JEE April 2024

Test Date	08/04/2024
Test Time	9:00 AM - 12:00 PM
Subject	B. Tech

Section : **Mathematics Section A**

Q.1 The set of all α, for which the vectors $\vec{a} = \alpha t\,\hat{i} + 6\hat{j} - 3\hat{k}$ and $\vec{b} = t\,\hat{i} - 2\hat{j} - 2\alpha t\,\hat{k}$ are inclined at an obtuse angle for all $t \in \mathbb{R}$, is

Options

1. $[0, 1)$
2. $(-2, 0]$
3. $\left(-\frac{4}{3}, 1\right)$
4. $\left(-\frac{4}{3}, 0\right]$

Question Type : **MCQ**
Question ID : **68019114351**
Option 1 ID : **68019156059**
Option 2 ID : **68019156060**
Option 3 ID : **68019156062**
Option 4 ID : **68019156061**

Q.2 Let $f(x) = 4\cos^3 x + 3\sqrt{3}\cos^2 x - 10$. The number of points of local maxima of f in interval $(0, 2\pi)$ is

Options

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

Question Type : **MCQ**
Question ID : **68019114342**
Option 1 ID : **68019156026**
Option 2 ID : **68019156024**
Option 3 ID : **68019156023**
Option 4 ID : **68019156025**

Q.3 The value of $k \in \mathbb{N}$ for which the integral $I_n = \int_0^1 \left(1 - x^k\right)^n dx$, $n \in \mathbb{N}$, satisfies $147\, I_{20} = 148\, I_{21}$ is

Options
1. 14
2. 10
3. 7
4. 8

Question Type : **MCQ**
Question ID : **68019114344**
Option 1 ID : **68019156033**
Option 2 ID : **68019156032**
Option 3 ID : **68019156034**
Option 4 ID : **68019156031**

Q.4 The sum of all the solutions of the equation $(8)^{2x} - 16\cdot(8)^x + 48 = 0$ is :

Options
1. $1 + \log_6(8)$
2. $\log_8(6)$
3. $1 + \log_8(6)$
4. $\log_8(4)$

Question Type : **MCQ**
Question ID : **68019114336**
Option 1 ID : **68019156001**
Option 2 ID : **68019156000**
Option 3 ID : **68019156002**
Option 4 ID : **68019155999**

Q.5 Let the circles $C_1 : (x-\alpha)^2 + (y-\beta)^2 = r_1^2$ and $C_2 : (x-8)^2 + \left(y - \frac{15}{2}\right)^2 = r_2^2$ touch each other externally at the point (6, 6). If the point (6, 6) divides the line segment joining the centres of the circles C_1 and C_2 internally in the ratio 2:1, then $(\alpha+\beta) + 4\left(r_1^2 + r_2^2\right)$ equals

Options
1. 110
2. 130
3. 145
4. 125

Question Type : **MCQ**
Question ID : **68019114348**
Option 1 ID : **68019156047**
Option 2 ID : **68019156049**
Option 3 ID : **68019156050**
Option 4 ID : **68019156048**

Q.6 Let $P(x, y, z)$ be a point in the first octant, whose projection in the xy-plane is the point Q. Let $OP = \gamma$; the angle between OQ and the positive x-axis be θ; and the angle between OP and the positive z-axis be ϕ, where O is the origin. Then the distance of P from the x-axis is

Options

1. $\gamma\sqrt{1-\sin^2\phi\cos^2\theta}$
2. $\gamma\sqrt{1-\sin^2\theta\cos^2\phi}$
3. $\gamma\sqrt{1+\cos^2\theta\sin^2\phi}$
4. $\gamma\sqrt{1+\cos^2\phi\sin^2\theta}$

Question Type : **MCQ**
Question ID : **68019114350**
Option 1 ID : **68019156055**
Option 2 ID : **68019156056**
Option 3 ID : **68019156057**
Option 4 ID : **68019156058**

Q.7 For the function $f(x)=(\cos x)-x+1$, $x \in \mathbb{R}$, between the following two statements

(S1) $f(x) = 0$ for only one value of x in $[0, \pi]$.

(S2) $f(x)$ is decreasing in $\left[0, \frac{\pi}{2}\right]$ and increasing in $\left[\frac{\pi}{2}, \pi\right]$.

