

JEE Main 2024 Question Paper

Total Time Allowed : 180 minutes	Maximum Marks : 300	Total Questions : 90	Questions to be answered : 90
-------------------------------------	------------------------	----------------------	----------------------------------

Mathematics

Question 1: Let d be the distance of the point of intersection of the lines:

$$\frac{x+6}{3} = \frac{y}{2} = \frac{z+1}{1} \quad \text{and} \quad \frac{x-7}{4} = \frac{y-9}{3} = \frac{z-4}{2}$$

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

Options:

- (1) 72
- (2) 69
- (3) 75
- (4) 78

Question 2: 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:

Options:

- (1) 72
- (2) 60
- (3) 80
- (4) 64

Question 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 $I = OP^2 + PQ^2 + OQ^2$, then the greatest integer less than or equal to I is:

Options:

- (1) 44
- (2) 48
- (3) 46

(4) 42

Question 4: If $y = y(x)$ is the solution of the differential equation:

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

then $y\left(\frac{\pi}{8}\right)$ is equal to:

Options:

- (1) $e^{-\pi/8}$
 - (2) $e^{-\pi/4}$
 - (3) $e^{\pi/4}$
 - (4) $e^{\pi/8}$
-

Question 5: For the function:

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

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,

- (1) only (I) is true.
 - (2) only (II) is true.
 - (3) neither (I) nor (II) is true.
 - (4) both (I) and (II) are true.
-

Question 6: 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:

Options:

- (1) 49
 - (2) 45
 - (3) 47
 - (4) 51
-

Question 7: 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:

Options:

- (1) 180
 - (2) 120
 - (3) 480
 - (4) 240
-

Question 8: If the function

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

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

Options:

- (1) 2
 - (2) -2
 - (3) 4
 - (4) -4
-

Question 9: The integral

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

is equal to:

Options:

- (1) $3\pi - 50 \log_e 2 + 20 \log_e 5$
 - (2) $3\pi - 25 \log_e 2 + 10 \log_e 5$
 - (3) $3\pi - 10 \log_e(2\sqrt{2}) + 10 \log_e 5$
 - (4) $3\pi - 30 \log_e 2 + 20 \log_e 5$
-

Question 10: 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:

Options:

- (1) $\frac{3}{256}$
- (2) $\frac{1}{128}$
- (3) $\frac{1}{64}$
- (4) $\frac{3}{128}$

Question 11: Let A and B be two square matrices of order 3 such that $|A| = 3$ and $|B| = 2$. Then:

$$\left| A^T A (\text{adj}(2A))^{-1} (\text{adj}(4B)) (\text{adj}(AB))^{-1} A A^T \right|$$

is equal to:

Options:

- (1) 64
- (2) 81
- (3) 32
- (4) 108

Question 12: 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:

Options:

- (1) $2\sqrt{2}$
- (2) 5
- (3) $4\sqrt{2}$
- (4) 4

Question 13: 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:

Options:

- (1) 10
- (2) 11
- (3) 13
- (4) 12

Question 14: Consider the following two statements:

Statement I: For any two non-zero complex numbers z_1, z_2 ,

$$(|z_1| + |z_2|) \frac{|z_1|}{|z_1|} + \frac{|z_2|}{|z_2|} \leq 2(|z_1| + |z_2|).$$

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:

- (1) Both Statement I and Statement II are incorrect.
- (2) Statement I is incorrect but Statement II is correct.
- (3) Statement I is correct but Statement II is incorrect.
- (4) Both Statement I and Statement II are correct.

Question 15: Suppose $\theta \in [0, \frac{\pi}{4}]$ is a solution of $4 \cos \theta - 3 \sin \theta = 1$. Then $\cos \theta$ is equal to:

Options:

- (1) $\frac{4}{3\sqrt{6}-2}$
- (2) $\frac{6-\sqrt{6}}{3\sqrt{6}-2}$
- (3) $\frac{6+\sqrt{6}}{3\sqrt{6}+2}$
- (4) $\frac{4}{3\sqrt{6}+2}$

Question 16: If

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

and

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

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

Options:

- (1) $11(x - 1) - 100(y - 2) = 0$
- (2) $11(x - 2) - 100(y - 1) = 0$
- (3) $11(x - 1) - 100y = 0$

