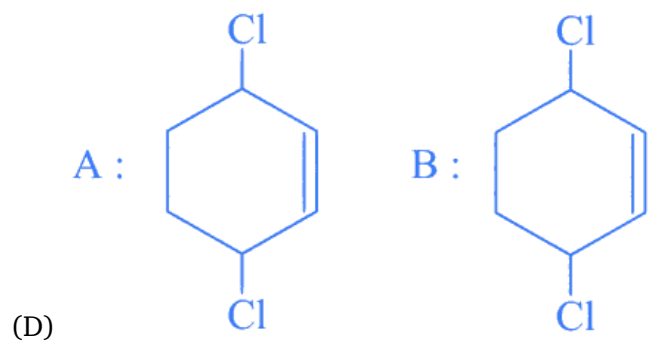
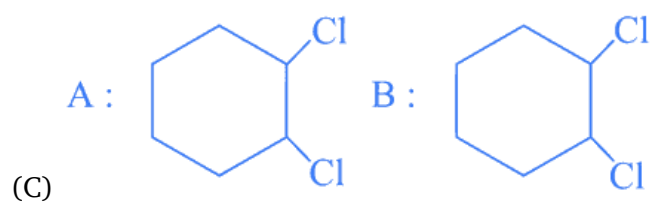
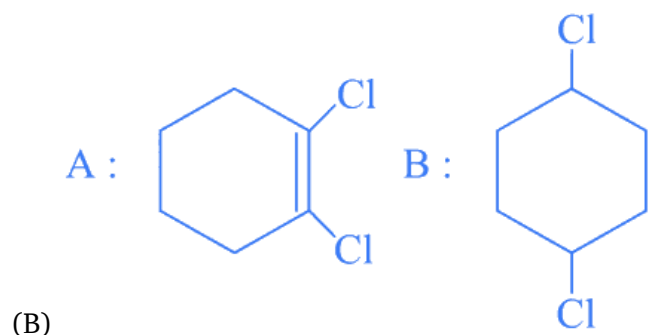
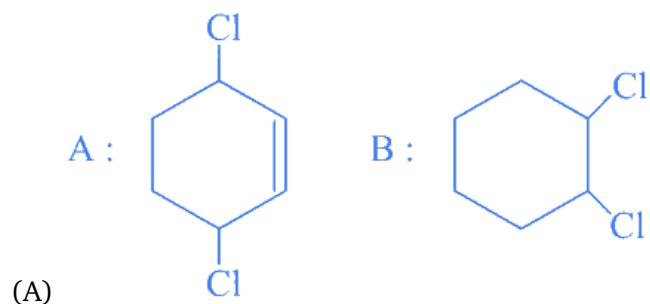
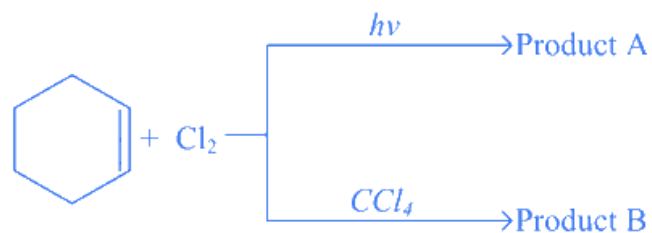
- (A) **A** is false but **R** is true
 (B) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**
 (C) Both **A** and **R** are true and **R** is the correct explanation of **A**
 (D) **A** is true but **R** is false