Options

1. Both (S1) and (S2) are correct.
2. Only (S1) is correct.
3. Only (S2) is correct.
4. Both (S1) and (S2) are incorrect.

Question Type : **MCQ**
Question ID : **68019114340**
Option 1 ID : **68019156015**
Option 2 ID : **68019156016**
Option 3 ID : **68019156017**
Option 4 ID : **68019156018**

Q.8 Let $A=\begin{bmatrix}2 & a & 0\\ 1 & 3 & 1\\ 0 & 5 & b\end{bmatrix}$. If $A^3 = 4A^2 - A - 21I$, where I is the identity matrix of order 3×3, then $2a + 3b$ is equal to

Options
1. -10
2. -9
3. -13
4. -12

Question Type : **MCQ**
Question ID : **68019114337**
Option 1 ID : **68019156006**
Option 2 ID : **68019156003**
Option 3 ID : **68019156004**
Option 4 ID : **68019156005**

Q.9 The equations of two sides AB and AC of a triangle ABC are $4x + y = 14$ and $3x - 2y = 5$, respectively. The point $\left(2,-\frac{4}{3}\right)$ divides the third side BC internally in the ratio 2:1. the equation of the side BC is

Options
1. $x + 6y + 6 = 0$
2. $x - 3y - 6 = 0$
3. $x + 3y + 2 = 0$
4. $x - 6y - 10 = 0$

Question Type : **MCQ**
Question ID : **68019114338**
Option 1 ID : **68019156009**
Option 2 ID : **68019156008**
Option 3 ID : **68019156007**
Option 4 ID : **68019156010**

Q.10 If the set $R=\{(a,b): a+5b=42, a,b\in\mathbb{N}\}$ has m elements and $\sum_{n=1}^{m}\left(1-i^{n!}\right)=x+iy$, where $i=\sqrt{-1}$, then the value of $m+x+y$ is

Options
1. 5
2. 12
3. 4
4. 8

Question Type : **MCQ**
Question ID : **68019114339**
Option 1 ID : **68019156013**
Option 2 ID : **68019156011**
Option 3 ID : **68019156014**
Option 4 ID : **68019156012**

Q.11 Let $H:\frac{-x^2}{a^2}+\frac{y^2}{b^2}=1$ be the hyperbola, whose eccentricity is $\sqrt{3}$ and the length of the latus rectum is $4\sqrt{3}$. Suppose the point $(\alpha, 6)$, $\alpha > 0$ lies on H. If β is the product of the focal distances of the point $(\alpha, 6)$, then $\alpha^2 + \beta$ is equal to

Options
1. 170
2. 169
3. 171
4. 172

Question Type : **MCQ**
Question ID : **68019114349**
Option 1 ID : **68019156052**
Option 2 ID : **68019156051**
Option 3 ID : **68019156053**
Option 4 ID : **68019156054**

Q.12 Let $I(x)=\int \frac{6}{\sin^2 x(1-\cot x)^2}dx$. If $I(0) = 3$, then $I\left(\frac{\pi}{12}\right)$ is equal to

Options
1. $3\sqrt{3}$
2. $\sqrt{3}$
3. $6\sqrt{3}$
4. $2\sqrt{3}$

Question Type : **MCQ**
Question ID : **68019114343**
Option 1 ID : **68019156028**
Option 2 ID : **68019156030**
Option 3 ID : **68019156029**
Option 4 ID : **68019156027**

Q.13 Let z be a complex number such that $|z + 2| = 1$ and $\text{Im}\left(\frac{z+1}{z+2}\right)=\frac{1}{5}$. Then the value of $\left|\text{Re}\left(\overline{z+2}\right)\right|$ is

Options
1. $\frac{1+\sqrt{6}}{5}$
2. $\frac{2\sqrt{6}}{5}$
3. $\frac{24}{5}$
4. $\frac{\sqrt{6}}{5}$

Question Type : **MCQ**
Question ID : **68019114335**
Option 1 ID : **68019155998**
Option 2 ID : **68019155995**
Option 3 ID : **68019155996**
Option 4 ID : **68019155997**

Q.14 If $\sin x = -\frac{3}{5}$, where $\pi < x < \frac{3\pi}{2}$, then $80(\tan^2 x - \cos x)$ is equal to