(4) $11x - 100y = 0$

Question 17: Let $f(x) = x^5 + 2x^3 + 3x + 1$, $x \in R$, and $g(x)$ be a function such that $g(f(x)) = x$ for all $x \in R$. Then:

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

is equal to:

Options:

- (1) 7
 - (2) 42
 - (3) 1
 - (4) 14
-

Question 18: 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:

Options:

- (1) $12\sqrt{29}$
 - (2) $24\sqrt{29}$
 - (3) $24\sqrt{7}$
 - (4) $48\sqrt{7}$
-

Question 19: The value of the integral:

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

is:

Options:

- (1) π^2
 - (2) $\frac{\pi^2}{2}$
 - (3) $\frac{\pi}{2}$
 - (4) $2\pi^2$
-

Question 20: 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:

Options:

- (1) 13
- (2) 4
- (3) 5
- (4) 6

Question 21: 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 _____.

Question 22: 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 _____.

Question 23: The area of the region enclosed by the parabolas

$$y = x^2 - 5x \quad \text{and} \quad y = 7x - x^2$$

is _____.

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

Question 25: If

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

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

$$72 \sum_{a \in S} a \quad \text{is equal to} \quad \text{_____}.$$

Question 26: 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

Question 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

Question 28: Let

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

and let $\vec{c}$ 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

Question 29: The number of distinct real roots of the equation

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

is

Question 30: 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

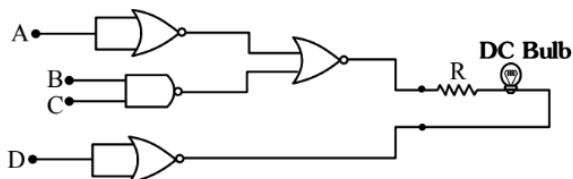
Physics

Question 31: Light emerges out of a convex lens when a source of light is kept at its focus. The shape of the wavefront of the light is:

Options:

- (1) Both spherical and cylindrical
 - (2) Cylindrical
 - (3) Spherical
 - (4) Plane
-

Question 32: Following gate section is connected in a complete suitable circuit. For which of the following combinations, the bulb will glow (ON):



Options:

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

Question 33: If G be the gravitational constant and u be the energy density, then which of the following quantities has the same dimension as $\sqrt{uG}$:

Options:

- (1) Pressure gradient per unit mass
- (2) Force per unit mass
- (3) Gravitational potential
- (4) Energy per unit mass

Question 34: 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° .

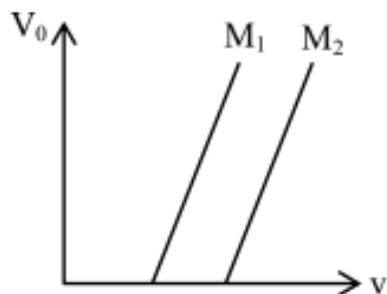
Statement-II: The contact angle between a solid and a liquid is a property of the material of the solid and liquid as well.

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

Options:

- (1) Statement-I is false but Statement-II is true.
- (2) Both Statement-I and Statement-II are true.
- (3) Both Statement-I and Statement-II are false.
- (4) Statement-I is true and Statement-II is false.

Question 35: Given below are two statements:



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

Statement-II: M_2 will emit photoelectrons of greater kinetic energy for the incident radiation having the same frequency.

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

Options:

- (1) Statement-I is correct and Statement-II is incorrect.
- (2) Statement-I is incorrect but Statement-II is correct.
- (3) Both Statement-I and Statement-II are incorrect.
- (4) Both Statement-I and Statement-II are correct.

