

JEE Main 2024 Paper 1 (B.E./B.Tech) 5 April 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 2**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 5 April 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. Let a rectangle ABCD of sides 2 and 4 be inscribed in another rectangle PQRS such that the vertices of the rectangle ABCD lie on the sides of the rectangle PQRS. Let a and b be the sides of the rectangle PQRS when its area is maximum. Then $(a+b)^2$ is equal to :

- (A) 64 (B) 80
(C) 60 (D) 72

2. Let

$$A = \{1, 3, 7, 9, 11\}$$

and

$$B = \{2, 4, 5, 7, 8, 10, 12\}$$

. Then the total number of one-one maps $f : A \rightarrow B$, such that

$$f(1) + f(3) = 14$$

, is :

- (A) 120 (B) 180
(C) 240 (D) 480

3. Let two straight lines drawn from the origin O intersect the line $3x + 4y = 12$ at the points P and Q such that $\triangle OPQ$ is an isosceles triangle and $\angle POQ = 90^\circ$

. If

$$l = OP^2 + PQ^2 + QO^2$$

, then the greatest integer less than or equal to l is :

- (A) 42 (B) 46
(C) 48 (D) 44

4. If the line

$$\frac{2-x}{3} = \frac{3y-2}{4\lambda+1} = 4-z$$

makes a right angle with the line

$$\frac{x+3}{3\mu} = \frac{1-2y}{6} = \frac{5-z}{7}$$

, then $4\lambda + 9\mu$ is equal to :

- (A) 4 (B) 13
(C) 5 (D) 6

5. Consider the following two statements :

Statement I: For any two non-zero complex numbers

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

, and

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

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

, then

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

Between the above two statements,

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

6. Let A and B be two square matrices of order 3 such that

$$|A| = 3$$

and

$$|B| = 2$$

. Then

$|A^T A (\text{adj}(2A))^{-1} (\text{adj}(4B)) (\text{adj}(AB))^{-1} A A^T|$ is equal to :

- (A) 32 (B) 81
(C) 64 (D) 108

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

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

8. Let

$f(x) = x^5 + 2x^3 + 3x + 1, x \in \mathbf{R}$, and $g(x)$ be a function such that

$$g(f(x)) = x$$

for all $x \in \mathbf{R}$. Then

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

is equal to :

- (A) 42 (B) 7
(C) 1 (D) 14

9. The coefficients a, b, c in the quadratic equation $ax^2 + bx + c = 0$ are chosen from the set $\{1, 2, 3, 4, 5, 6, 7, 8\}$. The probability of this equation having repeated roots is :

- (A) $\frac{1}{128}$
(B) $\frac{1}{64}$
(C) $\frac{3}{256}$
(D) $\frac{3}{128}$

10. If the system of equations

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

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

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

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

- (A) 51 (B) 45
(C) 47 (D) 49

11. The integral

$$\int_0^{\pi/4} \frac{136 \sin x}{3 \sin x + 5 \cos x} dx$$

is equal to :

- (A) $3\pi - 50 \log_e 2 + 20 \log_e 5$
(B) $3\pi - 25 \log_e 2 + 10 \log_e 5$
(C) $3\pi - 10 \log_e (2\sqrt{2}) + 10 \log_e 5$
(D) $3\pi - 30 \log_e 2 + 20 \log_e 5$

12. If

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

and

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

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

- (A) $11(x - 1) - 100y = 0$
(B) $11x - 100y = 0$
(C) $11(x - 1) - 100(y - 2) = 0$
(D) $11(x - 2) - 100(y - 1) = 0$

13. Let d be the distance of the point of intersection of the lines

$$\frac{x+6}{3} = \frac{y}{2} = \frac{z+1}{1}$$

and

$$\frac{x-7}{4} = \frac{y-9}{3} = \frac{z-4}{2}$$

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

- (A) 75 (B) 78
(C) 72 (D) 69

14. If the function

$$f(x) = \frac{\sin 3x + \alpha \sin x - \beta \cos 3x}{x^3}, x \in \mathbf{R}$$

, is continuous at $x = 0$, then $f(0)$ is equal to :