63. The major product(P) in the following reaction is

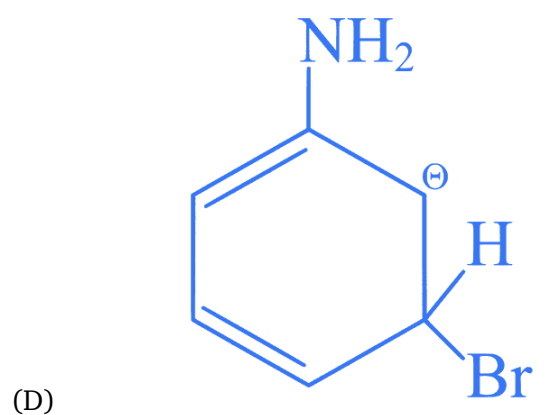
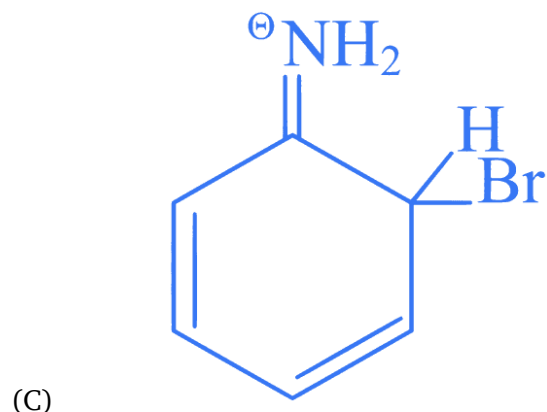
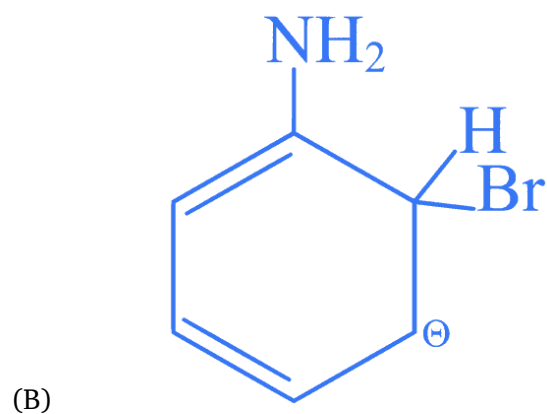
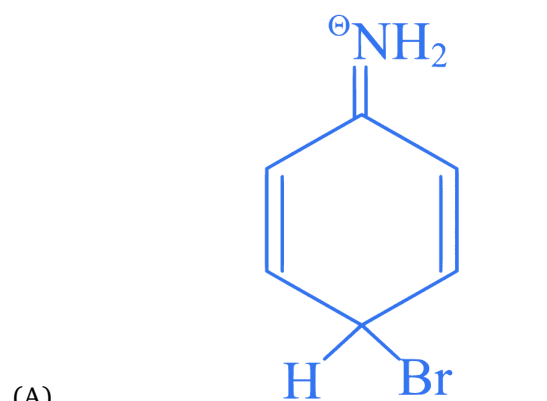


- (A)
- (B)
- (C)
- (D)

64. Identify product A and product B :



65. the arenium ion which is not involved in the bromination of Aniline is _____.



66. Given below are two statements :

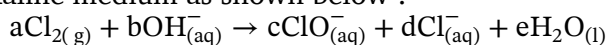
Statement I : The electronegativity of group 14 elements from Si to Pb, gradually decreases.

Statement II : Group 14 contains non-metallic, metallic, as well as metalloid elements.

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

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

67. Chlorine undergoes disproportionation in alkaline medium as shown below :



The values of a , b , c and d in a balanced redox reaction are respectively :

- (A) 3, 4, 4 and 2
(B) 1, 2, 1 and 1
(C) 2, 4, 1 and 3
(D) 2, 2, 1 and 3

68. In chromyl chloride test for confirmation of Cl^{-} ion, a yellow solution is obtained. Acidification of the solution and addition of amyl alcohol and 10% H_2O_2 turns organic layer blue indicating formation of chromium pentoxide. The oxidation state of chromium in that is

- (A) +6
(B) +5
(C) +3
(D) +10

69. Type of amino acids obtained by hydrolysis of proteins is :

- (A) γ
(B) β
(C) α
(D) δ

70. The correct set of four quantum numbers for the valence electron of rubidium atom

($Z = 37$)

is :

- (A) $5, 1, 1, +\frac{1}{2}$
(B) $5, 0, 0, +\frac{1}{2}$
(C) $5, 0, 1, +\frac{1}{2}$
(D) $5, 1, 0, +\frac{1}{2}$

71. The difference in energy between the actual structure and the lowest energy resonance structure for the given compound is

