JEE MAINS PAPER 1 2025

Test Date	22/01/2025
Test Time	9:00 AM - 12:00 PM
Subject	B. Tech

Section : **Mathematics Section A**

Q.1 The area of the region, inside the circle $(x-2\sqrt{3})^2+y^2=12$ and outside the parabola $y^2=2\sqrt{3}\,x$ is :

Options

1. $6\pi-16$
2. $3\pi-8$
3. $3\pi+8$
4. $6\pi-8$

Question Type : **MCQ**
Question ID : **65644594**
Option 1 ID : **656445331**
Option 2 ID : **656445330**
Option 3 ID : **656445328**
Option 4 ID : **656445329**

Q.2 Let $a_1, a_2, a_3, \ldots$ be a G.P. of increasing positive terms. If $a_1a_5=28$ and $a_2+a_4=29$, then a_6 is equal to :

Options

1. 526
2. 812
3. 628
4. 784

Question Type : **MCQ**
Question ID : **65644581**
Option 1 ID : **656445276**
Option 2 ID : **656445279**
Option 3 ID : **656445277**
Option 4 ID : **656445278**

Q.3 If $\sum_{r=1}^{n} T_r = \frac{(2n-1)(2n+1)(2n+3)(2n+5)}{64}$, then $\lim_{n \to \infty} \sum_{r=1}^{n} \left(\frac{1}{T_r}\right)$ is equal to :

Options

1. 1
2. $\frac{1}{3}$
3. 0
4. $\frac{2}{3}$

Question Type : **MCQ**
Question ID : **65644580**
Option 1 ID : **656445275**
Option 2 ID : **656445273**
Option 3 ID : **656445272**
Option 4 ID : **656445274**

Q.4 A coin is tossed three times. Let X denote the number of times a tail follows a head. If μ and σ^2 denote the mean and variance of X, then the value of $64(\mu + \sigma^2)$ is :

Options

1. 32
2. 64
3. 51
4. 48

Question Type : **MCQ**
Question ID : **65644583**
Option 1 ID : **656445284**
Option 2 ID : **656445287**
Option 3 ID : **656445286**
Option 4 ID : **656445285**

Q.5 The number of non-empty equivalence relations on the set {1, 2, 3} is :

Options

1. 6
2. 7
3. 5
4. 4

Question Type : **MCQ**
Question ID : **65644577**
Option 1 ID : **656445262**
Option 2 ID : **656445263**
Option 3 ID : **656445261**
Option 4 ID : **656445260**

Q.6 A circle C of radius 2 lies in the second quadrant and touches both the coordinate axes. Let r be the radius of a circle that has centre at the point (2, 5) and intersects the circle C at exactly two points. If the set of all possible values of r is the interval (α, β), then $3\beta - 2\alpha$ is equal to :

Options

1. 14
2. 15
3. 12
4. 10

Question Type : **MCQ**
Question ID : **65644586**
Option 1 ID : **656445298**
Option 2 ID : **656445299**
Option 3 ID : **656445297**
Option 4 ID : **656445296**

Q.7

Let z_1, z_2 and z_3 be three complex numbers on the circle $|z|=1$ with $\arg(z_1)=\frac{-\pi}{4}$, $\arg(z_2)=0$ and $\arg(z_3)=\frac{\pi}{4}$. If $|z_1\bar{z}_2+z_2\bar{z}_3+z_3\bar{z}_1|^2=\alpha+\beta\sqrt{2}, \alpha,\beta \in \mathbf{Z}$, then the value of $\alpha^2+\beta^2$ is :

Options

1. 24
2. 29
3. 31
4. 41

Question Type : **MCQ**
Question ID : **65644579**
Option 1 ID : **656445268**
Option 2 ID : **656445269**
Option 3 ID : **656445270**
Option 4 ID : **656445271**

Q.8

Let $L_1: \frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}$ and $L_2: \frac{x-2}{3}=\frac{y-4}{4}=\frac{z-5}{5}$ be two lines. Then which of the following points lies on the line of the shortest distance between L_1 and L_2 ?

Options

1. $\left(2, 3, \frac{1}{3}\right)$
2. $\left(-\frac{5}{3}, -7, 1\right)$
3. $\left(\frac{14}{3}, -3, \frac{22}{3}\right)$
4. $\left(\frac{8}{3}, -1, \frac{1}{3}\right)$

Question Type : **MCQ**
Question ID : **65644590**
Option 1 ID : **656445314**
Option 2 ID : **656445312**
Option 3 ID : **656445315**
Option 4 ID : **656445313**

Q.9 From all the English alphabets, five letters are chosen and are arranged in alphabetical order. The total number of ways, in which the middle letter is 'M', is :

Options

1. 4356
2. 14950
3. 5148
4. 6084

Question Type : **MCQ**
Question ID : **65644582**
Option 1 ID : **656445281**
Option 2 ID : **656445280**
Option 3 ID : **656445283**
Option 4 ID : **656445282**

Q.10 Let $A = \{1, 2, 3, \ldots, 10\}$ and $B = \left\{\frac{m}{n} : m, n \in A, m < n \text{ and } \gcd(m, n) = 1\right\}$. Then $n(B)$ is equal to :

Options

1. 29
2. 36
3. 31
4. 37

Question Type : **MCQ**
Question ID : **65644576**
Option 1 ID : **656445256**
Option 2 ID : **656445258**
Option 3 ID : **656445257**
Option 4 ID : **656445259**

Q.11

The product of all solutions of the equation $e^{5(\log_e x)^2 + 3} = x^8$, $x > 0$, is :

Options

1. e
2. e^2
3. $e^{8/5}$
4. $e^{6/5}$

Question Type : **MCQ**
Question ID : **65644578**
Option 1 ID : **656445264**
Option 2 ID : **656445265**
Option 3 ID : **656445267**
Option 4 ID : **656445266**

Q.12

Let $f(x)$ be a real differentiable function such that $f(0) = 1$ and $f(x+y) = f(x)f'(y) + f'(x)f(y)$ for all $x, y \in \mathbf{R}$. Then $\sum_{n=1}^{100} \log_e f(n)$ is equal to :

Options

1. 2525
2. 2406
3. 5220
4. 2384

Question Type : **MCQ**
Question ID : **65644592**
Option 1 ID : **656445322**
Option 2 ID : **656445321**
Option 3 ID : **656445323**
Option 4 ID : **656445320**