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

15. Let the line

$$2x + 3y - k = 0, k > 0$$

, intersect the x -axis and y -axis at the points A and B, respectively. If the equation of the circle having the line segment AB as a diameter is

$$x^2 + y^2 - 3x - 2y = 0$$

and the length of the latus rectum of the ellipse $x^2 + 9y^2 = k^2$ is $\frac{m}{n}$, where m and n are coprime, then $2m + n$ is equal to

- (A) 12 (B) 13
(C) 11 (D) 10

16. The value of

$$\int_{-\pi}^{\pi} \frac{2y(1 + \sin y)}{1 + \cos^2 y} dy$$

is :

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

17. Suppose

$$\theta \in \left[0, \frac{\pi}{4}\right]$$

is a solution of

$$4 \cos \theta - 3 \sin \theta = 1$$

. Then $\cos \theta$ is equal to :

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

18. For the function

$$f(x) = \sin x + 3x - \frac{2}{\pi}(x^2 + x), \text{ where } x \in \left[0, \frac{\pi}{2}\right],$$

consider the following two statements :

(I) f is increasing in

$$\left(0, \frac{\pi}{2}\right)$$

.

(II) f' is decreasing in

$$\left(0, \frac{\pi}{2}\right)$$

.

Between the above two statements,

- (A) only (I) is true. (B) both (I) and (II) are true.
(C) only (II) is true. (D) neither (I) nor (II) is true.

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

- (A) $24\sqrt{7}$
(B) $48\sqrt{7}$
(C) $24\sqrt{29}$
(D) $12\sqrt{29}$

20. If

$$y = y(x)$$

is the solution of the differential equation

$$\frac{dy}{dx} + 2y = \sin(2x), y(0) = \frac{3}{4}$$

, then

$$y\left(\frac{\pi}{8}\right)$$

is equal to :

- (A) $e^{-\pi/8}$
(B) $e^{\pi/4}$
(C) $e^{-\pi/4}$
(D) $e^{\pi/8}$

21. The area of the region enclosed by the parabolas $y = x^2 - 5x$ and $y = 7x - x^2$ is _____.

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

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

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

25. Let f be a differentiable function in the interval $(0, \infty)$ such that

$$f(1) = 1$$

and

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

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

26. If

$$S = \{a \in \mathbf{R} : |2a - 1| = 3[a] + 2\{a\}\}$$

, where $[t]$ denotes the greatest integer less than or equal to t and $\{t\}$ represents the fractional part of t , then

$$72 \sum_{a \in S} a$$

is equal to _____.

27. Let $a_1, a_2, a_3, \dots$ be in an arithmetic progression of positive terms.

Let

$$A_k = a_1^2 - a_2^2 + a_3^2 - a_4^2 + \dots + a_{2k-1}^2 - a_{2k}^2$$

If

$$A_3 = -153, A_5 = -435$$

and

$$a_1^2 + a_2^2 + a_3^2 = 66$$

, then $a_{17} - A_7$ is equal to _____.

28. Let

$$\vec{a} = \hat{i} - 3\hat{j} + 7\hat{k}, \vec{b} = 2\hat{i} - \hat{j} + \hat{k}$$

and $\vec{c}$ be a vector such that

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

. If

$$\vec{a} \cdot \vec{c} = 130$$

, then $\vec{b} \cdot \vec{c}$ is equal to _____.

29. If the constant term in the expansion of

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

is p , then $108p$ is equal to _____.

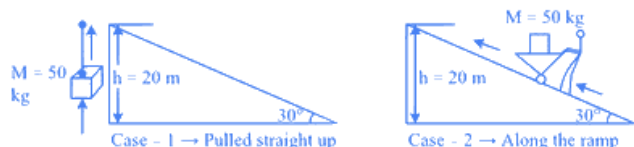
30. The number of distinct real roots of the equation

$$|x||x+2| - 5|x+1| - 1 = 0$$

is _____.

