

JEE Main 2024 Jan 31 Shift 1 Question Paper

MATHEMATICS

SECTION-A

Question 1:

For $0 < c < b < a$, let

$$(a + b - 2c)x^2 + (b + c - 2a)x + (c + a - 2b) = 0$$

and $\alpha \neq 1$ be one of its roots. Then, among the two statements:

(I) If $\alpha \in (-1, 0)$, then b cannot be the geometric mean of a and c .

(II) If $\alpha \in (0, 1)$, then b may be the geometric mean of a and c .

Which of the following is true?

- (1) Both (I) and (II) are true
- (2) Neither (I) nor (II) is true
- (3) Only (II) is true
- (4) Only (I) is true

Question 2:

Let a be the sum of all coefficients in the expansion of $(1 - 2x + 2x^2)^{2023}(3 - 4x^2 + 2x^3)^{2024}$, and $b = \lim_{x \rightarrow 0} \frac{\int_0^x \frac{\log(1+t)}{t^{2024}+1} dt}{x^2}$. If the equations

$$cx^2 + dx + e = 0 \quad \text{and} \quad 2bx^2 + ax + 4 = 0$$

have a common root, where $c, d, e \in \mathbb{R}$, then $d : c : e$ equals:

- (1) $2 : 1 : 4$
- (2) $4 : 1 : 4$
- (3) $1 : 2 : 4$
- (4) $1 : 1 : 4$

Question 3:

If the foci of a hyperbola are the same as that of the ellipse

$$\frac{x^2}{9} + \frac{y^2}{25} = 1,$$

and the eccentricity of the hyperbola is $\frac{15}{8}$ times that of the ellipse, then the smaller focal distance of the point $\left(\frac{14}{3}, \frac{2\sqrt{5}}{3}\right)$ on the hyperbola is:

- (1) $7\sqrt{\frac{2}{5}} - \frac{8}{3}$

- (2) $14\sqrt{\frac{2}{5}} - \frac{4}{3}$
 (3) $14\sqrt{\frac{2}{5}} - \frac{16}{3}$
 (4) $7\sqrt{\frac{2}{5}} + \frac{8}{3}$

Question 4:

If one of the diameters of the circle $x^2 + y^2 - 10x + 4y + 13 = 0$ is a chord of another circle C , whose center is the point of intersection of the lines $2x + 3y = 12$ and $3x - 2y = 5$, then the radius of the circle C is:

- (1) $\sqrt{20}$
 (2) 4
 (3) 6
 (4) $3\sqrt{2}$

Question 5:

The area of the region

$$\{(x, y) : y^2 \leq 4x, x < 4, \frac{xy(x-1)(x-2)}{(x-3)(x-4)} > 0, x \neq 3\}$$

is:

- (1) $\frac{16}{3}$
 (2) $\frac{64}{3}$
 (3) $\frac{8}{3}$
 (4) $\frac{32}{3}$

Question 6:

If $f(x) = \frac{4x+3}{6x-4}$, $x \neq \frac{2}{3}$, and $(f \circ f)(x) = g(x)$, where

$$g : \mathbb{R} - \left\{\frac{2}{3}\right\} \rightarrow \mathbb{R} - \left\{\frac{2}{3}\right\},$$

then $(g \circ g \circ g)(4)$ is equal to:

- (1) $-\frac{19}{20}$
 (2) $\frac{19}{20}$
 (3) -4
 (4) 4

Question 7:

$$\lim_{x \rightarrow 0} \frac{e^{2|\sin x|} - 2|\sin x| - 1}{x^2}$$

is:

- (1) is equal to 1
- (2) does not exist
- (3) is equal to 1
- (4) is equal to 2

Question 8:

If the system of linear equations:

$$x - 2y + z = -4, \quad 2x + \alpha y + 3z = 5, \quad 3x - y + \beta z = 3$$

has infinitely many solutions, then $12\alpha + 13\beta$ is equal to:

- (1) 60
- (2) 64
- (3) 54
- (4) 58

Question 9:

The solution curve of the differential equation:

$$y \frac{dx}{dy} = x (\log_e x - \log_e y + 1), \quad x > 0, y > 0,$$

passing through the point $(e, 1)$ is:

- (1) $\log_e \frac{y}{x} = x$
- (2) $\log_e \frac{y}{x} = y^2$
- (3) $\log_e \frac{x}{y} = y$
- (4) $2 \log_e \frac{x}{y} = y + 1$

Question 10:

Let $\alpha, \beta, \gamma, \delta \in \mathbb{Z}$ and let $A(\alpha, \beta)$, $B(1, 0)$, $C(\gamma, \delta)$, and $D(1, 2)$ be the vertices of a parallelogram $ABCD$. If $AB = \sqrt{10}$ and the points A and C lie on the line $3y = 2x + 1$, then $2(\alpha + \beta + \gamma + \delta)$ is equal to:

- (1) 10
- (2) 5
- (3) 12
- (4) 8

Question 11:

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

$$\frac{dy}{dx} = \frac{(\tan x) + y}{\sin x (\sec x - \sin x \tan x)},$$

$x \in (0, \frac{\pi}{2})$ satisfying the condition $y(\frac{\pi}{4}) = 2$. Then, $y(\frac{\pi}{3})$ is:

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

Question 12:

Let $\vec{a} = 3\hat{i} + \hat{j} - 2\hat{k}$, $\vec{b} = 4\hat{i} + \hat{j} + 7\hat{k}$, and $\vec{c} = \hat{i} - 3\hat{j} + 4\hat{k}$ be three vectors. If a vector $\vec{p}$ satisfies $\vec{p} \times \vec{b} = \vec{c} \times \vec{b}$ and $\vec{p} \cdot \vec{a} = 0$, then $\vec{p} \cdot (\hat{i} - \hat{j} - \hat{k})$ is equal to:

- (1) 24
- (2) 36
- (3) 28
- (4) 32

Question 13:

The sum of the series:

$$\frac{1}{1 - 3 \cdot 1^2 + 1^4} + \frac{2}{1 - 3 \cdot 2^2 + 2^4} + \frac{3}{1 - 3 \cdot 3^2 + 3^4} + \dots \text{ up to 10 terms is:}$$

- (1) $\frac{45}{109}$
- (2) $-\frac{45}{109}$
- (3) $\frac{55}{109}$
- (4) $-\frac{55}{109}$

Question 14:

The distance of the point $Q(0, 2, -2)$ from the line passing through the point $P(5, -4, 3)$ and perpendicular to the lines:

$$\vec{r} = (-3\hat{i} + 2\hat{k}) + \lambda(2\hat{i} + 3\hat{j} + 5\hat{k}),$$

and

$$\vec{r} = (i - 2j + k) + \mu(-\hat{i} + 3\hat{j} + 2\hat{k}),$$

is:

- (1) $\sqrt{86}$
- (2) $\sqrt{20}$
- (3) $\sqrt{54}$
- (4) $\sqrt{74}$

Question 15:

For $\alpha, \beta, \gamma \neq 0$, if $\sin^{-1} \alpha + \sin^{-1} \beta + \sin^{-1} \gamma = \pi$ and $(\alpha + \beta + \gamma)(\alpha - \gamma + \beta) = 3\alpha\beta$, then γ is equal to:

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

Question 16:

Two marbles are drawn in succession from a box containing 10 red, 30 white, 20 blue, and 15 orange marbles, with replacement being made after each drawing. Then the probability that the first drawn marble is red and the second drawn marble is white, is:

- (1) $\frac{2}{25}$
- (2) $\frac{4}{25}$
- (3) $\frac{2}{3}$
- (4) $\frac{4}{75}$

Question 17:

Let $g(x)$ be a linear function and:

$$f(x) = \begin{cases} g(x), & x \leq 0, \\ \frac{1+x}{2+x}, & x > 0, \end{cases}$$

is continuous at $x = 0$. If $f'(1) = f(-1)$, then the value of $g(3)$ is:

- (1) $\frac{1}{3} \log_e \frac{4}{9}$
- (2) $\frac{1}{3} \log_e \frac{4}{9} + 1$
- (3) $\log_e \frac{4}{9} - 1$
- (4) $\log_e \frac{4}{9^{1/3}}$

Question 18:

$$\text{If } f(x) = \begin{vmatrix} x^3 & 2x^2+1 & 1+3x \\ 3x^2+2 & 2x & x^3+6 \\ x^3-x & 4 & x^2-2 \end{vmatrix}$$

then $2f(0) + f'(0)$ is equal to:

- (1) 48
- (2) 24
- (3) 42
- (4) 18

Question 19:

Three rotten apples are accidentally mixed with fifteen good apples. Assuming the random variable x to be the number of rotten apples in a draw of two apples, the variance of x is:

- (1) $\frac{37}{153}$
- (2) $\frac{57}{153}$
- (3) $\frac{47}{153}$
- (4) $\frac{40}{153}$