Q.13

Let for $f(x)=7\tan^8 x+7\tan^6 x-3\tan^4 x-3\tan^2 x$, $I_1=\int_0^{\pi/4} f(x)dx$ and $I_2=\int_0^{\pi/4} x f(x)dx$. Then $7I_1+12I_2$ is equal to :

Options

1. 2
2. π
3. 1
4. 2π

Question Type : **MCQ**
Question ID : **65644593**
Option 1 ID : **656445327**
Option 2 ID : **656445325**
Option 3 ID : **656445326**
Option 4 ID : **656445324**

Q.14

Let $f:\mathbf{R}\to\mathbf{R}$ be a twice differentiable function such that $f(x+y)=f(x)\,f(y)$ for all $x, y \in \mathbf{R}$. If $f'(0)=4a$ and f satisfies $f''(x)-3af'(x)-f(x)=0$, $a>0$, then the area of the region $R=\{(x, y)\,|\,0\le y\le f(ax),\ 0\le x\le 2\}$ is :

Options

1. e^4-1
2. e^4+1
3. e^2+1
4. e^2-1

Question Type : **MCQ**
Question ID : **65644591**
Option 1 ID : **656445318**
Option 2 ID : **656445319**
Option 3 ID : **656445316**
Option 4 ID : **656445317**

Q.15

Let $x=x(y)$ be the solution of the differential equation $y^2dx+\left(x-\frac{1}{y}\right)dy=0$. If $x(1)=1$, then $x\left(\frac{1}{2}\right)$ is :

Options

1. $\frac{1}{2}+e$
2. $3-e$
3. $\frac{3}{2}+e$
4. $3+e$

Question Type : **MCQ**
Question ID : **65644595**
Option 1 ID : **656445332**
Option 2 ID : **656445333**
Option 3 ID : **656445334**
Option 4 ID : **656445335**

Q.16

Two balls are selected at random one by one without replacement from a bag containing 4 white and 6 black balls. If the probability that the first selected ball is black, given that the second selected ball is also black, is $\frac{m}{n}$, where $\gcd(m, n)=1$, then $m+n$ is equal to :

Options

1. 14
2. 4
3. 13
4. 11

Question Type : **MCQ**
Question ID : **65644584**
Option 1 ID : **656445291**
Option 2 ID : **656445289**
Option 3 ID : **656445290**
Option 4 ID : **656445288**

Q.17 Using the principal values of the inverse trigonometric functions, the sum of the maximum and the minimum values of $16((\sec^{-1}x)^2+(\operatorname{cosec}^{-1}x)^2)$ is :

Options

1. $31\pi^2$
2. $24\pi^2$
3. $22\pi^2$
4. $18\pi^2$

Question Type : **MCQ**
Question ID : **65644589**
Option 1 ID : **656445311**
Option 2 ID : **656445310**
Option 3 ID : **656445309**
Option 4 ID : **656445308**

Q.18 Let the parabola $y=x^2+px-3$, meet the coordinate axes at the points P, Q and R. If the circle C with centre at $(-1, -1)$ passes through the points P, Q and R, then the area of ΔPQR is :

Options

1. 7
2. 6
3. 5
4. 4

Question Type : **MCQ**
Question ID : **65644587**
Option 1 ID : **656445303**
Option 2 ID : **656445302**
Option 3 ID : **656445301**
Option 4 ID : **656445300**

Q.19 Let the triangle PQR be the image of the triangle with vertices (1, 3), (3, 1) and (2, 4) in the line $x+2y=2$. If the centroid of ΔPQR is the point (α, β), then $15(\alpha-\beta)$ is equal to :

Options

1. 19
2. 21
3. 22
4. 24

Question Type : **MCQ**
Question ID : **65644585**
Option 1 ID : **656445292**
Option 2 ID : **656445293**
Option 3 ID : **656445294**
Option 4 ID : **656445295**

Q.20 Let the foci of a hyperbola be (1, 14) and (1, −12). If it passes through the point (1, 6), then the length of its latus-rectum is :

Options

1. $\frac{144}{5}$
2. $\frac{24}{5}$
3. $\frac{25}{6}$
4. $\frac{288}{5}$

Question Type : **MCQ**
Question ID : **65644588**
Option 1 ID : **656445306**
Option 2 ID : **656445307**
Option 3 ID : **656445304**
Option 4 ID : **656445305**

Section : **Mathematics Section B**

Q.21 Let the function,

$$f(x)=\begin{cases}-3ax^2-2, & x<1\\ a^2+bx, & x\geq 1\end{cases}$$

be differentiable for all $x \in \mathbf{R}$, where $a>1$, $b \in \mathbf{R}$. If the area of the region enclosed by $y=f(x)$ and the line $y=-20$ is $\alpha+\beta\sqrt{3}$, $\alpha, \beta \in \mathbf{Z}$, then the value of $\alpha+\beta$ is _____.

Question Type : **SA**
Question ID : **656445100**

Q.22 If $\sum_{r=0}^{5} \frac{^{11}C_{2r+1}}{2r+2} = \frac{m}{n}$, $\gcd(m, n) = 1$, then $m - n$ is equal to _____.

Question Type : **SA**
Question ID : **65644597**

Q.23 Let $\vec{c}$ be the projection vector of $\vec{b} = \lambda\hat{i} + 4\hat{k}$, $\lambda > 0$, on the vector $\vec{a} = \hat{i} + 2\hat{j} + 2\hat{k}$. If $|\vec{a} + \vec{c}| = 7$, then the area of the parallelogram formed by the vectors $\vec{b}$ and $\vec{c}$ is _____.

Question Type : **SA**
Question ID : **65644598**

Q.24 Let A be a square matrix of order 3 such that $\det(A) = -2$ and $\det(3\text{adj}(-6\text{adj}(3A))) = 2^{m+n} \cdot 3^{mn}$, $m > n$. Then $4m + 2n$ is equal to _____.