Physics - Section A · Multiple Choice Questions

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



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

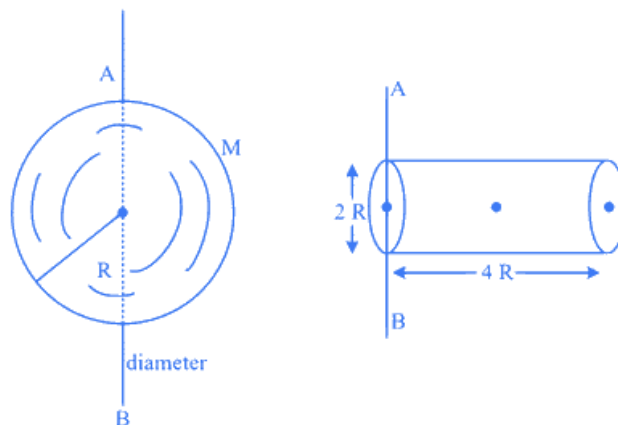
32. If G be the gravitational constant and u be the energy density then which of the following quantity have the dimensions as that of the $\sqrt{uG}$:

- (A) Gravitational potential
 (B) pressure gradient per unit mass
 (C) Energy per unit mass
 (D) Force per unit mass

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

- (A) 10 A
 (B) 8 A
 (C) 13 A
 (D) 12 A

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



- (A) 34
 (B) 51
 (C) 67
 (D) 17

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

- (A) 10^{19}
 (B) 10^{39}
 (C) 10^{29}
 (D) 10^{36}

36. A simple pendulum doing small oscillations at a place R height above earth surface has time period of

$$T_1 = 4 \text{ s}$$

. T_2 would be it's time period if it is brought to a point which is at a height $2R$ from earth surface. Choose the correct relation [

$$R =$$

radius of earth] :

- (A) $3 T_1 = 2 T_2$
 (B) $T_1 = T_2$
 (C) $2 T_1 = 3 T_2$
 (D) $2 T_1 = T_2$

37. Match List I with List II :

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

(Where

radius of planet orbit, $a =$

radius of planet, $r =$

mass of Sun, $M =$

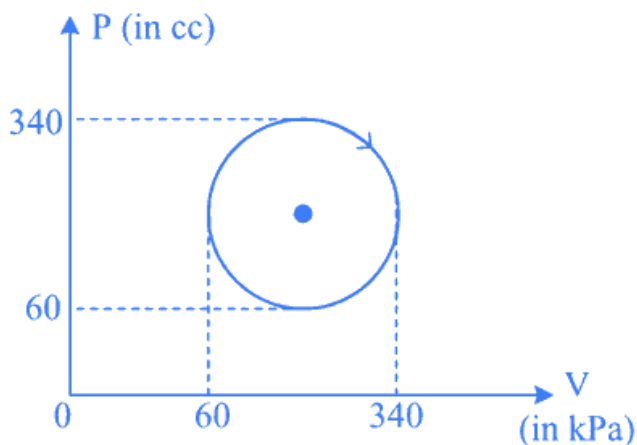
mass of planet) $m =$

Choose the correct answer from the options given below :