Question 36: The angle between vector $\vec{Q}$ and the resultant of $(2\vec{Q} + 2\vec{P})$ and $(2\vec{Q} - 2\vec{P})$ is:

Options:

- (1) 0°
- (2) $\tan^{-1} \left(\frac{2\vec{Q} - 2\vec{P}}{2\vec{Q} + 2\vec{P}} \right)$
- (3) $\tan^{-1} \left(\frac{\vec{P}}{\vec{Q}} \right)$
- (4) $\tan^{-1} \left(\frac{2\vec{Q}}{\vec{P}} \right)$

Question 37: In a hydrogen-like system, the ratio of Coulombian force and gravitational force between an electron and a proton is in the order of:

Options:

- (1) 10^{39}
- (2) 10^{19}
- (3) 10^{29}
- (4) 10^{36}

Question 38: In a co-axial straight cable, the central conductor and the outer conductor carry equal currents in opposite directions. The magnetic field is zero:

Options:

- (1) inside the outer conductor
- (2) in between the two conductors
- (3) outside the cable
- (4) inside the inner conductor

Question 39: An electron rotates in a circle around a nucleus having positive charge Ze . The correct relation between the total energy (E) of the electron to its potential energy (U) is:

Options:

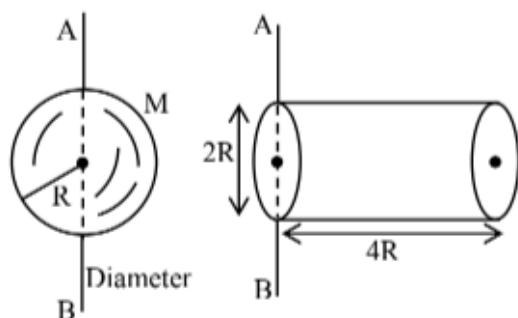
- (1) $E = 2U$
- (2) $2E = 3U$
- (3) $E = U$
- (4) $2E = U$

Question 40: 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:

Options:

- (1) $\frac{\sqrt{3}}{2}Z$
- (2) $\frac{4}{3}Z$
- (3) $\frac{2}{\sqrt{3}}Z$
- (4) $\frac{3}{4}Z$

Question 41: Ratio of the radius of gyration of a hollow sphere to that of a solid cylinder of equal mass, for the moment of inertia about their diameter axis AB as shown in the figure is $\sqrt{\frac{8}{x}}$. The value of x is:



Options:

- (1) 34
- (2) 17
- (3) 67
- (4) 51

Question 42: Two conducting circular loops A and B are placed in the same plane with their centers coinciding as shown in the figure. The mutual inductance between them is:

Options:

- (1) $\frac{\mu_0 \pi a^2}{2b}$
- (2) $\frac{\mu_0 b^2}{2\pi a}$
- (3) $\frac{\mu_0 \pi b^2}{2a}$
- (4) $\frac{\mu_0}{2\pi} \frac{a^2}{b}$

Question 43: Match List-I with List-II:

List-I	List-II
(A) Kinetic energy of planet	(I) $-\frac{GMm}{a}$
(B) Gravitational potential energy of Sun-planet system	(II) $\frac{GMm}{2a}$
(C) Total mechanical energy of planet	(III) $\frac{GMm}{2a}$
(D) Escape energy at the surface of planet for unit mass object	(IV) $\frac{GMm}{2a}$

(Where a = radius of planet orbit, r = radius of planet, M = mass of Sun, m = mass of planet)

Choose the correct answer from the options given below:

Options:

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

Question 44: A wooden block of mass 5 kg rests on a soft horizontal floor. When an iron cylinder of mass 25 kg is placed on 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:

Options:

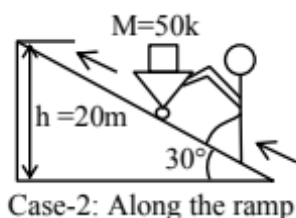
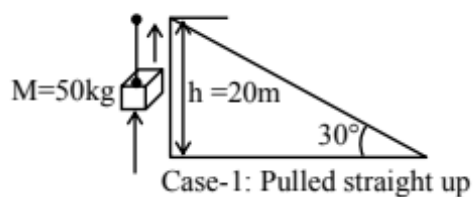
- (1) 297 N
- (2) 294 N
- (3) 291 N
- (4) 196 N

Question 45: A simple pendulum doing small oscillations at a place R height above Earth's surface has time period of $T_1 = 4$ s. T_2 would be its time period if it is brought to a point which is at a height $2R$ from Earth's surface. Choose the correct relation [R = radius of Earth]:

Options:

- (1) $T_1 = T_2$
- (2) $2T_1 = 3T_2$
- (3) $3T_1 = 2T_2$
- (4) $2T_1 = T_2$

Question 46: A body of mass 50 kg is lifted to a height of 20 m from the ground in two different ways as shown in the figures. The ratio of work done against gravity in both respective cases will be:



Options:

- (1) 1 : 1
- (2) 2 : 1
- (3) $\sqrt{3} : 2$
- (4) 1 : 2

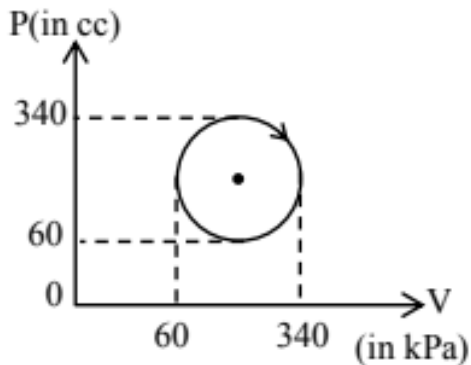
Question 47: Time periods of oscillation of the same simple pendulum measured using four different measuring clocks were recorded as 4.62 s, 4.632 s, 4.6 s, and 4.64 s. The arithmetic mean of these readings in correct significant figures is:

Options:

- (1) 4.623 s
- (2) 4.62 s
- (3) 4.6 s

(4) 5 s

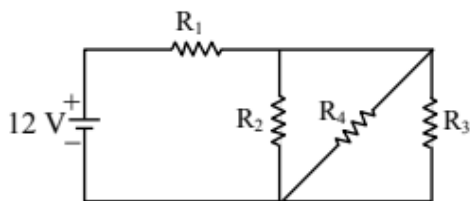
Question 48: The heat absorbed by a system in going through the given cyclic process is:



Options:

- (1) 61.6 J
- (2) 431.2 J
- (3) 616 J
- (4) 19.6 J

Question 49: In the given figure $R_1 = 10\ \Omega$, $R_2 = 8\ \Omega$, $R_3 = 4\ \Omega$, and $R_4 = 8\ \Omega$. The battery is ideal with an emf of 12 V. The equivalent resistance of the circuit and the current supplied by the battery are, respectively:



Options:

- (1) $12\ \Omega$ and 1.14 A
- (2) $10.5\ \Omega$ and 1.14 A
- (3) $10.5\ \Omega$ and 1 A
- (4) $12\ \Omega$ and 1 A

Question 50: An alternating voltage of amplitude 40 V and frequency 4 kHz is applied directly across a capacitor of $12\ \mu F$. The maximum displacement current between the plates of the capacitor is nearly:

Options:

- (1) 13 A

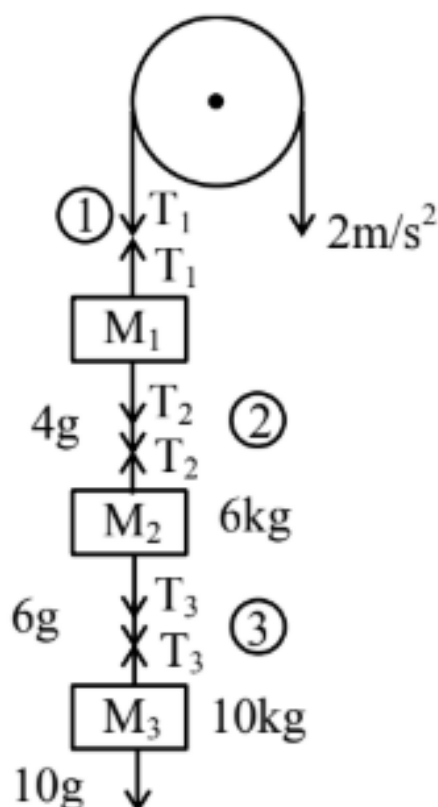
- (2) 8 A
- (3) 10 A
- (4) 12 A

Question 51: 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 $x = 0$ cm. The value of x for the third maxima is ... mm.

Question 52: A 2A current carrying straight metal wire of resistance $1\ \Omega$, 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 $\dots \times 10^{-1}\text{ T}$ (given, $g = 10\text{ m/s}^2$).