- (A) electromeric energy
(B) resonance energy
(C) ionization energy
(D) hyperconjugation energy

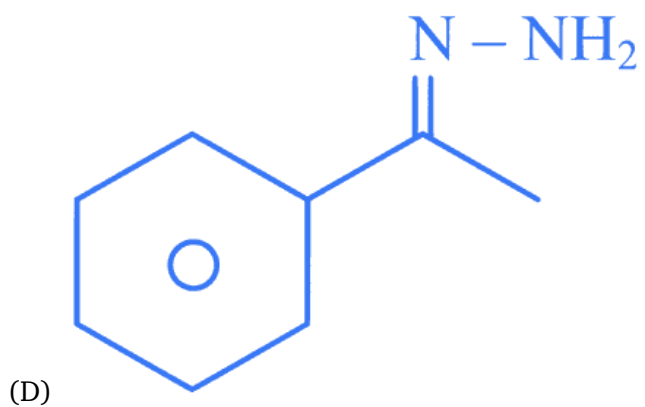
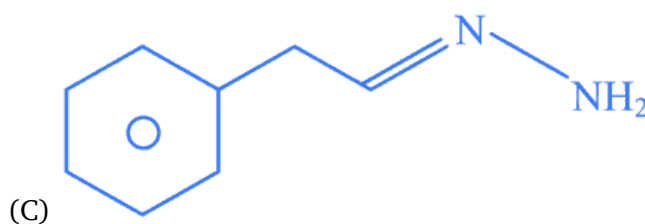
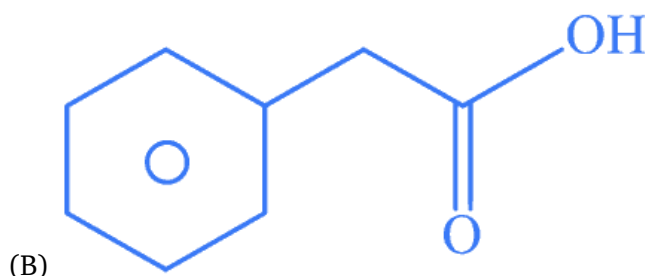
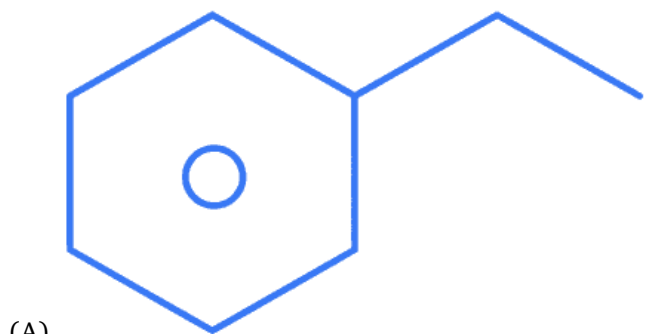
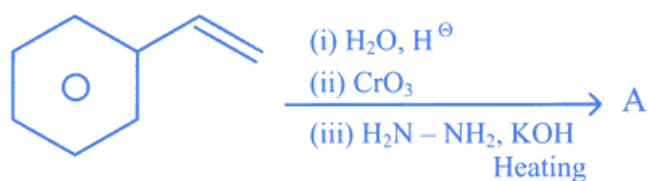
72. Match List I with List II

	List - I (Substances)		List - II (Element Present)
(A)	Ziegler catalyst	(I)	Rhodium
(B)	Blood Pigment	(II)	Cobalt
(C)	Wilkinson catalyst	(III)	Iron
(D)	Vitamin B ₁₂	(IV)	Titanium

Choose the correct answer from the options given below:

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

73. The final product A formed in the following multistep reaction sequence is



74. Which of the following is not correct?

- | | |
|---|---|
| (A) ΔG is positive for a spontaneous reaction | (B) ΔG is positive for a non-spontaneous reaction |
| (C) ΔG is zero for a reversible reaction | (D) ΔG is negative for a spontaneous reaction |