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

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

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



- (A) 61.6 J (B) 431.2 J
(C) 19.6 J (D) 616 J

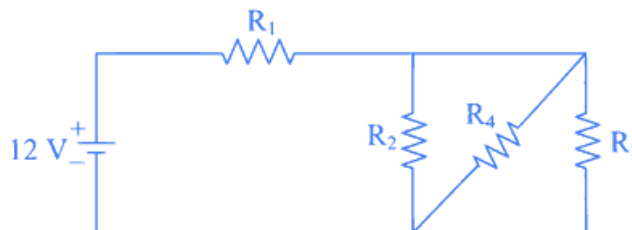
39. In the given figure

$$R_1 = 10\Omega, R_2 = 8\Omega, R_3 = 4\Omega$$

and

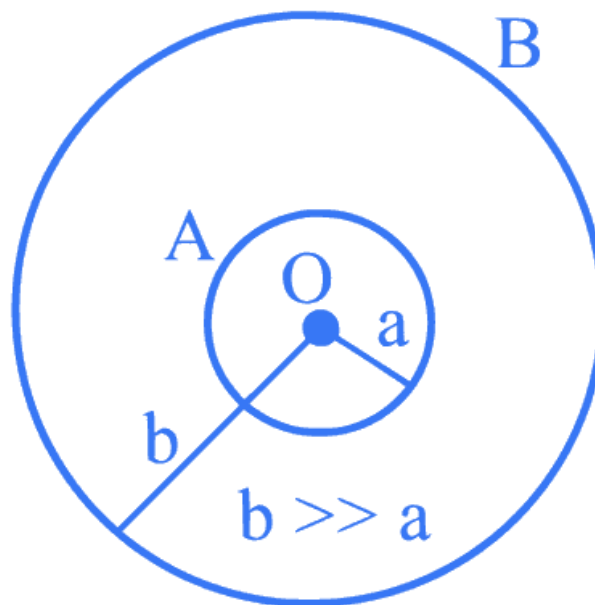
$$R_4 = 8\Omega$$

. Battery is ideal with emf 12 V. Equivalent resistance of the circuit and current supplied by battery are respectively :



- (A) 12Ω and 11.4 A (B) 10.5Ω and 1.14 A
(C) 10.5Ω and 1 A (D) 12Ω and 1 A

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

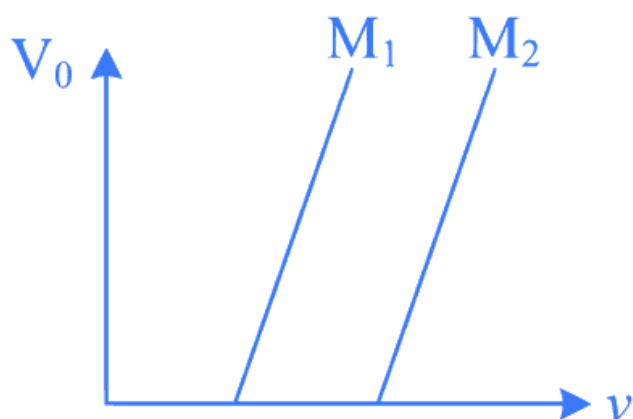


- (A) $\frac{\mu_0}{2\pi} \cdot \frac{b^2}{a}$
(B) $\frac{\mu_0 \pi a^2}{2b}$
(C) $\frac{\mu_0 \pi b^2}{2a}$
(D) $\frac{\mu_0}{2\pi} \cdot \frac{a^2}{b}$

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

- (A) $\frac{\sqrt{3}}{2}Z$
 (B) $\frac{2}{\sqrt{3}}Z$
 (C) $\frac{3}{4}Z$
 (D) $\frac{4}{3}Z$

42. Given below are two statements :



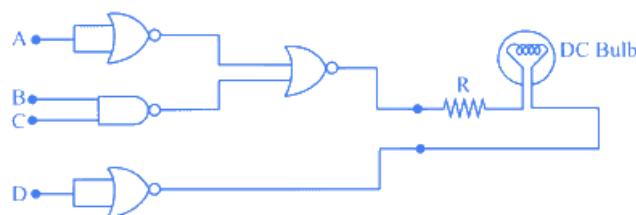
Statement I : Figure shows the variation of stopping potential with frequency (v) for the two photosensitive materials M_1 and M_2 . The slope gives value of $\frac{h}{e}$, where h is Planck's constant, e is the charge of electron.

Statement II :

M_2 will emit photoelectrons of greater kinetic energy for the incident radiation having same frequency. In the light of the above statements, choose the most appropriate answer from the options given below.

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

43. Following gates section is connected in a complete suitable circuit.



For which of the following combination, bulb will glow (ON) :

- (A) $A = 1, B = 1, C = 1, D = 0$
 (B) $A = 1, B = 0, C = 0, D = 0$
 (C) $A = 0, B = 0, C = 0, D = 1$
 (D) $A = 0, B = 1, C = 1, D = 1$

44. Given below are two statements :

Statement I : When a capillary tube is dipped into a liquid, the liquid neither rises nor falls in the capillary. The contact angle may be 0° .

Statement II : The contact angle between a solid and a liquid is a property of the material of the solid and liquid as well.

In the light of the above statement, choose the correct answer from the options given below.