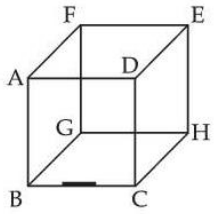
Question Type : **SA**
Question ID : **65644596**

Q.25 Let $L_1 : \frac{x-1}{3} = \frac{y-1}{-1} = \frac{z+1}{0}$ and $L_2 : \frac{x-2}{2} = \frac{y}{0} = \frac{z+4}{\alpha}$, $\alpha \in \mathbf{R}$, be two lines, which intersect at the point B. If P is the foot of perpendicular from the point A(1, 1, −1) on L_2, then the value of $26\,\alpha\,(PB)^2$ is _____.

Question Type : **SA**
Question ID : **65644599**

Section : **Physics Section A**

Q.26 A line charge of length $\frac{'a'}{2}$ is kept at the center of an edge BC of a cube ABCDEFGH having edge length 'a' as shown in the figure. If the density of line charge is λ C per unit length, then the total electric flux through all the faces of the cube will be _____. (Take, ϵ_0 as the free space permittivity)



Options

1. $\frac{\lambda a}{16\epsilon_0}$
2. $\frac{\lambda a}{8\epsilon_0}$
3. $\frac{\lambda a}{4\epsilon_0}$
4. $\frac{\lambda a}{2\epsilon_0}$

Question Type : **MCQ**
Question ID : **656445112**
Option 1 ID : **656445388**
Option 2 ID : **656445387**
Option 3 ID : **656445386**
Option 4 ID : **656445385**

Q.27 An amount of ice of mass 10^{-3} kg and temperature $-10°C$ is transformed to vapour of temperature 110°C by applying heat. The total amount of work required for this conversion is,
(Take, specific heat of ice = 2100 $Jkg^{-1}K^{-1}$, specific heat of water = 4180 $Jkg^{-1}K^{-1}$, specific heat of steam = 1920 $Jkg^{-1}K^{-1}$, Latent heat of ice = 3.35×10^5 Jkg^{-1} and Latent heat of steam = 2.25×10^6 Jkg^{-1})

Options

1. 3043 J
2. 3022 J
3. 3024 J
4. 3003 J

Question Type : **MCQ**
Question ID : **656445107**
Option 1 ID : **656445365**
Option 2 ID : **656445367**
Option 3 ID : **656445366**
Option 4 ID : **656445368**

Q.28 Given below are two statements :

Statement I : In a vernier callipers, one vernier scale division is always smaller than one main scale division.

Statement II : The vernier constant is given by one main scale division multiplied by the number of vernier scale divisions.

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

Options

1. Both **Statement I** and **Statement II** are false
2. Both **Statement I** and **Statement II** are true
3. **Statement I** is false but **Statement II** is true
4. **Statement I** is true but **Statement II** is false

Question Type : **MCQ**
Question ID : **656445102**
Option 1 ID : **656445346**
Option 2 ID : **656445345**
Option 3 ID : **656445348**
Option 4 ID : **656445347**

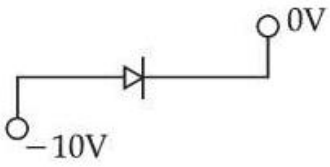
Q.29 A parallel-plate capacitor of capacitance 40μF is connected to a 100 V power supply. Now the intermediate space between the plates is filled with a dielectric material of dielectric constant K = 2. Due to the introduction of dielectric material, the extra charge and the change in the electrostatic energy in the capacitor, respectively, are

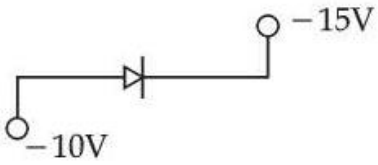
Options

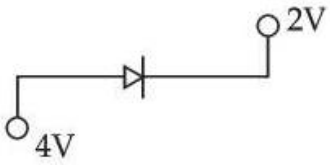
1. 4 mC and 0.2 J
2. 2 mC and 0.4 J
3. 2 mC and 0.2 J
4. 8 mC and 2.0 J

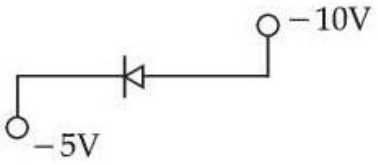
Question Type : **MCQ**
Question ID : **656445109**
Option 1 ID : **656445373**
Option 2 ID : **656445374**
Option 3 ID : **656445376**
Option 4 ID : **656445375**

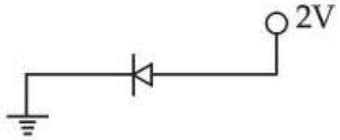
Q.30 Which of the following circuits represents a forward biased diode ?

(A) 

(B) 

(C) 

(D) 

(E) 

Choose the **correct** answer from the options given below :

Options

1. (A) and (D) only

2. (B), (D) and (E) only

3. (C) and (E) only

4. (B), (C) and (E) only

Question Type : **MCQ**
Question ID : **656445120**
Option 1 ID : **656445417**
Option 2 ID : **656445420**
Option 3 ID : **656445418**
Option 4 ID : **656445419**

Q.31 Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion-(A) : If Young's double slit experiment is performed in an optically denser medium than air, then the consecutive fringes come closer.

Reason-(R) : The speed of light reduces in an optically denser medium than air while its frequency does not change.

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

Options

1. **(A)** is true but **(R)** is false

2. Both **(A)** and **(R)** are true but **(R)** is **not** the correct explanation of **(A)**

3. **(A)** is false but **(R)** is true

4. Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**

Question Type : **MCQ**
Question ID : **656445115**
Option 1 ID : **656445399**
Option 2 ID : **656445398**
Option 3 ID : **656445400**
Option 4 ID : **656445397**

Q.32 If B is magnetic field and μ_0 is permeability of free space, then the dimensions of (B/μ_0) is

Options

1. $LT^{-2}A^{-1}$

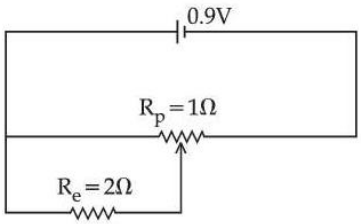
2. $ML^2T^{-2}A^{-1}$

3. $MT^{-2}A^{-1}$

4. $L^{-1}A$

Question Type : **MCQ**
Question ID : **656445101**
Option 1 ID : **656445343**
Option 2 ID : **656445341**
Option 3 ID : **656445342**
Option 4 ID : **656445344**