Question 53: 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 $\dots\ \Omega$. (Given, $\log 3 = 1.1$)

Question 54: Three blocks M_1 , M_2 , M_3 having masses 4 kg, 6 kg, and 10 kg respectively are hanging from a smooth pulley using ropes 1, 2, and 3 as shown in the figure. The tension in the rope 1, T_1 , when they are moving upward with acceleration of 2 m/s^2 is ... N (if $g = 10\text{ m/s}^2$).

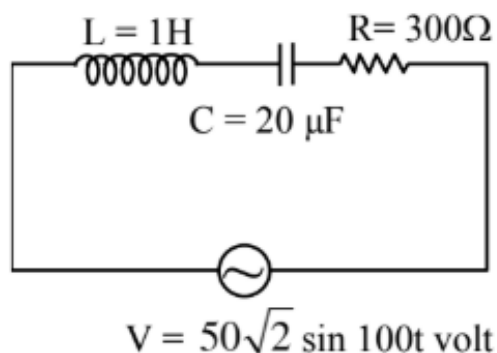


Question 55: The density and breaking stress of a wire are $6 \times 10^4 \text{ kg/m}^3$ and $1.2 \times 10^8 \text{ N/m}^2$ respectively. The wire is suspended from a rigid support on a planet where acceleration due to gravity is $\frac{1}{3}$ of the value on the surface of Earth. The maximum length of the wire with breaking is ... m (take, $g = 10 \text{ m/s}^2$).

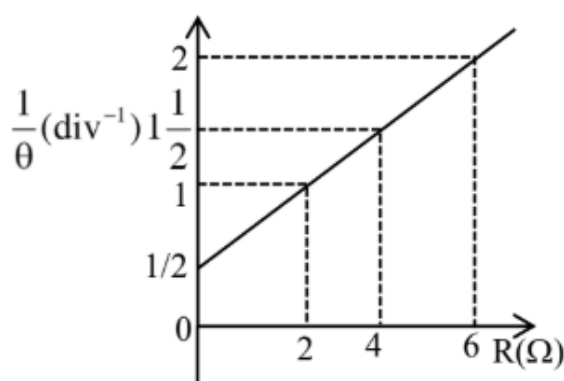
Question 56: A body moves on a frictionless plane starting from rest. If S_n is distance moved between $t = n - 1$ and $t = n$ and S_{n-1} is distance moved between $t = n - 2$ and $t = n - 1$, then the ratio $\frac{S_{n-1}}{S_n}$ is $(1 - \frac{2}{x})$ for $n = 10$. The value of x is ...

Question 57: If three helium nuclei combine to form a carbon nucleus then the energy released in this reaction is $\dots \times 10^{-2} \text{ MeV}$. (Given $1 \text{ u} = 931 \text{ MeV}/c^2$, atomic mass of helium = 4.002603 u)

Question 58: An ac source is connected in a given series LCR circuit. The rms potential difference across the capacitor of $20 \mu\text{F}$ is ... V.



Question 59: In the experiment to determine the galvanometer resistance by the half-deflection method, the plot of $\frac{1}{\theta}$ vs the resistance (R) of the resistance box is shown in the figure. The figure of merit of the galvanometer is $\dots \times 10^{-1}$ A/division. [The source has emf 2V]



Question 60: Three capacitors of capacitances $25 \mu F$, $30 \mu F$, and $45 \mu F$ 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 ...

Chemistry

Question 61: The incorrect postulates of Dalton's atomic theory are:

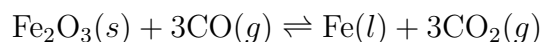
- (A) Atoms of different elements differ in mass.
- (B) Matter consists of divisible atoms.
- (C) Compounds are formed when atoms of different elements combine in a fixed ratio.
- (D) All the atoms of a given element have different properties including mass.
- (E) Chemical reactions involve the reorganization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

Choose the correct answer from the options given below:

Options:

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

Question 62: The following reaction occurs in the Blast furnace where iron ore is reduced to iron metal:

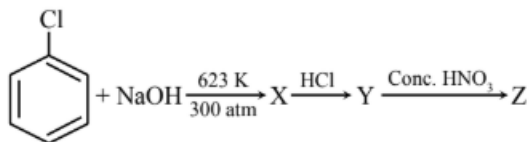


Using Le Chatelier's principle, predict which one of the following will *not* disturb the equilibrium.