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

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

- (A) cylindrical (B) spherical
(C) plane (D) both spherical and cylindrical
-

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

- (A) $2E = 3U$
(B) $E = U$
(C) $2E = U$
(D) $E = 2U$
-

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

- (A) 5 s (B) 4.6 s
(C) 4.62 s (D) 4.623 s
-

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

- (A) $\tan^{-1}(P/Q)$
(B) 0°
(C) $\tan^{-1} \frac{(2\vec{Q} - 2\vec{P})}{2\vec{Q} + 2\vec{P}}$
(D) $\tan^{-1}(2Q/P)$
-

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

- (A) inside the outer conductor (B) outside the cable
(C) in between the two conductors (D) inside the inner conductor
-

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

- (A) 297 N (B) 291 N
(C) 196 N (D) 294 N
-

51. The electric field between the two parallel plates of a capacitor of $1.5\mu\text{F}$ capacitance drops to one third of its initial value in $6.6\mu\text{s}$ when the plates are connected by a thin wire. The resistance of this wire is $\frac{\log 3}{\log 2} \Omega$. (Given, $\log 3 = 1.1$)

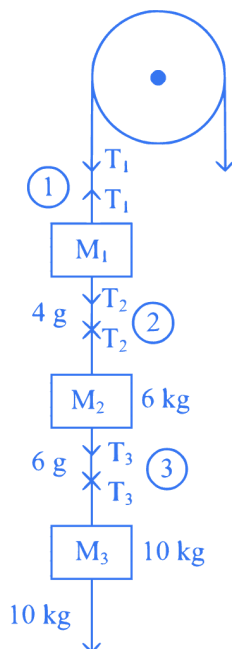
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52. If three helium nuclei combine to form a carbon nucleus then the energy released in this reaction is $\frac{1}{2} \times 10^{-2} \text{ MeV}$. (Given $1\text{u} = 931 \text{ MeV}/c^2$, atomic mass of helium = 4.002603u)

)

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

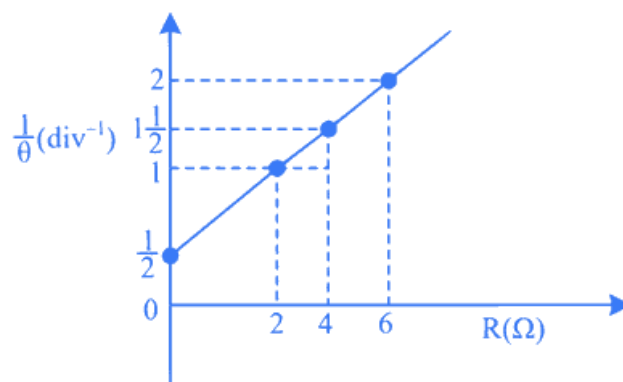
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54. Three capacitors of capacitances $25\mu\text{F}, 30\mu\text{F}$ and $45\mu\text{F}$ are connected in parallel to a supply of 100 V . Energy stored in the above combination is E . When these capacitors are connected in series to the same supply,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

. The value of x is $\frac{1}{2}$.

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

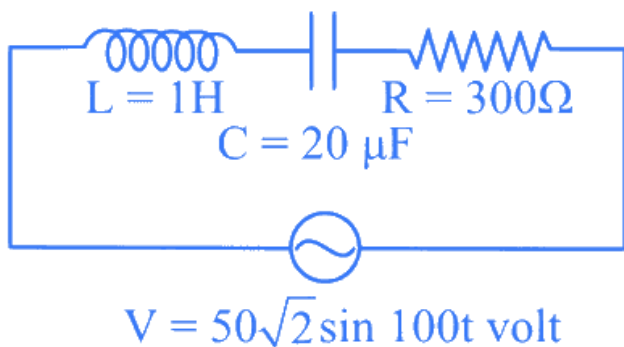


56. The density and breaking stress of a wire are $6 \times 10^4 \text{ kg/m}^3$ and $1.2 \times 10^8 \text{ N/m}^2$ respectively. The wire is suspended from a rigid support on a planet where acceleration due to gravity is

$$\frac{1^{\text{rd}}}{3}$$

of the value on the surface of earth. The maximum length of the wire with breaking is _____ m (take, $g = 10 \text{ m/s}^2$).