Options
1. 109
2. 18
3. 19
4. 108

Question Type : **MCQ**
Question ID : **68019114353**
Option 1 ID : **68019156067**
Option 2 ID : **68019156070**
Option 3 ID : **68019156069**
Option 4 ID : **68019156068**

Q.15 Let $[t]$ be the greatest integer less than or equal to t. Let A be the set of all prime factors of 2310 and $f : A \to \mathbb{Z}$ be the function $f(x) = \left[\log_2\left(x^2 + \left[\frac{x^3}{5}\right]\right)\right]$. The number of one-to-one functions from A to the range of f is

Options
1. 25
2. 120
3. 24
4. 20

Question Type : **MCQ**
Question ID : **68019114334**
Option 1 ID : **68019155994**
Option 2 ID : **68019155993**
Option 3 ID : **68019155992**
Option 4 ID : **68019155991**

Q.16 Let $y = y(x)$ be the solution of the differential equation $(1+y^2)e^{\tan x}\,dx + \cos^2 x\,(1 + e^{2\tan x})\,dy = 0$, $y(0) = 1$. Then $y\left(\frac{\pi}{4}\right)$ is equal to

Options
1. $\frac{2}{e}$
2. $\frac{1}{e^2}$
3. $\frac{2}{e^2}$
4. $\frac{1}{e}$

Question Type : **MCQ**
Question ID : **68019114346**
Option 1 ID : **68019156041**
Option 2 ID : **68019156039**
Option 3 ID : **68019156042**
Option 4 ID : **68019156040**

Q.17 Let $f(x)$ be a positive function such that the area bounded by $y = f(x)$, $y = 0$ from $x = 0$ to $x = a > 0$ is $e^{-a} + 4a^2 + a - 1$. Then the differential equation, whose general solution is $y = c_1 f(x) + c_2$, where c_1 and c_2 are arbitrary constants, is

Options

1. $\left(8e^x + 1\right)\frac{d^2y}{dx^2} + \frac{dy}{dx} = 0$
2. $\left(8e^x - 1\right)\frac{d^2y}{dx^2} + \frac{dy}{dx} = 0$
3. $\left(8e^x - 1\right)\frac{d^2y}{dx^2} - \frac{dy}{dx} = 0$
4. $\left(8e^x + 1\right)\frac{d^2y}{dx^2} - \frac{dy}{dx} = 0$

Question Type : **MCQ**
Question ID : **68019114345**
Option 1 ID : **68019156037**
Option 2 ID : **68019156036**
Option 3 ID : **68019156035**
Option 4 ID : **68019156038**

Q.18 The number of critical points of the function $f(x) = (x - 2)^{2/3}(2x + 1)$ is

Options

1. 3
2. 1
3. 2
4. 0

Question Type : **MCQ**
Question ID : **68019114341**
Option 1 ID : **68019156022**
Option 2 ID : **68019156020**
Option 3 ID : **68019156021**
Option 4 ID : **68019156019**

Q.19 Let the sum of two positive integers be 24. If the probability, that their product is not less than $\frac{3}{4}$ times their greatest possible product, is $\frac{m}{n}$, where $\gcd(m, n) = 1$, then $n - m$ equals

Options

1. 8
2. 10
3. 9
4. 11

Question Type : **MCQ**
Question ID : **68019114352**
Option 1 ID : **68019156064**
Option 2 ID : **68019156066**
Option 3 ID : **68019156065**
Option 4 ID : **68019156063**

Q.20 If the shortest distance between the lines

$$L_1 : \vec{r} = (2+\lambda)\hat{i} + (1-3\lambda)\hat{j} + (3+4\lambda)\hat{k}, \qquad \lambda \in \mathbb{R}$$

$$L_2 : \vec{r} = 2(1+\mu)\hat{i} + 3(1+\mu)\hat{j} + (5+\mu)\hat{k}, \qquad \mu \in \mathbb{R}$$

is $\frac{m}{\sqrt{n}}$, where gcd$(m, n) = 1$, then the value of $m + n$ equals

Options
1. 377
2. 390
3. 387
4. 384

Question Type : **MCQ**
Question ID : **68019114347**
Option 1 ID : **68019156043**
Option 2 ID : **68019156045**
Option 3 ID : **68019156046**
Option 4 ID : **68019156044**

Section : **Mathematics Section B**

Q.21 The value of $\lim\limits_{x\to 0} 2\left(\frac{1-\cos x\sqrt{\cos 2x}\sqrt[3]{\cos 3x}.....\sqrt[10]{\cos 10x}}{x^2}\right)$ is _____.