Q.33



Sliding contact of a potentiometer is in the middle of the potentiometer wire having resistance $R_p = 1\Omega$ as shown in the figure. An external resistance of $R_e = 2\Omega$ is connected via the sliding contact. The electric current in the circuit is :

Options

1. 1.35 A
2. 0.9 A
3. 0.3 A
4. 1.0 A

Question Type : **MCQ**
Question ID : **656445114**
Option 1 ID : **656445396**
Option 2 ID : **656445394**
Option 3 ID : **656445393**
Option 4 ID : **656445395**

Q.34

The work functions of cesium (Cs) and lithium (Li) metals are 1.9 eV and 2.5 eV, respectively. If we incident a light of wavelength 550 nm on these two metal surfaces, then photo-electric effect is possible for the case of

Options

1. Cs only
2. Both Cs and Li
3. Neither Cs nor Li
4. Li only

Question Type : **MCQ**
Question ID : **656445118**
Option 1 ID : **656445409**
Option 2 ID : **656445411**
Option 3 ID : **656445412**
Option 4 ID : **656445410**

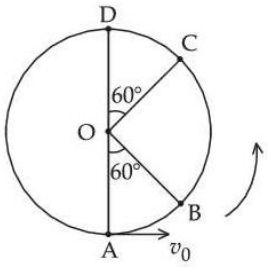
Q.35 An electron is made to enter symmetrically between two parallel and equally but oppositely charged metal plates, each of 10 cm length. The electron emerges out of the electric field region with a horizontal component of velocity 10^6 m/s. If the magnitude of the electric field between the plates is 9.1 V/cm, then the vertical component of velocity of electron is
(mass of electron $= 9.1 \times 10^{-31}$ kg and charge of electron $= 1.6 \times 10^{-19}$ C)

Options

1. 1×10^6 m/s
2. 16×10^4 m/s
3. 16×10^6 m/s
4. 0

Question Type : **MCQ**
Question ID : **656445110**
Option 1 ID : **656445378**
Option 2 ID : **656445377**
Option 3 ID : **656445380**
Option 4 ID : **656445379**

Q.36 A bob of mass m is suspended at a point O by a light string of length l and left to perform vertical motion (circular) as shown in figure. Initially, by applying horizontal velocity v_0 at the point 'A', the string becomes slack when, the bob reaches at the point 'D'. The ratio of the kinetic energy of the bob at the points B and C is _____.

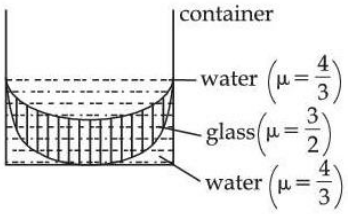


Options

1. 3
2. 4
3. 1
4. 2

Question Type : **MCQ**
Question ID : **656445103**
Option 1 ID : **656445351**
Option 2 ID : **656445352**
Option 3 ID : **656445349**
Option 4 ID : **656445350**

Q.37 In the diagram given below, there are three lenses formed. Considering negligible thickness of each of them as compared to $|R_1|$ and $|R_2|$, i.e., the radii of curvature for upper and lower surfaces of the glass lens, the power of the combination is



Options

1. $\frac{1}{6}\left(\frac{1}{|R_1|}+\frac{1}{|R_2|}\right)$

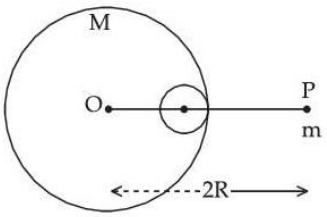
2. $-\frac{1}{6}\left(\frac{1}{|R_1|}+\frac{1}{|R_2|}\right)$

3. $\frac{1}{6}\left(\frac{1}{|R_1|}-\frac{1}{|R_2|}\right)$

4. $-\frac{1}{6}\left(\frac{1}{|R_1|}-\frac{1}{|R_2|}\right)$

Question Type : **MCQ**
Question ID : **656445117**
Option 1 ID : **656445407**
Option 2 ID : **656445408**
Option 3 ID : **656445405**
Option 4 ID : **656445406**

Q.38 A small point of mass m is placed at a distance 2R from the centre 'O' of a big uniform solid sphere of mass M and radius R. The gravitational force on 'm' due to M is F_1. A spherical part of radius R/3 is removed from the big sphere as shown in the figure and the gravitational force on m due to remaining part of M is found to be F_2. The value of ratio $F_1 : F_2$ is



Options

1. 12 : 11
2. 16 : 9
3. 11 : 10
4. 12 : 9

Question Type : **MCQ**
Question ID : **656445105**
Option 1 ID : **656445358**
Option 2 ID : **656445360**
Option 3 ID : **656445359**
Option 4 ID : **656445357**

Q.39 Given below are two statements :

Statement-I : The equivalent emf of two nonideal batteries connected in parallel is smaller than either of the two emfs.

Statement-II : The equivalent internal resistance of two nonideal batteries connected in parallel is smaller than the internal resistance of either of the two batteries.

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

Options

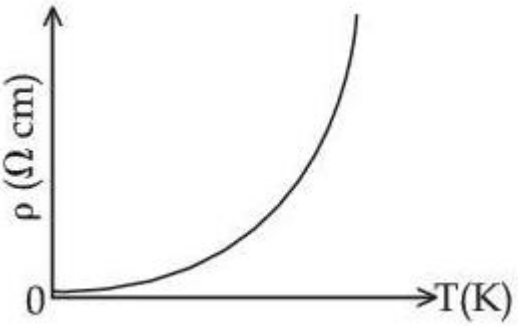
1. **Statement-I** is false but **Statement-II** is true
2. Both **Statement-I** and **Statement-II** are false
3. Both **Statement-I** and **Statement-II** are true
4. **Statement-I** is true but **Statement-II** is false

Question Type : **MCQ**
Question ID : **656445113**
Option 1 ID : **656445392**
Option 2 ID : **656445390**
Option 3 ID : **656445389**
Option 4 ID : **656445391**

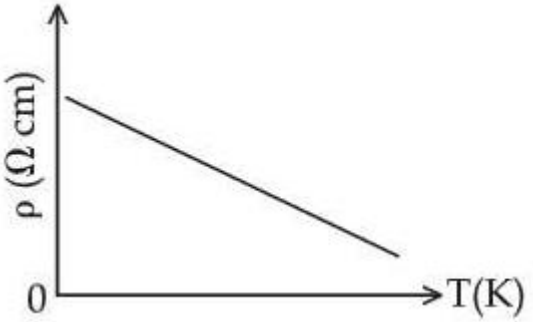
Q.40 Which of the following resistivity (ρ) v/s temperature (T) curves is most suitable to be used in wire bound standard resistors ?