Question 20:

Let S be the set of positive integral values of a for which:

$$\frac{ax^2 + 2(a+1)x + 9a + 4}{x^2 - 8x + 32} < 0, \quad \forall x \in \mathbb{R}.$$

Then, the number of elements in S is:

- (1) 1
- (2) 0
- (3) ∞
- (4) 3

SECTION-B**Question 21:**

If the integral:

$$525 \int_0^{\pi/2} \sin 2x \cos^{-2} x (1 + \cos^2 x)^{1/2} dx$$

is equal to:

$$n (\sqrt{2} - 64),$$

then n is equal to:

Question 22:

Let $S = (-1, \infty)$ and $f : S \rightarrow \mathbb{R}$ be defined as:

$$f(x) = \int_{-1}^x (e^{-1})^{(2t-1)^5} (t-2)^2 (t-3)^{12} (2t-10)^{61} dt.$$

Let p = Sum of squares of the values of x , where $f(x)$ attains local maxima on S , and q = Sum of the values of x , where $f(x)$ attains local minima on S . Then, the value of $p^2 + 2q$ is:

Question 23:

The total number of words (with or without meaning) that can be formed out of

the letters of the word 'DISTRIBUTION' taken four at a time, is equal to:

Question 24:

Let Q and R be the feet of the perpendiculars from the point $P(a, a, a)$ on the lines $x = y, z = 1$ and $x = -y, z = -1$, respectively. If $\angle QPR$ is a right angle, then $12a^2$ is equal to:

Question 25:

In the expansion of:

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

the sum of the coefficients of x^3 and x^{-13} is equal to:

Question 26:

If α denotes the number of solutions of:

$$|1-i|^x = 2^x$$

and $\beta = \left| \frac{z}{\arg(z)} \right|$, where:

$$z = \frac{\pi}{4}(1+i)^4 \left(\frac{1-\sqrt{\pi}i}{\sqrt{\pi}+i} + \frac{\sqrt{\pi}-i}{1+\sqrt{\pi}} \right), \quad i = \sqrt{-1},$$

then the distance of the point (α, β) from the line $4x - 3y = 7$ is:

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

Question 27:

Let the foci and length of the latus rectum of an ellipse:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, \quad a > b,$$

be $(\pm 5, 0)$ and $\sqrt{50}$, respectively. Then, the square of the eccentricity of the hyperbola:

$$\frac{x^2}{b^2} - \frac{y^2}{a^2} = 1,$$

equals:

Question 28:

Let $\vec{a}$ and $\vec{b}$ be two vectors such that:

$$|\vec{a}| = 1, |\vec{b}| = 4, \vec{a} \cdot \vec{b} = 2.$$

If $\vec{c} = (2\vec{a} \times \vec{b}) \times \vec{b}$ and the angle between $\vec{b}$ and $\vec{c}$ is α , then $192 \sin^2 \alpha$ is equal to:

Question 29:

Let $A = \{1, 2, 3, 4\}$ and $R = \{(1, 2), (2, 3), (1, 4)\}$ be a relation on A . Let S be the equivalence relation on A such that $R \subset S$ and the number of elements in S is n . Then, the minimum value of n is:

Question 30:

Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a function defined by:

$$f(x) = \frac{4x}{4^x + 2}.$$

Let:

$$M = \int_{f(1-a)}^{f(a)} x \sin^4(x(1-x)) dx,$$
$$N = \int_{f(1-a)}^{f(a)} \sin^4(x(1-x)) dx, \quad a \neq \frac{1}{2}.$$

If $\alpha M = \beta N$, $\alpha, \beta \in \mathbb{N}$, then the least value of $\alpha^2 + \beta^2$ is:

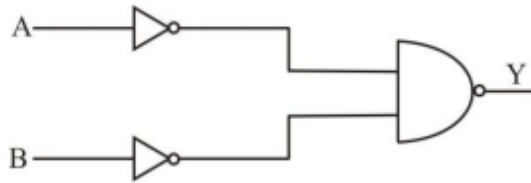
PHYSICS**SECTION-A****Question 31:**

The parameter that remains the same for molecules of all gases at a given temperature is:

- (1) kinetic energy
- (2) momentum
- (3) mass
- (4) speed

Question 32:

Identify the logic operation performed by the given circuit:



- (1) NAND
- (2) NOR
- (3) OR
- (4) AND

Question 33:

The relation between time t and distance x is:

$$t = \alpha x^2 + \beta x,$$

where α and β are constants. The relation between acceleration (a) and velocity (v) is:

- (1) $a = -2\alpha v^3$
- (2) $a = -3\alpha v^2$
- (3) $a = -5\alpha v^5$
- (4) $a = -4\alpha v^4$

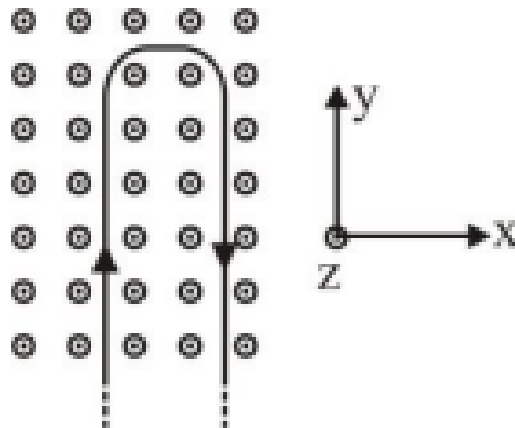
Question 34:

The refractive index of a prism with apex angle A is $\cot \frac{A}{2}$. The angle of minimum deviation is:

- (1) $\delta_m = 180^\circ - A$
- (2) $\delta_m = 180^\circ - 3A$
- (3) $\delta_m = 180^\circ - 4A$
- (4) $\delta_m = 180^\circ - 2A$

Question 35:

A rigid wire consists of a semicircular portion of radius R and two straight sections. The wire is partially immersed in a perpendicular magnetic field $B = B_0 \hat{j}$. The magnetic force on the wire if it has a current i is:



- (1) $-iBR\hat{j}$
- (2) $2iBR\hat{j}$
- (3) $iBR\hat{j}$
- (4) $-2iBR\hat{j}$

Question 36:

If the wavelength of the first member of the Lyman series of hydrogen is λ , the wavelength of the second member will be:

- (1) $\frac{27}{32}\lambda$
- (2) $\frac{32}{27}\lambda$
- (3) $\frac{27}{5}\lambda$
- (4) $\frac{5}{27}\lambda$

Question 37:

Four identical particles of mass m are kept at the four corners of a square. If the gravitational force exerted on one of the masses by the other masses is $\left(\frac{2\sqrt{2}+1}{32}\right) \frac{Gm^2}{L^2}$,

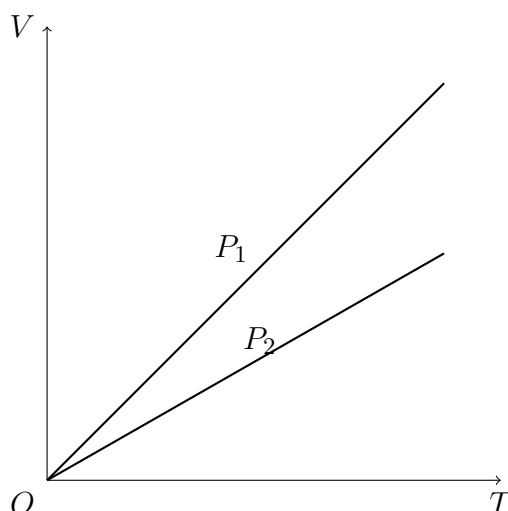
1 the length of the sides of the square is:

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

Question 38:

The given figure represents two isobaric processes for the same mass of an ideal gas. Then:

- (1) $P_2 \geq P_1$
- (2) $P_2 > P_1$
- (3) $P_1 = P_2$
- (4) $P_1 > P_2$

**Question 39:**

If the percentage errors in measuring the length and the diameter of a wire are 0.1 percent each. The percentage error in measuring its resistance will be:

- (1) 1 0.2 percent
- (2) 0.3 percent
- (3) 0.1 percent
- (4) 0.144 percent

Question 40:

In a plane EM wave, the electric field oscillates sinusoidally at a frequency of 5×10^{10} Hz and an amplitude of 50 Vm^{-1} . The total average energy density of the electromagnetic field of the wave is:

[Use $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{Nm}^2$]

- (1) $1.106 \times 10^{-8} \text{ Jm}^{-3}$
- (2) $4.425 \times 10^{-8} \text{ Jm}^{-3}$
- (3) $2.212 \times 10^{-1} \text{ Jm}^{-3}$
- (4) $2.212 \times 10^{-10} \text{ Jm}^{-3}$

Question 41:

A force is represented by $F = ax^2 + bt^{1/2}$, where x is distance and t is time. The dimensions of b^2/a are:

- (1) $[ML^3T^3]$
- (2) $[MLT^2]$
- (3) $[ML^{-1}T^{-1}]$
- (4) $[ML^2T^3]$

Question 42:

Two charges q and $3q$ are separated by a distance r in air. At a distance x from charge q , the resultant electric field is zero. The value of x is:

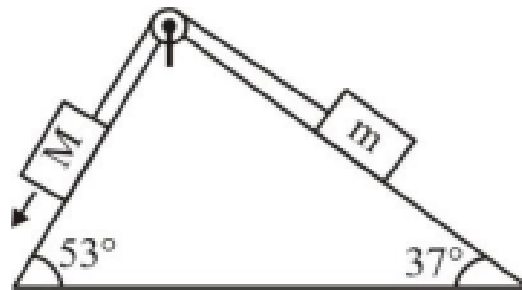
- 1. $r(1 + \sqrt{3})$
- 2. $r(3(1 + \sqrt{3}))$

3. $r(1 + \sqrt{3})$

4. $r(1 + \sqrt{3})$

Question 43:

In the given arrangement of a doubly inclined plane, two blocks of masses M and m are placed. The blocks are connected by a light string passing over an ideal pulley as shown. The coefficient of friction between the surface of the plane and the blocks is 0.25. The value of m , for which $M = 10$ kg will move down with an acceleration of 2 m/s^2 , is: (Take $g = 10 \text{ m/s}^2$ and $\tan 37^\circ = 3/4$).

**Options:**

- (1) 9 kg (2) 4.5 kg (3) 6.5 kg (4) 2.25 kg

Question 44.

A coil is placed perpendicular to a magnetic field of 5000 T. When the field is changed to 3000 T in 2 seconds, an induced emf of 22 V is produced in the coil. If the diameter of the coil is 0.02 m, then the number of turns in the coil is:

Options:

- (A) 7
(B) 70
(C) 35
(D) 140

Question 45.

The fundamental frequency of a closed organ pipe is equal to the first overtone frequency of an open organ pipe. If the length of the open pipe is 60 cm, the length of the closed pipe will be:

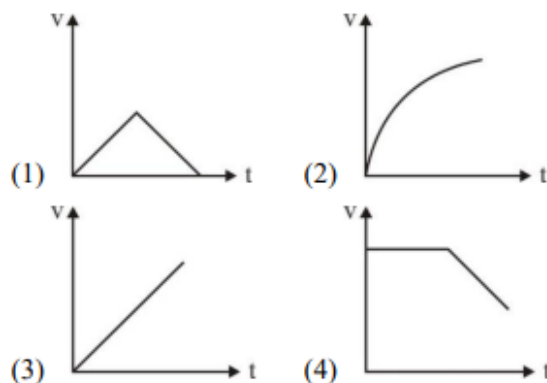
Options:

- (A) 60 cm
(B) 45 cm

- (C) 30 cm
(D) 15 cm

Question 46.

A small steel ball is dropped into a long cylinder containing glycerine. Which one of the following is the correct representation of the velocity-time graph for the transit of the ball?



Options:

(Refer to the provided figure)

Question 47.

A coin is placed on a disc. The coefficient of friction between the coin and the disc is μ . If the distance of the coin from the center of the disc is r , the maximum angular velocity which can be given to the disc, so that the coin does not slip away, is:

Options:

- (1) $\frac{g}{r\mu}$
(2) $\frac{r}{\mu g}$
(3) $\frac{g}{r\mu}$
(4) $\frac{rg}{\mu}$

Question 48.

Two conductors have the same resistances at 0°C but their temperature coefficients of resistance are α_1 and α_2 . The respective temperature coefficients for their series and parallel combinations are:

Options:

- (1) $\frac{\alpha_1 + \alpha_2}{\alpha_1 + \alpha_2}$
(2) $\frac{\alpha_1 + \alpha_2}{2}$

- (3) $\frac{\alpha_1 + \alpha_2}{\alpha_1 + \alpha_2}$
(4) $\frac{\alpha_1 + \alpha_2}{2}$

Question 49.

An artillery piece of mass M_1 fires a shell of mass M_2 horizontally. Instantaneously after the firing, the ratio of kinetic energy of the artillery and that of the shell is:

Options:

- (1) $\frac{M_1}{M_1 + M_2}$
(2) $\frac{M_1}{M_2}$
(3) $\frac{M_2}{M_1 + M_2}$
(4) $\frac{M_1}{2M_2}$

Question 50.