Question Type : **SA**
Question ID : **68019114359**

Q.22 Let $\alpha = \sum\limits_{r=0}^{n}\left(4r^2+2r+1\right)\ {}^{n}C_r$ and $\beta = \left(\sum\limits_{r=0}^{n}\frac{{}^{n}C_r}{r+1}\right) + \frac{1}{n+1}$. If $140 < \frac{2\alpha}{\beta} < 281$, then the value of n is _____.

Question Type : **SA**
Question ID : **68019114357**

Q.23 If the orthocentre of the triangle formed by the lines $2x + 3y - 1 = 0$, $x + 2y - 1 = 0$ and $ax + by - 1 = 0$, is the centroid of another triangle, whose circumcentre and orthocentre respectively are $(3, 4)$ and $(-6, -8)$, then the value of $|a - b|$ is _____.

Question Type : **SA**
Question ID : **68019114362**

Q.24 Let $A = \begin{bmatrix} 2 & -1 \\ 1 & 1 \end{bmatrix}$. If the sum of the diagonal elements of A^{13} is 3^n, then n is equal to _____.

Question Type : **SA**
Question ID : **68019114355**

Q.25 Three balls are drawn at random from a bag containing 5 blue and 4 yellow balls. Let the random variables X and Y respectively denote the number of blue and yellow balls. If $\bar{X}$ and $\bar{Y}$ are the means of X and Y respectively, then $7\bar{X}+4\bar{Y}$ is equal to _____.

Question Type : **SA**
Question ID : **68019114363**

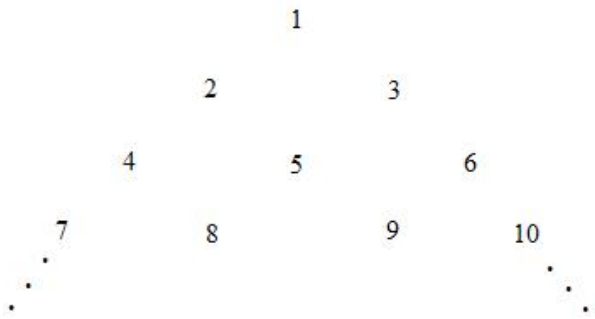
Q.26 If the range of $f(\theta)=\frac{\sin^4\theta+3\cos^2\theta}{\sin^4\theta+\cos^2\theta}$, $\theta\in\mathbb{R}$ is $[\alpha, \beta]$, then the sum of the infinite G.P., whose first term is 64 and the common ratio is $\frac{\alpha}{\beta}$, is equal to _____.

Question Type : **SA**
Question ID : **68019114354**

Q.27 Let the area of the region enclosed by the curve $y=\min\{\sin x, \cos x\}$ and the x-axis between $x=-\pi$ to $x=\pi$ be A. Then A^2 is equal to _____.

Question Type : **SA**
Question ID : **68019114360**

Q.28 Let the positive integers be written in the form :



If the k^{th} row contains exactly k numbers for every natural number k, then the row in which the number 5310 will be, is _____.

Question Type : **SA**
Question ID : **68019114358**

Q.29 Let $\vec{a}=9\hat{i}-13\hat{j}+25\hat{k}, \vec{b}=3\hat{i}+7\hat{j}-13\hat{k}$ and $\vec{c}=17\hat{i}-2\hat{j}+\hat{k}$ be three given vectors. If $\vec{r}$ is a vector such that $\vec{r}\times\vec{a}=(\vec{b}+\vec{c})\times\vec{a}$ and $\vec{r}\cdot(\vec{b}-\vec{c})=0$, then $\frac{|593\vec{r}+67\vec{a}|^2}{(593)^2}$ is equal to _____.

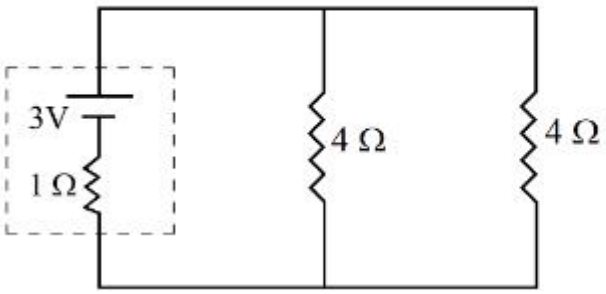
Question Type : **SA**
Question ID : **68019114361**

Q.30 The number of 3-digit numbers, formed using the digits 2, 3, 4, 5 and 7, when the repetition of digits is not allowed, and which are not divisible by 3, is equal to _____.