Options

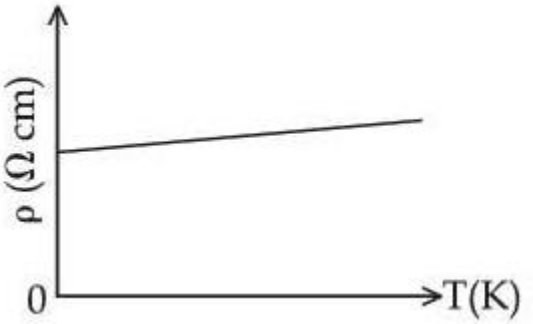
1.



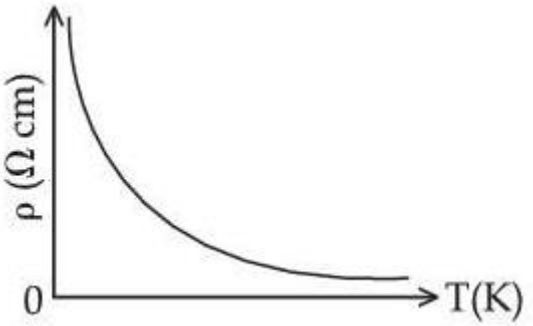
2.



3.



4.



Question Type : **MCQ**
Question ID : **656445111**
Option 1 ID : **656445381**
Option 2 ID : **656445384**
Option 3 ID : **656445383**
Option 4 ID : **656445382**

Q.41 A closed organ and an open organ tube are filled by two different gases having same bulk modulus but different densities ρ_1 and ρ_2, respectively. The frequency of 9^{th} harmonic of closed tube is identical with 4^{th} harmonic of open tube. If the length of the closed tube is 10 cm and the density ratio of the gases is $\rho_1 : \rho_2 = 1 : 16$, then the length of the open tube is :

Options

1. $\frac{20}{7}$ cm
2. $\frac{15}{7}$ cm
3. $\frac{20}{9}$ cm
4. $\frac{15}{9}$ cm

Question Type : **MCQ**
Question ID : **656445108**
Option 1 ID : **656445371**
Option 2 ID : **656445369**
Option 3 ID : **656445372**
Option 4 ID : **656445370**

Q.42 Two spherical bodies of same materials having radii 0.2 m and 0.8 m are placed in same atmosphere. The temperature of the smaller body is 800 K and temperature of the bigger body is 400 K. If the energy radiated from the smaller body is E, the energy radiated from the bigger body is (assume, effect of the surrounding temperature to be negligible),

Options

1. 64 E
2. E
3. 256 E
4. 16 E

Question Type : **MCQ**
Question ID : **656445106**
Option 1 ID : **656445362**
Option 2 ID : **656445364**
Option 3 ID : **656445361**
Option 4 ID : **656445363**

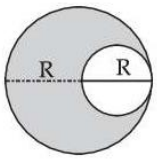
Q.43 An electron in the ground state of the hydrogen atom has the orbital radius of 5.3×10^{-11} m while that for the electron in third excited state is 8.48×10^{-10} m. The ratio of the de Broglie wavelengths of electron in the ground state to that in the excited state is

Options

1. 16
2. 3
3. 4
4. 9

Question Type : **MCQ**
Question ID : **656445119**
Option 1 ID : **656445416**
Option 2 ID : **656445413**
Option 3 ID : **656445414**
Option 4 ID : **656445415**

Q.44 A uniform circular disc of radius 'R' and mass 'M' is rotating about an axis perpendicular to its plane and passing through its centre. A small circular part of radius R/2 is removed from the original disc as shown in the figure. Find the moment of inertia of the remaining part of the original disc about the axis as given above.



Options

1. $\frac{9}{32}MR^2$
2. $\frac{17}{32}MR^2$
3. $\frac{13}{32}MR^2$
4. $\frac{7}{32}MR^2$

Question Type : **MCQ**
Question ID : **656445104**
Option 1 ID : **656445354**
Option 2 ID : **656445356**
Option 3 ID : **656445353**
Option 4 ID : **656445355**

Q.45 Given is a thin convex lens of glass (refractive index μ) and each side having radius of curvature R. One side is polished for complete reflection. At what distance from the lens, an object be placed on the optic axis so that the image gets formed on the object itself ?

Options

1. R/μ
2. μR
3. $R/(2\mu-3)$
4. $R/(2\mu-1)$

Question Type : **MCQ**
Question ID : **656445116**
Option 1 ID : **656445401**
Option 2 ID : **656445403**
Option 3 ID : **656445404**
Option 4 ID : **656445402**

Section : **Physics Section B**

Q.46 The driver sitting inside a parked car is watching vehicles approaching from behind with the help of his side view mirror, which is a convex mirror with radius of curvature R = 2 m. Another car approaches him from behind with a uniform speed of 90 km/hr. When the car is at a distance of 24 m from him, the magnitude of the acceleration of the image of the car in the side view mirror is 'a'. The value of 100a is _____ m/s^2.

Question Type : **SA**
Question ID : **656445125**

Q.47 Two soap bubbles of radius 2 cm and 4 cm, respectively, are in contact with each other. The radius of curvature of the common surface, in cm, is _____.