57. An ac source is connected in given series LCR circuit. The rms potential difference across the capacitor of $20 \mu\text{F}$ is _____ V.



58. A body moves on a frictionless plane starting from rest. If S_n is distance moved between

$$t = n - 1$$

and

$$t = n$$

and S_{n-1} is distance moved between

$$t = n - 2$$

and

$$t = n - 1$$

, then the ratio

$$\frac{S_{n-1}}{S_n}$$

is

$$\left(1 - \frac{2}{x}\right)$$

for

$$n = 10$$

. The value of x is _____.

59. In Young's double slit experiment, carried out with light of wavelength

$$5000 \text{ \AA}$$

, the distance between the slits is 0.3 mm and the screen is at 200 cm from the slits. The central maximum is at

$$x = 0 \text{ cm}$$

. The value of x for third maxima is _____ mm.

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

$$g = 10 \text{ m/s}^2$$

).

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

Assertion (A) : Cis form of alkene is found to be more polar than the trans form.

Reason (R) : Dipole moment of trans isomer of 2-butene is zero.

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

62. Given below are two statement :

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

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

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

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

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

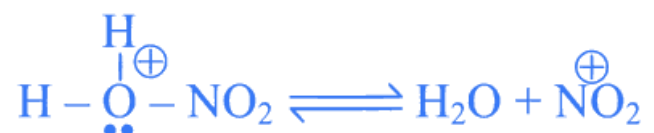
- (A) Atoms of different elements differ in mass.
 (B) Matter consists of divisible atoms.
 (C) Compounds are formed when atoms of different element combine in a fixed ratio.
 (D) All the atoms of given element have different properties including mass.
 (E) Chemical reactions involve reorganisation of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

Choose the correct answer from the options given below :

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

64. Given below are two statements :

Statement I : Nitration of benzene involves the following step -



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

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

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

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

- | | |
|------------------------|---------------|
| (A) Polyvinyl chloride | (B) Cellulose |
| (C) Egg albumin | (D) Starch |

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

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

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

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

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

67. Given below are two statements:

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

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

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

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

68. The metal that shows highest and maximum number of oxidation state is :

- | | |
|--------|--------|
| (A) Co | (B) Mn |
| (C) Fe | (D) Ti |

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

- | | |
|-------------|-------------|
| (A) 3 and 1 | (B) 5 and 1 |
| (C) 4 and 1 | (D) 5 and 2 |

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

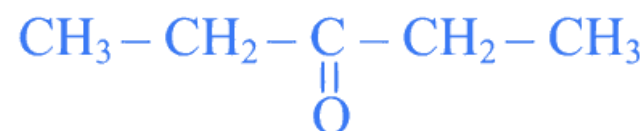
- | | |
|-----|---|
| (A) | $\text{C}_{14}\text{H}_{20}\text{O}_{10}$ |
| (B) | $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ |
| (C) | $\text{C}_{12}\text{H}_{20}\text{O}_{12}$ |
| (D) | $\text{C}_{11}\text{H}_{18}\text{O}_{12}$ |

71. For the Compounds :

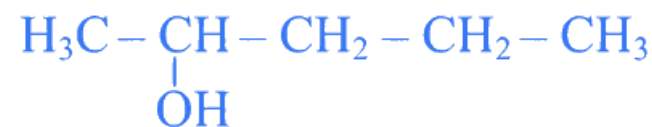
(A) $\text{H}_3\text{C}-\text{CH}_2-\text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_3$

(B) $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$

(C)



(D)



The increasing order of boiling point is :

Choose the correct answer from the options given below :

- | | |
|-----|-----------------------|
| (A) | (D) < (C) < (A) < (B) |
| (B) | (B) < (A) < (C) < (D) |
| (C) | (A) < (B) < (C) < (D) |
| (D) | (B) < (A) < (D) < (C) |