Question Type : **SA**
Question ID : **68019114356**

Section : **Physics Section A**

Q.31 In the given circuit, the terminal potential difference of the cell is :



Options
1. 3 V
2. 2 V
3. 1.5 V
4. 4 V

Question Type : **MCQ**
Question ID : **68019114373**
Option 1 ID : **68019156118**
Option 2 ID : **68019156117**
Option 3 ID : **68019156120**
Option 4 ID : **68019156119**

Q.32 Average force exerted on a non-reflecting surface at normal incidence is 2.4×10^{-4} N. If 360 W/cm^2 is the light energy flux during span of 1 hour 30 minutes, Then the area of the surface is:

Options
1. 0.2 m^2
2. 0.1 m^2
3. 0.02 m^2
4. 20 m^2

Question Type : **MCQ**
Question ID : **68019114375**
Option 1 ID : **68019156125**
Option 2 ID : **68019156126**
Option 3 ID : **68019156127**
Option 4 ID : **68019156128**

Q.33 A mixture of one mole of monoatomic gas and one mole of a diatomic gas (rigid) are kept at room temperature (27°C). The ratio of specific heat of gases at constant volume respectively is:

Options

1. $\frac{3}{2}$
2. $\frac{5}{3}$
3. $\frac{7}{5}$
4. $\frac{3}{5}$

Question Type : **MCQ**
Question ID : **68019114372**
Option 1 ID : **68019156113**
Option 2 ID : **68019156116**
Option 3 ID : **68019156115**
Option 4 ID : **68019156114**

Q.34 Binding energy of a certain nucleus is 18×10^8 J. How much is the difference between total mass of all the nucleons and nuclear mass of the given nucleus:

Options

1. 20 μg
2. 0.2 μg
3. 2 μg
4. 10 μg

Question Type : **MCQ**
Question ID : **68019114379**
Option 1 ID : **68019156142**
Option 2 ID : **68019156144**
Option 3 ID : **68019156141**
Option 4 ID : **68019156143**

Q.35 Correct Bernoulli's equation is (symbols have their usual meaning) :

Options

1. $P + mgh + \frac{1}{2}mv^2 = \text{constant}$
2. $P + \frac{1}{2}\rho gh + \frac{1}{2}\rho v^2 = \text{constant}$
3. $P + \rho gh + \rho v^2 = \text{constant}$
4. $P + \rho gh + \frac{1}{2}\rho v^2 = \text{constant}$

Question Type : **MCQ**
Question ID : **68019114369**
Option 1 ID : **68019156101**
Option 2 ID : **68019156102**
Option 3 ID : **68019156104**
Option 4 ID : **68019156103**

Q.36 Two charged conducting spheres of radii a and b are connected to each other by a conducting wire. The ratio of charges of the two spheres respectively is:

Options

1. $\frac{a}{b}$
2. $\sqrt{ab}$
3. $\frac{b}{a}$
4. ab

Question Type : **MCQ**
Question ID : **68019114378**
Option 1 ID : **68019156137**
Option 2 ID : **68019156140**
Option 3 ID : **68019156138**
Option 4 ID : **68019156139**

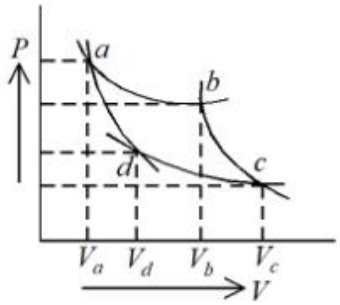
Q.37 A stationary particle breaks into two parts of masses m_A and m_B which move with velocities v_A and v_B respectively. The ratio of their kinetic energies $(K_B : K_A)$ is :

Options

1. $m_B : m_A$
2. $1 : 1$
3. $m_B v_B : m_A v_A$
4. $v_B : v_A$

Question Type : **MCQ**
Question ID : **68019114366**
Option 1 ID : **68019156090**
Option 2 ID : **68019156092**
Option 3 ID : **68019156091**
Option 4 ID : **68019156089**