Question Type : **SA**
Question ID : **656445123**

Q.48 A particle is projected at an angle of 30° from horizontal at a speed of 60 m/s. The height traversed by the particle in the first second is h_0 and height traversed in the last second, before it reaches the maximum height, is h_1. The ratio $h_0 : h_1$ is _____.
[Take, $g = 10\ m/s^2$]

Question Type : **SA**
Question ID : **656445122**

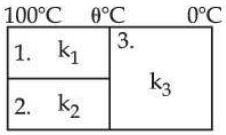
Q.49 The position vectors of two 1 kg particles, (A) and (B), are given by

$\vec{r}_A = \left(\alpha_1 t^2 \hat{i} + \alpha_2 t \hat{j} + \alpha_3 t \hat{k}\right)$ m and $\vec{r}_B = \left(\beta_1 t \hat{i} + \beta_2 t^2 \hat{j} + \beta_3 t \hat{k}\right)$ m, respectively;

($\alpha_1 = 1$ m/s^2, $\alpha_2 = 3n$ m/s, $\alpha_3 = 2$ m/s, $\beta_1 = 2$ m/s, $\beta_2 = -1$ m/s^2, $\beta_3 = 4p$ m/s), where t is time, n and p are constants. At t = 1 s, $\left|\vec{V}_A\right| = \left|\vec{V}_B\right|$ and velocities $\vec{V}_A$ and $\vec{V}_B$ of the particles are orthogonal to each other. At t = 1 s, the magnitude of angular momentum of particle (A) with respect to the position of particle (B) is $\sqrt{L}$ kgm^{2}s^{-1}. The value of L is _____.

Question Type : **SA**
Question ID : **656445121**

Q.50 Three conductors of same length having thermal conductivity k_1, k_2 and k_3 are connected as shown in figure.



Area of cross sections of 1st and 2nd conductor are same and for 3rd conductor it is double of the 1st conductor. The temperatures are given in the figure. In steady state condition, the value of θ is _____°C.

(Given : $k_1 = 60$ Js^{-1}m^{-1}K^{-1}, $k_2 = 120$ Js^{-1}m^{-1}K^{-1}, $k_3 = 135$ Js^{-1}m^{-1}K^{-1})

Question Type : **SA**
Question ID : **656445124**

Section : **Chemistry Section A**

Q.51

Match **List-I** with **List-II**.

	List-I		List-II
(A)	$Al^{3+} < Mg^{2+} < Na^{+} < F^{-}$	(I)	Ionisation Enthalpy
(B)	$B < C < O < N$	(II)	Metallic character
(C)	$B < Al < Mg < K$	(III)	Electronegativity
(D)	$Si < P < S < Cl$	(IV)	Ionic radii

Choose the **correct** answer from the options given below :

Options

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

Question Type : **MCQ**
Question ID : **656445134**
Option 1 ID : **656445461**
Option 2 ID : **656445459**
Option 3 ID : **656445460**
Option 4 ID : **656445458**

Q.52

The **incorrect** statements regarding geometrical isomerism are :

(A) Propene shows geometrical isomerism.
(B) Trans isomer has identical atoms/groups on the opposite sides of the double bond.
(C) Cis-but-2-ene has higher dipole moment than trans-but-2-ene.
(D) 2-methylbut-2-ene shows two geometrical isomers.
(E) Trans-isomer has lower melting point than cis isomer.

Choose the **correct** answer from the options given below :

Options

1. (C), (D) and (E) Only
2. (B) and (C) Only
3. (A), (D) and (E) Only
4. (A) and (E) Only

Question Type : **MCQ**
Question ID : **656445140**
Option 1 ID : **656445484**
Option 2 ID : **656445483**
Option 3 ID : **656445485**
Option 4 ID : **656445482**

Q.53 Which of the following statement is not true for radioactive decay ?

Options

1. Half life is ln 2 times of $\frac{1}{\text{rate constant}}$.

2. Amount of radioactive substance remained after three half lives is $\frac{1}{8}$ th of original amount.

3. Decay constant increases with increase in temperature.

4. Decay constant does not depend upon temperature.

Question Type : **MCQ**
Question ID : **656445132**
Option 1 ID : **656445450**
Option 2 ID : **656445452**
Option 3 ID : **656445453**
Option 4 ID : **656445451**

Q.54 Which of the following electronegativity order is **incorrect** ?

Options

1. $Al < Mg < B < N$

2. $Mg < Be < B < N$

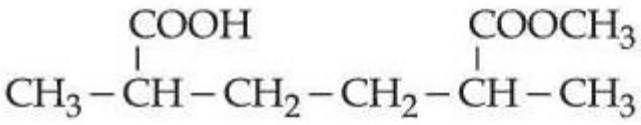
3. $Al < Si < C < N$

4. $S < Cl < O < F$

Question Type : **MCQ**
Question ID : **656445133**
Option 1 ID : **656445455**
Option 2 ID : **656445454**
Option 3 ID : **656445456**
Option 4 ID : **656445457**

Q.55

The IUPAC name of the following compound is :



Options

1. Methyl-6-carboxy-2,5-dimethylhexanoate.
2. 6-Methoxycarbonyl-2,5-dimethylhexanoic acid.
3. Methyl-5-carboxy-2-methylhexanoate.
4. 2-Carboxy-5-methoxycarbonylhexane.

Question Type : **MCQ**
Question ID : **656445138**
Option 1 ID : **656445474**
Option 2 ID : **656445477**
Option 3 ID : **656445476**
Option 4 ID : **656445475**

Q.56

Arrange the following solutions in order of their increasing boiling points.

(i) 10^{-4} M NaCl (ii) 10^{-4} M Urea
(iii) 10^{-3} M NaCl (iv) 10^{-2} M NaCl

Options

1. (i) < (ii) < (iii) < (iv)
2. (ii) < (i) < (iii) < (iv)
3. (iv) < (iii) < (i) < (ii)
4. (ii) < (i) ≡ (iii) < (iv)

Question Type : **MCQ**
Question ID : **656445128**
Option 1 ID : **656445434**
Option 2 ID : **656445437**
Option 3 ID : **656445436**
Option 4 ID : **656445435**

Q.57

Lanthanoid ions with $4f^7$ configuration are :

(A) Eu^{2+}

(B) Gd^{3+}

(C) Eu^{3+}

(D) Tb^{3+}

(E) Sm^{2+}

Choose the correct answer from the options given below :

Options

1. (A) and (B) only

2. (B) and (E) only

3. (A) and (D) only

4. (B) and (C) only

Question Type : **MCQ**
Question ID : **656445135**
Option 1 ID : **656445462**
Option 2 ID : **656445465**
Option 3 ID : **656445463**
Option 4 ID : **656445464**

Q.58

From the magnetic behaviour of $[NiCl_4]^{2-}$ (paramagnetic) and $[Ni(CO)_4]$ (diamagnetic), choose the correct geometry and oxidation state.