When a metal surface is illuminated by light of wavelength λ , the stopping potential is 8V. When the same surface is illuminated by light of wavelength 3λ , the stopping potential is 2V. The threshold wavelength for this surface is:

Options:

- (1) 5λ
(2) 3λ
(3) 9λ
(4) 4.5λ

SECTION-B**Question 51.**

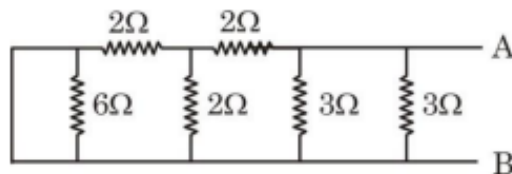
An electron moves through a uniform magnetic field $\vec{B} = B_0\hat{i} + 2B_0\hat{j}$ T. At a particular instant of time, the velocity of the electron is $\vec{u} = 3\hat{i} + 5\hat{j}$ m/s. If the magnetic force acting on the electron is $\vec{F} = 5e\hat{k}$ N, where e is the charge of the electron, then the value of B_0 is:

Question 52.

A parallel plate capacitor with plate separation 5 mm is charged up by a battery. It is found that on introducing a dielectric sheet of thickness 2 mm, while keeping the battery connections intact, the capacitor draws 25 percent more charge from the battery than before. The dielectric constant of the sheet is:

Question 53.

Equivalent resistance of the following network is..... .

**Question 54.**

A solid circular disc of mass 50 kg rolls along a horizontal floor so that its center of mass has a speed of 0.4 m/s. The absolute value of work done on the disc to stop it is J.

Question 55.

A body starts falling freely from height H and hits an inclined plane in its path at height h . As a result of this perfectly elastic impact, the direction of the velocity of the body becomes horizontal. The value of $\frac{H}{h}$ for which the body will take the maximum time to reach the ground is

Question 56.

Two waves of intensity ratio 1 : 9 cross each other at a point. The resultant intensities at the point, when (a) Waves are incoherent is I_1 , (b) Waves are coherent is I_2 and differ in phase by 60° . If $\frac{I_1}{I_2} = 10$, then $x = \dots\dots$

Question 57.

A small square loop of wire of side a is placed inside a large square loop of wire of side L (where $L = 2a$). The loops are coplanar and their centers coincide. The value of the mutual inductance of the system is $x \times 10^{-7}$ H, where $x = \dots\dots$

Question 58.

The depth below the surface of the sea to which a rubber ball can be taken so as to decrease its volume by 0.02 percent is m. (Take density of sea water = 10^3 kg/m^3 , Bulk modulus of rubber = $9 \times 10^8 \text{ N/m}^2$, and $g = 10 \text{ m/s}^2$)

Question 59.

A particle performs simple harmonic motion with amplitude A . Its speed is increased to three times at an instant when its displacement is $\frac{2A}{3}$. The new amplitude of motion is nA . The value of n is

Question 60.

The mass defect in a particular reaction is 0.4 g. The amount of energy liberated

is $n \times 10^7$ kWh, where $n = \dots\dots$
(Speed of light = 3×10^8 m/s)

CHEMISTRY

SECTION-A

Question 61.

Give below are two statements:

Statement-I: Noble gases have very high boiling points.

Statement-II: Noble gases are monoatomic gases. They are held together by strong dispersion forces. Because of this, they are liquefied at very low temperatures. Hence, they have very high boiling points.

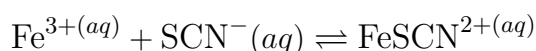
In the light of the above statements, choose the correct answer from the options given below:

Options:

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

Question 62.

For the given reaction, choose the correct expression of K_C from the following:



Options:

- (1) $K_C = \frac{[\text{FeSCN}^{2+}]_{aq}}{[\text{Fe}^{3+}]_{aq}[\text{SCN}^-]_{aq}}$
- (2) $K_C = \frac{[\text{FeSCN}^{2+}]_{aq}}{[\text{Fe}^{3+}]_{aq}[\text{SCN}^-]_{aq}^2}$
- (3) $K_C = \frac{[\text{FeSCN}^{2+}]_{aq}^2}{[\text{Fe}^{3+}]_{aq}[\text{SCN}^-]_{aq}}$
- (4) $K_C = \frac{[\text{FeSCN}^{2+}]_{aq}^2}{[\text{Fe}^{3+}]_{aq}[\text{SCN}^-]_{aq}^2}$

Question 63.