Q.38 Two different adiabatic paths for the same gas intersect two isothermal curves as shown in P-V diagram. The relation between the ratio $\frac{V_a}{V_d}$ and the ratio $\frac{V_b}{V_c}$ is:



Options

1. $\frac{V_a}{V_d} = \left(\frac{V_b}{V_c}\right)^2$
2. $\frac{V_a}{V_d} = \left(\frac{V_b}{V_c}\right)^{-1}$
3. $\frac{V_a}{V_d} = \frac{V_b}{V_c}$
4. $\frac{V_a}{V_d} \neq \frac{V_b}{V_c}$

Question Type : **MCQ**
Question ID : **68019114370**
Option 1 ID : **68019156108**
Option 2 ID : **68019156107**
Option 3 ID : **68019156105**
Option 4 ID : **68019156106**

Q.39 Two planets A and B having masses m_1 and m_2 move around the sun in circular orbits of r_1 and r_2 radii respectively. If angular momentum of A is L and that of B is 3L, the ratio of time period $\left(\frac{T_A}{T_B}\right)$ is:

Options

1. $\left(\frac{r_2}{r_1}\right)^{\frac{3}{2}}$
2. $\frac{1}{27}\left(\frac{m_2}{m_1}\right)^3$
3. $27\left(\frac{m_1}{m_2}\right)^3$
4. $\left(\frac{r_1}{r_2}\right)^3$

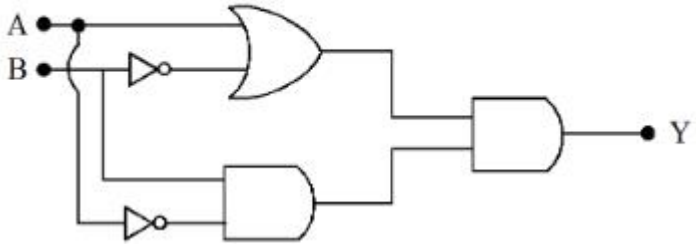
Question Type : **MCQ**
Question ID : **68019114371**
Option 1 ID : **68019156112**
Option 2 ID : **68019156109**
Option 3 ID : **68019156110**
Option 4 ID : **68019156111**

Q.40 Young's modulus is determined by the equation given by $Y = 49000\frac{m}{l}\frac{dyne}{cm^2}$ where M is the mass and l is the extension of wire used in the experiment. Now error in Young modules(Y) is estimated by taking data from M-l plot in graph paper. The smallest scale divisions are 5 g and 0.02 cm along load axis and extension axis respectively. If the value of M and l are 500 g and 2 cm respectively then percentage error of Y is :

Options
1. $0.5\ \%$
2. $0.02\ \%$
3. $2\ \%$
4. $0.2\ \%$

Question Type : **MCQ**
Question ID : **68019114381**
Option 1 ID : **68019156152**
Option 2 ID : **68019156149**
Option 3 ID : **68019156151**
Option 4 ID : **68019156150**

Q.41 The output Y of following circuit for given inputs is :



Options
1. $\bar{A} \cdot B$
2. 0
3. $A \cdot B$
4. $A \cdot B(A + B)$

Question Type : **MCQ**
Question ID : **68019114380**
Option 1 ID : **68019156147**
Option 2 ID : **68019156145**
Option 3 ID : **68019156146**
Option 4 ID : **68019156148**

Q.42 Three bodies A, B and C have equal kinetic energies and their masses are 400 g, 1.2 kg and 1.6 kg respectively. The ratio of their linear momenta is :

Options
1. $\sqrt{2}:\sqrt{3}:1$
2. $\sqrt{3}:\sqrt{2}:1$
3. $1:\sqrt{3}:2$
4. $1:\sqrt{3}:\sqrt{2}$

Question Type : **MCQ**
Question ID : **68019114368**
Option 1 ID : **68019156100**
Option 2 ID : **68019156099**
Option 3 ID : **68019156097**
Option 4 ID : **68019156098**

Q.43 In an expression $a \times 10^b$:

Options
1. b is order of magnitude for $5 < a \leq 10$
2. b is order of magnitude for $a \leq 5$
3. a is order of magnitude for $b \leq 5$
4. b is order of magnitude for $a \geq 5$