Options

1. $[NiCl_4]^{2-}$: Ni^{II}, square planar
   $[Ni(CO)_4]$: Ni(0), square planar

2. $[NiCl_4]^{2-}$: Ni^{II}, tetrahedral
   $[Ni(CO)_4]$: Ni(0), tetrahedral

3. $[NiCl_4]^{2-}$: Ni(0), tetrahedral
   $[Ni(CO)_4]$: Ni(0), square planar

4. $[NiCl_4]^{2-}$: Ni^{II}, tetrahedral
   $[Ni(CO)_4]$: Ni^{II}, square planar

Question Type : **MCQ**
Question ID : **656445136**
Option 1 ID : **656445466**
Option 2 ID : **656445467**
Option 3 ID : **656445469**
Option 4 ID : **656445468**

Q.59 A solution of aluminium chloride is electrolysed for 30 minutes using a current of 2A. The amount of the aluminium deposited at the cathode is _____.
[Given : molar mass of aluminium and chlorine are 27 g mol^{-1} and 35.5 g mol^{-1} respectively. Faraday constant = 96500 C mol^{-1}]

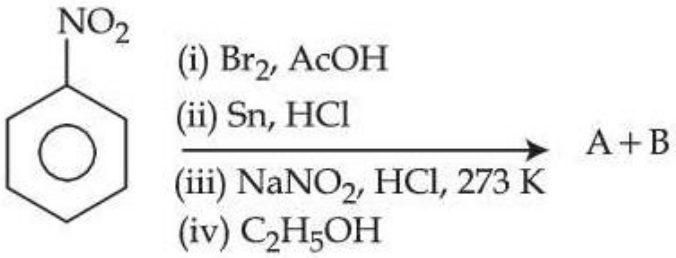
Options

1. 0.441 g
2. 1.660 g
3. 0.336 g
4. 1.007 g

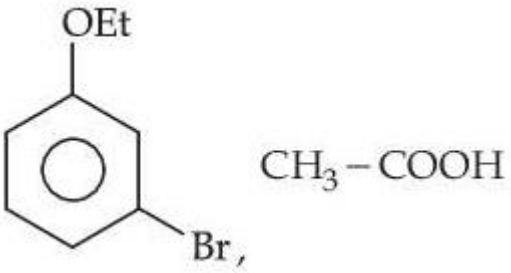
Question Type : **MCQ**
Question ID : **656445130**
Option 1 ID : **656445443**
Option 2 ID : **656445442**
Option 3 ID : **656445445**
Option 4 ID : **656445444**

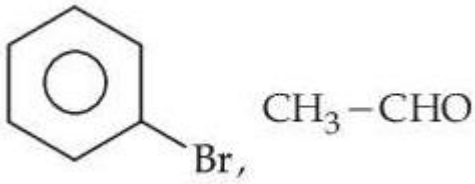
Q.60

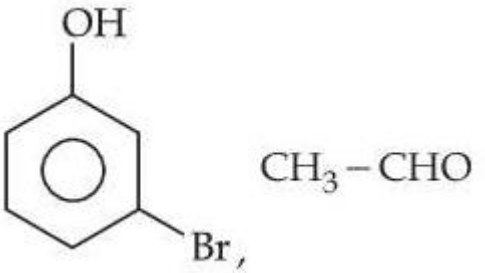
The products formed in the following reaction sequence are :

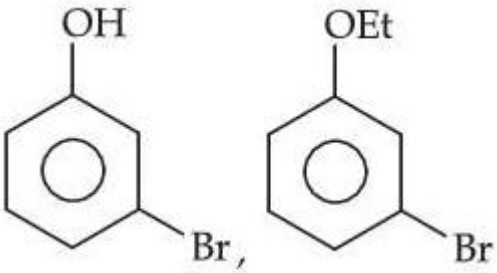


Options

1. 

2. 

3. 

4. 

Question Type : **MCQ**
Question ID : **656445143**
Option 1 ID : **656445497**
Option 2 ID : **656445495**
Option 3 ID : **656445496**
Option 4 ID : **656445494**

Q.61 A liquid when kept inside a thermally insulated closed vessel at 25°C was mechanically stirred from outside. What will be the correct option for the following thermodynamic parameters ?

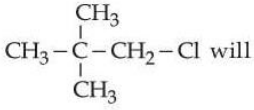
Options

1. $\Delta U = 0,\ q < 0,\ w > 0$
2. $\Delta U = 0,\ q = 0,\ w = 0$
3. $\Delta U > 0,\ q = 0,\ w > 0$
4. $\Delta U < 0,\ q = 0,\ w > 0$

Question Type : **MCQ**
Question ID : **656445127**
Option 1 ID : **656445433**
Option 2 ID : **656445432**
Option 3 ID : **656445430**
Option 4 ID : **656445431**

Q.62 Given below are two statements :

Statement I : $CH_3 - O - CH_2 - Cl$ will undergo S_N1 reaction though it is a primary halide.

Statement II :  will not undergo S_N2 reaction very easily though it is a primary halide.

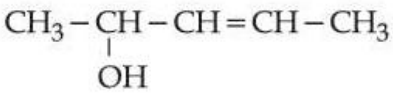
In the light of the above statements, choose the **most appropriate answer** from the options given below :

Options

1. Both **Statement I** and **Statement II** are incorrect
2. Both **Statement I** and **Statement II** are correct
3. **Statement I** is incorrect but **Statement II** is correct
4. **Statement I** is correct but **Statement II** is incorrect

Question Type : **MCQ**
Question ID : **656445142**
Option 1 ID : **656445491**
Option 2 ID : **656445490**
Option 3 ID : **656445493**
Option 4 ID : **656445492**

Q.63 How many different stereoisomers are possible for the given molecule ?



Options

1. 3
2. 1
3. 4
4. 2

Question Type : **MCQ**
Question ID : **656445139**
Option 1 ID : **656445479**
Option 2 ID : **656445481**
Option 3 ID : **656445478**
Option 4 ID : **656445480**

Q.64 Which of the following electrolyte can be used to obtain $H_2S_2O_8$ by the process of electrolysis ?