Identify the mixture that shows positive deviations from Raoult's Law.

Options:

- (1) $(\text{CH}_3)_2\text{CO} + \text{C}_6\text{H}_5\text{NH}_2$
- (2) $\text{CHCl}_3 + \text{C}_6\text{H}_6$
- (3) $\text{CHCl}_3 + (\text{CH}_3)_2\text{CO}$
- (4) $(\text{CH}_3)_2\text{CO} + \text{CS}_2$

Question 64.

The compound that is white in color is:

Options:

- (1) Ammonium sulphide
- (2) Lead sulphate
- (3) Lead iodide
- (4) Ammonium arsinomolybdate

Question 65.

The metals that are employed in the battery industries are:

- A. Fe
- B. Mn
- C. Ni
- D. Cr
- E. Cd

Choose the correct answer from the options given below:

Options:

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

Question 66.

A species having carbon with a sextet of electrons and can act as an electrophile is called:

Options:

- (1) Carbon free radical
- (2) Carbanion
- (3) Carbocation
- (4) Pentavalent carbon

Question 67.

Identify the factor from the following that does not affect electrolytic conductance of a solution:

Options:

- (1) The nature of the electrolyte added.

- (2) The nature of the electrode used.
- (3) Concentration of the electrolyte.
- (4) The nature of solvent used.

Question 68.

The product (C) in the below mentioned reaction is:

**Options:**

- (1) Propan-1-ol
- (2) Propene
- (3) Propyne
- (4) Propan-2-ol

Question 69.

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

Assertion A: Alcohols react both as nucleophiles and electrophiles.

Reason R: Alcohols react with active metals such as sodium, potassium, and aluminum to yield corresponding alkoxides and liberate hydrogen.

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

Options:

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

Question 70.

The correct sequence of electron gain enthalpy of the elements listed below is:

- A. Ar
- B. Br
- C. F
- D. S

Choose the most appropriate from the options given below:

Options:

- (1) $C > B > D > A$
- (2) $A > D > B > C$
- (3) $A > D > C > B$
- (4) $D > C > B > A$

Question 71.

Identify correct statements from below:

- A. The chromate ion is square planar.
- B. Dichromates are generally prepared from chromates.
- C. The green manganate ion is diamagnetic.
- D. Dark green coloured K_2MnO_4 disproportionates in a neutral or acidic medium to give permanganate.
- E. With increasing oxidation number of transition metal, ionic character of the oxides decreases.

Choose the correct answer from the options given below:

Options:

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

Question 72.

‘Adsorption’ principle is used for which of the following purification method?

Options:

- (1) Extraction
- (2) Chromatography
- (3) Distillation
- (4) Sublimation

Question 73.

Integrated rate law equation for a first order gas phase reaction is given by (where P_i is initial pressure and P_t is total pressure at time t):

Options:

- (1) $\frac{2.303}{k} \log \left(\frac{P_i}{P_t - P_i} \right) = t$
- (2) $\frac{2.303}{k} \log \left(\frac{2P_i}{P_t - P_i} \right) = t$
- (3) $\frac{2.303}{k} \log \left(\frac{P_t - P_i}{P_i} \right) = t$

$$(4) \frac{2.303}{k} \log \left(\frac{P_i}{P_t} \right) = t$$

Question 74.

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

Assertion A: pK_a value of phenol is 10.0 while that of ethanol is 15.9.

Reason R: Ethanol is stronger acid than phenol.

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

Question 75.

Given below are two statements:

Statement I: IUPAC name of HO-CH₂-(CH₂)₃-CH₂-COCH₃ is 7-hydroxyheptan-2-one.

Statement II: 2-oxoheptan-7-ol is the correct IUPAC name for the above compound.

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

Options:

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

Question 76.

The correct statements from the following are:

- A.** The strength of anionic ligands can be explained by crystal field theory.
- B.** Valence bond theory does not give a quantitative interpretation of kinetic stability of coordination compounds.
- C.** The hybridization involved in formation of $[Ni(CN)_4]^{2-}$ complex is dsp².

D. The number of possible isomer(s) of $\text{cis-[PtCl}_2(\text{en})_2]^{2+}$ is one.

Choose the correct answer from the options given below:

Options:

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

Question 77.

The linear combination of atomic orbitals to form molecular orbitals takes place only when the combining atomic orbitals:

- A. have the same energy
- B. have the minimum overlap
- C. have same symmetry about the molecular axis
- D. have different symmetry about the molecular axis

Choose the most appropriate answer from the options given below:

Options:

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

Question 78.