72. The correct order of ligands arranged in increasing field strength.

- (A) $F^- < Br^- < I^- < NH_3$
 (B) $H_2O < ^-OH < CN^- < NH_3$
 (C) $Br^- < F^- < H_2O < NH_3$
 (D) $Cl^- < ^-OH < Br^- < CN^-$

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

- (A) 9 (B) 6
 (C) 4 (D) 3

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

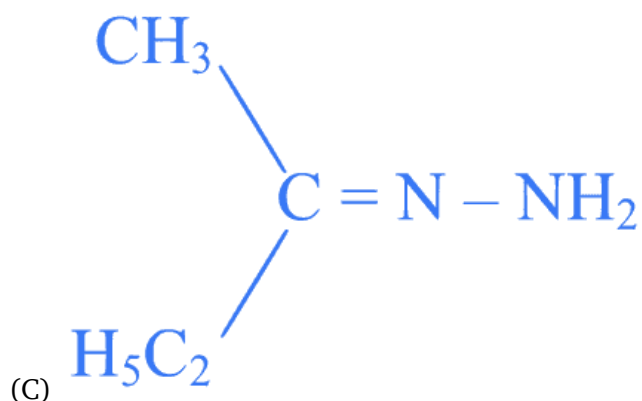
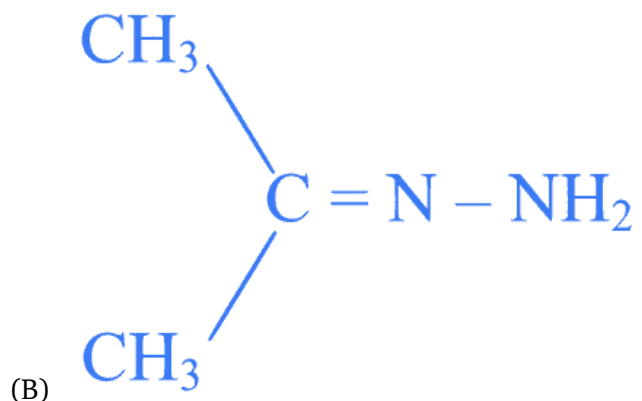
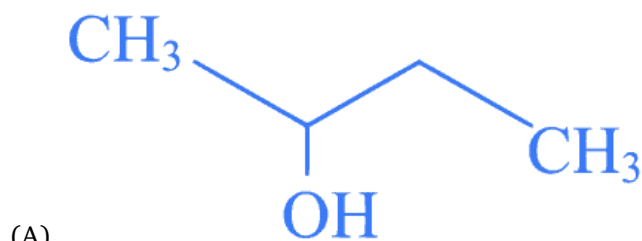
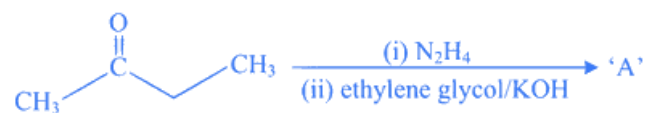
[Atomic number, Cr = 24, Mn = 25, Fe = 26, Co = 27]

- (A) $[Fe(H_2O)_6]^{2+}$
 (B) $[Mn(H_2O)_6]^{2+}$
 (C) $[Co(H_2O)_6]^{2+}$
 (D) $[Cr(H_2O)_6]^{2+}$

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

- (A) $187 \text{ S cm}^2 \text{ mol}^{-1}$
 (B) $260 \text{ S cm}^2 \text{ mol}^{-1}$
 (C) $65 \text{ S cm}^2 \text{ mol}^{-1}$
 (D) $130 \text{ S cm}^2 \text{ mol}^{-1}$

76. Identify 'A' in the following reaction :



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

- (A) All are isoelectronic
- (B) All have the same nuclear charge
- (C) O^{2-} has the largest ionic radii
- (D) Mg^{2+} has the smallest ionic radii

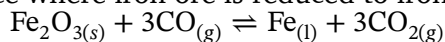
Choose the most appropriate answer from the options given below :

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

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

- | | |
|-----------------------------------|-----------------------------------|
| (A) oxidation of Mn from +2 to +7 | (B) reduction of Mn from +4 to +3 |
| (C) oxidation of Mn from +3 to +4 | (D) reduction of Mn from +7 to +2 |