Options:

- (1) Addition of Fe_2O_3
- (2) Addition of CO_2
- (3) Removal of CO
- (4) Removal of CO_2

Question 63: Identify compound (Z) in the following reaction sequence.

**Options:**

- (1)
- (2)
- (3)
- (4)

Question 64: 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.

Options:

- (1) (A) is true but (R) is false
- (2) Both (A) and (R) are true and (R) is the correct explanation of (A)
- (3) (A) is false but (R) is true
- (4) Both (A) and (R) are true but (R) is not the correct explanation of (A)

Question 65: The statement(s) that are correct about the species O^{2-} , F^- , Na^+ , and Mg^{2+} :

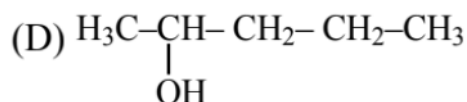
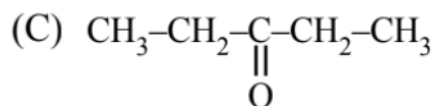
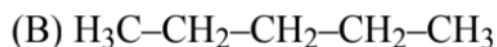
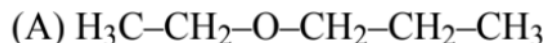
- (A) All are isoelectronic
- (B) All have the same nuclear charge
- (C) O^{2-} has the largest ionic radii
- (D) Mg^{2+} has the smallest ionic radii

Choose the most appropriate answer from the options given below:

Options:

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

Question 66: For the compounds:



The increasing order of boiling point is:

Choose the correct answer from the options given below:

Options:

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

Question 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:

Options:

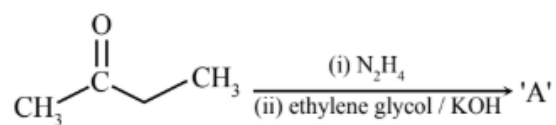
- (1) Statement I is incorrect but Statement II is correct
 - (2) Both Statement I and Statement II are correct
 - (3) Both Statement I and Statement II are incorrect
 - (4) Statement I is correct but Statement II is incorrect
-

Question 68: Number of σ and π bonds present in ethylene molecule is respectively:

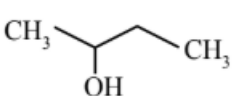
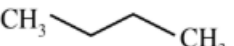
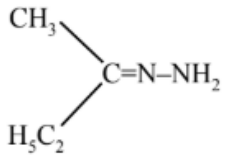
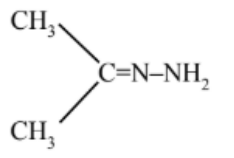
Options:

- (1) 3 and 1
 - (2) 5 and 2
 - (3) 4 and 1
 - (4) 5 and 1
-

Question 69: Identify 'A' in the following reaction:



Options:

- (1) 
- (2) 
- (3) 
- (4) 

Question 70: The reaction at cathode in the cells commonly used in clocks involves.

Options:

- (1) reduction of Mn from +4 to +3
(2) oxidation of Mn from +3 to +4
(3) reduction of Mn from +7 to +2
(4) oxidation of Mn from +2 to +7

Question 71: Which one of the following complexes will exhibit the least paramagnetic behaviour?

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

Options:

- (1) $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$
(2) $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
(3) $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$
(4) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$

Question 72: 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.

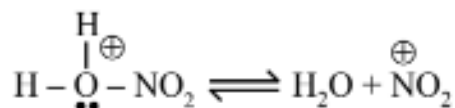
In the light of the above statements, choose the correct answer from the options given below:

Options:

- (1) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)
 - (2) (A) is true but (R) is false
 - (3) Both (A) and (R) are true and (R) is the correct explanation of (A)
 - (4) (A) is false but (R) is true
-

Question 73: 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:

Options:

- (1) Both Statement I and Statement II are incorrect
 - (2) Statement I is correct but Statement II is incorrect
 - (3) Both Statement I and Statement II are correct
 - (4) Statement I is incorrect but Statement II is correct
-

Question 74: The correct order of ligands arranged in increasing field strength.