Match List I with List II:

LIST-I	LIST-II
A. Glucose/ NaHCO_3 /Water	I. Gluconic acid
B. Glucose/ HNO_3	II. No reaction
C. Glucose/ HI /Water	III. n-hexane
D. Glucose/Bromine	IV. Saccharic acid

Choose the correct answer from the options given below:

Options:

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

Question 79.

Consider the oxides of group 14 elements SiO_2 , GeO_2 , SnO_2 , PbO_2 , CO and GeO .
The amphoteric oxides are:

Options:

- (1) GeO , GeO_2
- (2) SiO_2 , GeO_2
- (3) SnO_2 , PbO_2
- (4) SnO_2 , CO

Question 80.

Match List I with List II:

LIST I (Technique)	LIST II (Application)
A. Distillation B. Fractional distillation C. Steam distillation D. Distillation under reduced pressure	I. Separation of glycerol from spent-lye II. Aniline - Water mixture III. Separation of crude oil fractions IV. Chloroform-Aniline

Choose the correct answer from the options given below:

Options:

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

SECTION-B**Question 81.**

Molar mass of the salt from NaBr , NaNO_3 , KI and CaF_2 which does not evolve coloured vapours on heating with concentrated H_2SO_4 is g mol^{-1} .
(Molar mass in g mol^{-1} : Na : 23, N : 14, K : 39, O : 16, Br : 80, I : 127, F : 19, Ca : 40)

Options:

- (1) 102
- (2) 58
- (3) 78
- (4) 84

Question 82.

The 'Spin only' magnetic moment for $[\text{Ni}(\text{NH}_3)_6]^{2+}$ is $\times 10^{-1}$ BM.

(given: Atomic number of Ni = 28)

Options:

- (1) 2.8
- (2) 2.0
- (3) 3.0
- (4) 1.4

Question 83.

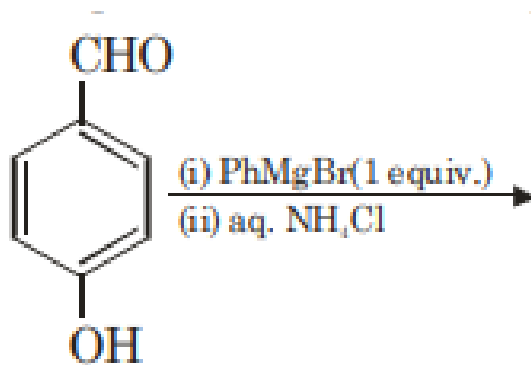
Number of moles of methane required to produce 22 g of CO_2 (g) after combustion is $x \times 10^{-2}$ moles. The value of x is

Options:

- (1) 25
- (2) 50
- (3) 75
- (4) 100

Question 84.

The product of the following reaction is P :



The number of hydroxyl groups present in the product P is

Question 85.

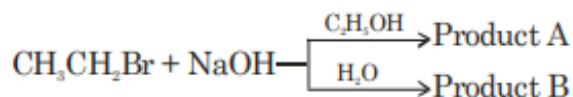
The number of species from the following in which the central atom uses sp^3 hybrid orbitals in its bonding is

NH_3 , SO_2 , SiO_2 , BeCl_2 , CO_2 , H_2O , CH_4 , BF_3

Options:

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

(4) 4

Question 86.

The total number of hydrogen atoms in product A and product B is

Question 87.

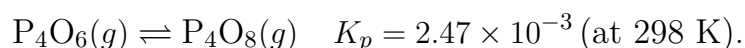
Number of alkanes obtained on electrolysis of a mixture of CH_3COONa and $\text{C}_2\text{H}_5\text{COONa}$ is

Options:

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

Question 88.

Consider the following reaction at 298 K.



The value of $\Delta_r G^\circ$ for the reaction iskJ.

(Given: $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

Options:

- (1) 150
- (2) 163
- (3) 175
- (4) 180

Question 89.

The ionization energy of sodium in kJ mol^{-1} . If electromagnetic radiation of wavelength 242 nm is just sufficient to ionize sodium atom, the ionization energy is

(Given: $h = 6.626 \times 10^{-34} \text{ J s}$, $c = 3.0 \times 10^8 \text{ m/s}$)

Options:

- (1) 380

- (2) 494
- (3) 500
- (4) 600

Question 90.

One Faraday of electricity liberates $x \times 10^{-1}$ gram atom of copper from copper sulfate. The value of x is

Options:

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