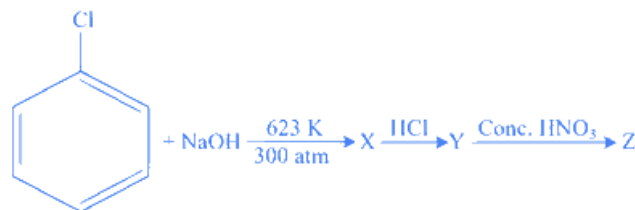
79. The following reaction occurs in the Blast furnace where iron ore is reduced to iron metal



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

- | | |
|---------------------------|-----------------------|
| (A) Addition of CO_2 | (B) Removal of CO |
| (C) Addition of Fe_2O_3 | (D) Removal of CO_2 |

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



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

Chemistry - Section B · Numerical Value Questions

81. The spin-only magnetic moment value of the ion among Ti^{2+} , V^{2+} , Co^{3+} and Cr^{2+} , that acts as strong oxidising agent in aqueous solution is _____ BM (Near integer).

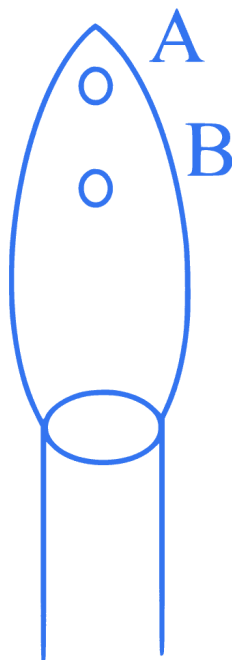
(Given atomic numbers :

Ti : 22, V : 23, Cr : 24, Co : 27

)

82. The heat of combustion of solid benzoic acid at constant volume is -321.30 kJ at 27°C . The heat of combustion at constant pressure is $(-321.30 - xR) \text{ kJ}$, the value of x is _____.

83.

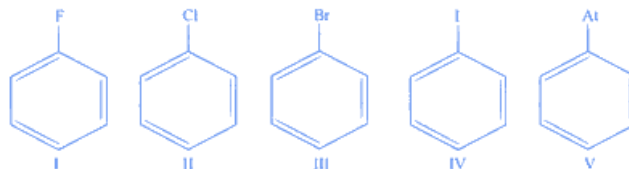


In a borax bead test under hot condition, a metal salt (one from the given) is heated at point B of the flame, resulted in green colour salt bead. The spin-only magnetic moment value of the salt is _____ BM (Nearest integer) [Given atomic number of

Cu = 29, Ni = 28, Mn = 25, Fe = 26

]

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



85. An artificial cell is made by encapsulating 0.2 M glucose solution within a semipermeable membrane. The osmotic pressure developed when the artificial cell is placed within a 0.05 M solution of NaCl at 300 K is _____ $\times 10^{-1} \text{ bar}$. (nearest integer).

[Given :

$$R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}$$

]

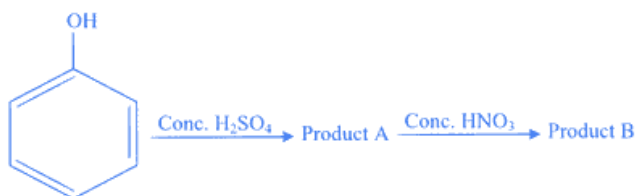
Assume complete dissociation of NaCl

86. In the lewis dot structure for NO_2^- , total number of valence electrons around nitrogen is _____.

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

88. 9.3 g of pure aniline is treated with bromine water at room temperature to give a white precipitate of the product 'P'. The mass of product 'P' obtained is 26.4 g. The percentage yield is _____ %.

89. Consider the given chemical reaction sequence :



Total sum of oxygen atoms in Product A and Product B are _____.

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

	A[M]	B[M]	initial rate of formation of D
I	0.1	0.1	6.0×10^{-3}
II	0.3	0.2	7.2×10^{-2}
III	0.3	0.4	2.88×10^{-1}
IV	0.4	0.1	2.40×10^{-2}

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

- End of Question Paper -