Options:

- (1) $\text{Cl}^- < ^-\text{OH} < \text{Br}^- < \text{CN}^-$
 - (2) $\text{F}^- < \text{Br}^- < \text{I}^- < \text{NH}_3$
 - (3) $\text{Br}^- < \text{F}^- < \text{H}_2\text{O} < \text{NH}_3$
 - (4) $\text{H}_2\text{O} < ^-\text{OH} < \text{CN}^- < \text{NH}_3$
-

Question 75: Which of the following gives a positive test with ninhydrin?

Options:

- (1) Cellulose
 - (2) Starch
 - (3) Polyvinyl chloride
 - (4) Egg albumin
-

Question 76: The metal that shows highest and maximum number of oxidation state is:

Options:

- (1) Fe
 - (2) Mn
 - (3) Ti
 - (4) Co
-

Question 77: An organic compound has 42.1% carbon, 6.4% hydrogen, and the remainder is oxygen. If its molecular weight is 342, then its molecular formula is:

Options:

- (1) $C_{11}H_{18}O_{12}$
 - (2) $C_{12}H_{20}O_{12}$
 - (3) $C_{14}H_{20}O_{10}$
 - (4) $C_{12}H_{22}O_{11}$
-

Question 78: Given below are two statements:

Statement I: Bromination of phenol in solvents with low polarity such as $CHCl_3$ or CS_2 requires a Lewis acid catalyst.

Statement II: The Lewis acid catalyst polarizes the bromine to generate Br^+ .

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

Options:

- (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.
-

Question 79: 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 a solution of an electrolyte with the above cation and anion will be:

Options:

- (1) $65 \text{ S cm}^2 \text{ mol}^{-1}$
 - (2) $130 \text{ S cm}^2 \text{ mol}^{-1}$
 - (3) $187 \text{ S cm}^2 \text{ mol}^{-1}$
 - (4) $260 \text{ S cm}^2 \text{ mol}^{-1}$
-

Question 80: The number of neutrons present in the more abundant isotope

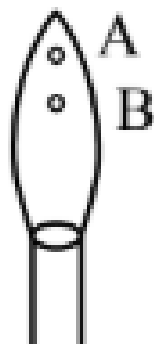
of boron is 'x'. Amorphous boron upon heating with air forms a product, in which the oxidation state of boron is 'y'. The value of $x + y$ is ...

Options:

- (1) 4
- (2) 6
- (3) 3
- (4) 9

Question 81: 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 = $\dots \times 10^5$ ms⁻¹ (nearest integer).

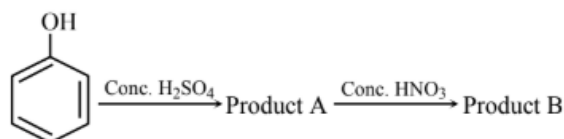
Question 82: In a borax bead test under hot conditions, a metal salt (one from the given) is heated at point B of the flame, resulted in a green colour salt bead. The spin-only magnetic moment value of the salt is ...BM (Nearest integer).



[Given atomic number of Cu = 29, Ni = 28, Mn = 25, Fe = 26]

Question 83: 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) kJ. The value of x is ...

Question 84: Consider the given chemical reaction sequence:



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

Question 85: The spin only magnetic moment value of the ion among Ti^{2+} ,

V^{2+} , Co^{3+} and Cr^{2+} , that acts as strong oxidizing agent in aqueous solution is ... BM (Near integer).

(Given atomic numbers : Ti : 22, V : 23, Cr : 24, Co : 27)

Question 86: During the 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}

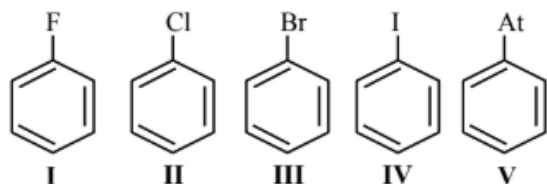
Based on the above data, the overall order of the reaction is ...

Question 87: An artificial cell is made by encapsulating a 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 ____ $\times 10^{-1}$ bar. (Nearest Integer)

[Given: $R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}$]

Assume complete dissociation of NaCl

Question 88: The number of halobenzenes from the following that can be prepared by Sandmeyer's reaction is ...



Question 89: In the Lewis dot structure for NO_2^- , the total number of valence electrons around nitrogen is ...

Question 90: 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 ... %.