Question Type : **MCQ**
Question ID : **68019114364**
Option 1 ID : **68019156082**
Option 2 ID : **68019156083**
Option 3 ID : **68019156081**
Option 4 ID : **68019156084**

Q.44 A clock has 75 cm, 60 cm long second hand and minute hand respectively. In 30 minutes duration the tip of second hand will travel x distance more than the tip of minute hand. The value of x in meter is nearly (Take $\pi = 3.14$) :

Options
1. 118.9
2. 139.4
3. 140.5
4. 220.0

Question Type : **MCQ**
Question ID : **68019114365**
Option 1 ID : **68019156085**
Option 2 ID : **68019156086**
Option 3 ID : **68019156087**
Option 4 ID : **68019156088**

Q.45 The diameter of a sphere is measured using a vernier caliper whose 9 divisions of main scale are equal to 10 divisions of vernier scale. The shortest division on the main scale is equal to 1mm. The main scale reading is 2 cm and second division of vernier scale coincides with a division on main scale. If mass of the sphere is 8.635 g, the density of the sphere is:

Options
1. $2.5\ g/cm^3$
2. $2.2\ g/cm^3$
3. $2.0\ g/cm^3$
4. $1.7\ g/cm^3$

Question Type : **MCQ**
Question ID : **68019114382**
Option 1 ID : **68019156155**
Option 2 ID : **68019156156**
Option 3 ID : **68019156153**
Option 4 ID : **68019156154**

Q.46 Paramagnetic substances:

A. align themselves along the directions of external magnetic field.
B. attract strongly towards external magnetic field.
C. has susceptibility little more than zero.
D. move from a region of strong magnetic field to weak magnetic field.

Choose the **most appropriate** answer from the options given below:

Options
1. A, C Only
2. A, B, C, D
3. A, B, C Only
4. B, D Only

Question Type : **MCQ**
Question ID : **68019114374**
Option 1 ID : **68019156122**
Option 2 ID : **68019156124**
Option 3 ID : **68019156121**
Option 4 ID : **68019156123**

Q.47 A proton and an electron are associated with same de-Broglie wavelength. The ratio of their kinetic energies is:

(Assume h=6.63 × 10^{-34} J s, m_e = 9.0 × 10^{-31} kg and m_p = 1836 times m_e)

Options

1. $1:\sqrt{1836}$
2. $1:\frac{1}{\sqrt{1836}}$
3. $1:1836$
4. $1:\frac{1}{1836}$

Question Type : **MCQ**
Question ID : **68019114377**
Option 1 ID : **68019156134**
Option 2 ID : **68019156136**
Option 3 ID : **68019156133**
Option 4 ID : **68019156135**

Q.48 Critical angle of incidence for a pair of optical media is 45°. The refractive indices of first and second media are in the ratio:

Options

1. $\sqrt{2}:1$
2. $2:1$
3. $1:\sqrt{2}$
4. $1:2$

Question Type : **MCQ**
Question ID : **68019114376**
Option 1 ID : **68019156131**
Option 2 ID : **68019156129**
Option 3 ID : **68019156130**
Option 4 ID : **68019156132**

Q.49 A LCR circuit is at resonance for a capacitor C, inductance L and resistance R. Now the value of resistance is halved keeping all other parameters same. The current amplitude at resonance will be now:

Options

1. Zero
2. halved
3. same
4. double

Question Type : **MCQ**
Question ID : **68019114383**
Option 1 ID : **68019156160**
Option 2 ID : **68019156159**
Option 3 ID : **68019156157**
Option 4 ID : **68019156158**

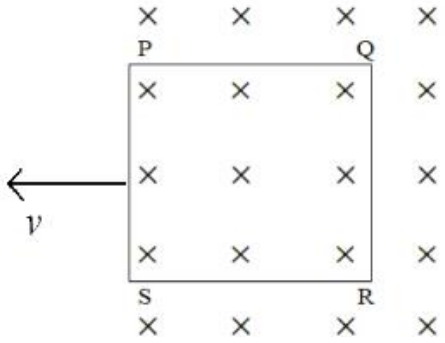
Q.50 A player caught a cricket ball of mass 150 g moving at a speed of 20 m/s. If the catching process is completed in 0.1 s, the magnitude of force exerted by the ball on the hand of the player is:

Options
1. 150 N
2. 3 N
3. 300 N
4. 30 N

Question Type : **MCQ**
Question ID : **68019114367**
Option 1 ID : **68019156093**
Option 2 ID : **68019156094**
Option 3 ID : **68019156096**
Option 4 ID : **68019156095**

Section : **Physics Section B**

Q.51 A square loop PQRS having 10 turns, area 3.6×10^{-3} m^2 and resistance 100 Ω is slowly and uniformly being pulled out of a uniform magnetic field of magnitude B=0.5 T as shown. Work done in pulling the loop out of the field in 1.0 s is _____ $\times 10^{-6}$ J.