75. The interaction between π bond and lone pair of electrons present on an adjacent atom is responsible for

- | | |
|----------------------|-------------------------|
| (A) Resonance effect | (B) Electromeric effect |
| (C) Hyperconjugation | (D) Inductive effect |

76. In which one of the following metal carbonyls, CO forms a bridge between metal atoms?

- | | |
|-----|---------------------------------|
| (A) | $[\text{Os}_3(\text{CO})_{12}]$ |
| (B) | $[\text{Ru}_3(\text{CO})_{12}]$ |
| (C) | $[\text{Mn}_2(\text{CO})_{10}]$ |
| (D) | $[\text{Co}_2(\text{CO})_8]$ |

77. KMnO_4 decomposes on heating at 513 K to form O_2 along with

- (A) K_2MnO_4 & Mn
- (B) MnO_2 & K_2O_2
- (C) K_2MnO_4 & MnO_2
- (D) Mn & KO_2

78. Appearance of blood red colour, on treatment of the sodium fusion extract of an organic compound with FeSO_4 in presence of concentrated H_2SO_4 indicates the presence of element/s

- (A) Br
- (B) S
- (C) N and S
- (D) N

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

Assertion A : Aryl halides cannot be prepared by replacement of hydroxyl group of phenol by halogen atom.

Reason R : Phenols react with halogen acids violently.

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

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

80. In alkaline medium, MnO_4^- oxidises I^- to

- (A) I_2
- (B) IO_3^-
- (C) IO^-
- (D) IO_4^-

Chemistry - Section B · Numerical Value Questions

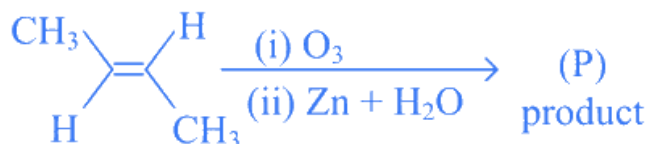
81. The mass of zinc produced by the electrolysis of zinc sulphate solution with a steady current of 0.015 A for 15 minutes is _____ $\times 10^{-4}$ g.

(Atomic mass of zinc = 65.4 amu)

82. A solution of H_2SO_4 is 31.4% H_2SO_4 by mass and has a density of 1.25 g/mL. The molarity of the H_2SO_4 solution is _____ M (nearest integer)

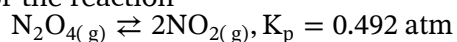
[Given molar mass of $\text{H}_2\text{SO}_4 = 98 \text{ g mol}^{-1}$]

83.



Consider the given reaction. The total number of oxygen atom/s present per molecule of the product (P) is _____.

84. For the reaction



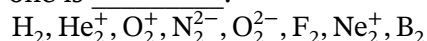
at 300 K. K_c for the reaction at same temperature is _____ $\times 10^{-2}$.

(Given :

$$R = 0.082 \text{ L atm mol}^{-1} \text{ K}^{-1}$$

)

85. The number of species from the following which are paramagnetic and with bond order equal to one is _____.



86. For a reaction taking place in three steps at same temperature, overall rate constant

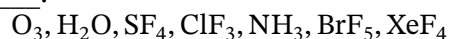
$$K = \frac{K_1 K_2}{K_3}$$

. If E_{a1}, E_{a2} and E_{a3} are 40, 50 and 60 kJ/mol respectively, the overall E_a is _____ kJ/mol.

87. From the compounds given below, number of compounds which give positive Fehling's test is _____.

Benzaldehyde, Acetaldehyde, Acetone, Acetophenone, Methanal, 4nitrobenzaldehyde, cyclohexane carbaldehyde.

88. Number of compounds with one lone pair of electrons on central atom amongst following is _____.



89. Number of compounds among the following which contain sulphur as heteroatom is _____.

Furan, Thiophene, Pyridine, Pyrrole, Cysteine, Tyrosine

90. The osmotic pressure of a dilute solution is $7 \times 10^5 \text{ Pa}$ at 273 K. Osmotic pressure of the same solution at 283 K is _____ $\times 10^4 \text{ Nm}^{-2}$.

- End of Question Paper -