Options

1. Concentrated solution of sulphuric acid
2. Acidified dilute solution of sodium sulphate.
3. Dilute solution of sodium sulphate.
4. Dilute solution of sulphuric acid

Question Type : **MCQ**
Question ID : **656445131**
Option 1 ID : **656445447**
Option 2 ID : **656445448**
Option 3 ID : **656445449**
Option 4 ID : **656445446**

Q.65 A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of CO_2 is converted into CO on addition of graphite. If total pressure at equilibrium is 0.8 atm, then Kp is :

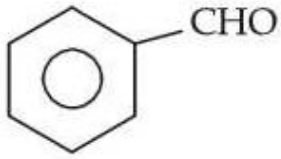
Options

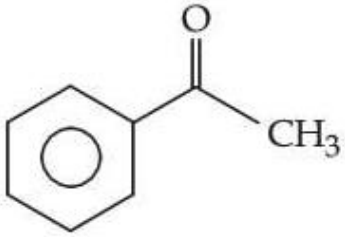
1. 0.18 atm
2. 1.8 atm
3. 0.3 atm
4. 3 atm

Question Type : **MCQ**
Question ID : **656445129**
Option 1 ID : **656445441**
Option 2 ID : **656445438**
Option 3 ID : **656445440**
Option 4 ID : **656445439**

Q.66

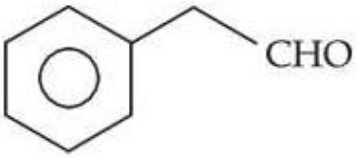
The compounds which give positive Fehling's test are :

(A) 

(B) 

(C) $HOCH_2-CO-(CHOH)_3-CH_2-OH$

(D) $CH_3-\overset{\overset{O}{\|}}{C}-H$

(E) 

Choose the **correct** answer from the options given below :

Options

1. (A), (C) and (D) Only

2. (C), (D) and (E) Only

3. (A), (D) and (E) Only

4. (A), (B) and (C) Only

Question Type : **MCQ**
Question ID : **656445145**
Option 1 ID : **656445504**
Option 2 ID : **656445502**
Option 3 ID : **656445503**
Option 4 ID : **656445505**

Q.67 In which of the following complexes the CFSE, Δ_o will be equal to zero ?

Options

1. $K_4[Fe(CN)_6]$
2. $K_3[Fe(SCN)_6]$
3. $[Fe(NH_3)_6]Br_2$
4. $[Fe(en)_3]Cl_3$

Question Type : **MCQ**
Question ID : **656445137**
Option 1 ID : **656445470**
Option 2 ID : **656445471**
Option 3 ID : **656445473**
Option 4 ID : **656445472**

Q.68 Which of the following acids is a vitamin ?

Options

1. Adipic acid
2. Ascorbic acid
3. Saccharic acid
4. Aspartic acid

Question Type : **MCQ**
Question ID : **656445144**
Option 1 ID : **656445500**
Option 2 ID : **656445499**
Option 3 ID : **656445501**
Option 4 ID : **656445498**

Q.69

Radius of the first excited state of Helium ion is given as :
$a_0 \rightarrow$ radius of first stationary state of hydrogen atom.

Options

1. $r = 4a_0$
2. $r = 2a_0$
3. $r = \frac{a_0}{4}$
4. $r = \frac{a_0}{2}$

Question Type : **MCQ**
Question ID : **656445126**
Option 1 ID : **656445426**
Option 2 ID : **656445429**
Option 3 ID : **656445428**
Option 4 ID : **656445427**

Q.70

Given below are two statements :

Statement I : One mole of propyne reacts with excess of sodium to liberate half a mole of H_2 gas.

Statement II : Four g of propyne reacts with $NaNH_2$ to liberate NH_3 gas which occupies 224 mL at STP.

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 incorrect
3. **Statement I** is correct but **Statement II** is incorrect
4. Both **Statement I** and **Statement II** are correct

Question Type : **MCQ**
Question ID : **656445141**
Option 1 ID : **656445489**
Option 2 ID : **656445487**
Option 3 ID : **656445488**
Option 4 ID : **656445486**

Section : **Chemistry Section B**

Q.71

In Carius method for estimation of halogens, 180 mg of an organic compound produced 143.5 mg of AgCl. The percentage composition of chlorine in the compound is _____%.
(Given : molar mass in g mol^{-1} of Ag : 108, Cl : 35.5)

Question Type : **SA**
Question ID : **656445149**

Q.72 Some CO_2 gas was kept in a sealed container at a pressure of 1 atm and at 273 K. This entire amount of CO_2 gas was later passed through an aqueous solution of $Ca(OH)_2$. The excess unreacted $Ca(OH)_2$ was later neutralized with 0.1 M of 40 mL HCl. If the volume of the sealed container of CO_2 was x, then x is _____ cm^3 (nearest integer).

[Given : The entire amount of $CO_2(g)$ reacted with exactly half the initial amount of $Ca(OH)_2$ present in the aqueous solution.]

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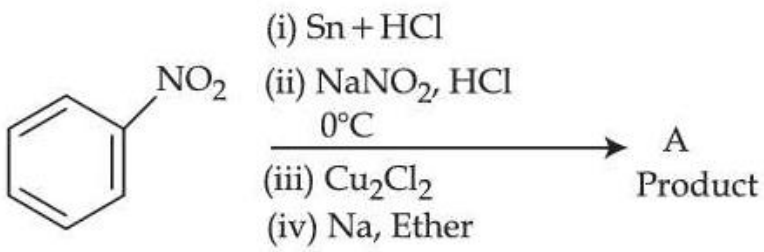
Q.73 Consider the following sequence of reactions :



Molar mass of the product formed (A) is _____ $g\ mol^{-1}$.

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Q.74

$$A \rightarrow B$$

The molecule A changes into its isomeric form B by following a first order kinetics at a temperature of 1000 K. If the energy barrier with respect to reactant energy for such isomeric transformation is 191.48 kJ mol^{-1} and the frequency factor is 10^{20}, the time required for 50% molecules of A to become B is _____ picoseconds (nearest integer). [R = 8.314 J K^{-1} mol^{-1}]

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Q.75 The number of molecules/ions that show linear geometry among the following is _____.

SO_2, $BeCl_2$, CO_2, N_3^-, NO_2, F_2O, XeF_2, NO_2^+, I_3^-, O_3

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Question ID : **656445147**