Question Type : **SA**
Question ID : **68019114393**

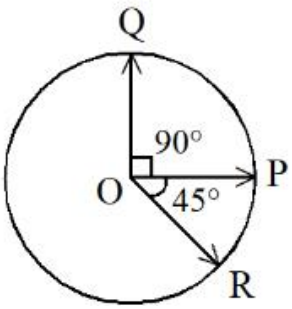
Q.52 A closed and an open organ pipe have same lengths. If the ratio of frequencies of their seventh overtones is $\left(\frac{a-1}{a}\right)$ then the value of a is _____.

Question Type : **SA**
Question ID : **68019114387**

Q.53 A liquid column of height 0.04 cm balances excess pressure of a soap bubble of certain radius. If density of liquid is 8×10^{3} kg m^{-3} and surface tension of soap solution is 0.28 Nm^{-1}, then diameter of the soap bubble is_____ cm.
(if g = 10 m s^{-2})

Question Type : **SA**
Question ID : **68019114386**

Q.54 Three vectors $\vec{OP}, \vec{OQ}$ and $\vec{OR}$ each of magnitude A are acting as shown in figure. The resultant of the three vectors is $A\sqrt{x}$. The value of x is _____.



Question Type : **SA**
Question ID : **68019114384**

Q.55 Resistance of a wire at 0 °C, 100 °C and t °C is found to be 10 Ω, 10.2 Ω and 10.95 Ω respectively. The temperature t in Kelvin scale is _____.

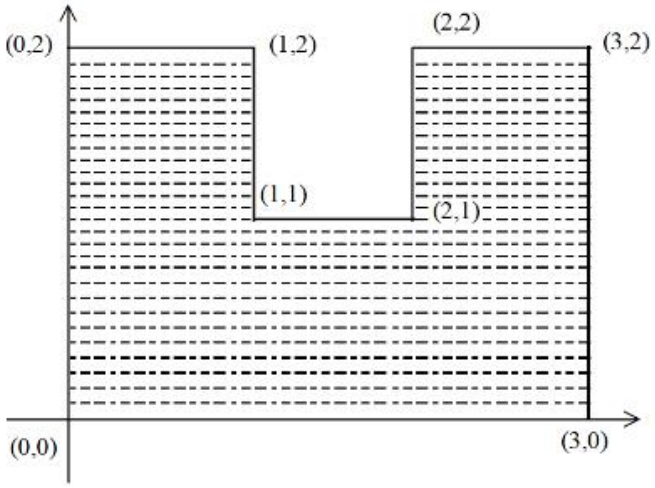
Question Type : **SA**
Question ID : **68019114389**

Q.56 In an alpha particle scattering experiment distance of closest approach for the α particle is 4.5×10^{-14}m. If target nucleus has atomic number 80, then maximum velocity of α- particle is_____ $\times 10^5$ m/s approximately.

($\frac{1}{4\pi \epsilon_0} = 9\times10^9$ SI unit, mass of α particle= 6.72×10^{-27} kg)

Question Type : **SA**
Question ID : **68019114391**

Q.57 A uniform thin metal plate of mass 10 kg with dimensions is shown. The ratio of x and y coordinates of center of mass of plate in $\frac{n}{9}$. The value of n is_____.



Question Type : **SA**
Question ID : **68019114385**

Q.58 An electric field, $\vec{E} = \frac{2\hat{i}+6\hat{j}+8\hat{k}}{\sqrt{6}}$ passes through the surface of 4 m^2 area having unit vector $\hat{n} = \left(\frac{2\hat{i}+\hat{j}+\hat{k}}{\sqrt{6}}\right)$. The electric flux for that surface is _____ V m.

Question Type : **SA**
Question ID : **68019114388**

Q.59 An electron with kinetic energy 5 eV enters a region of uniform magnetic field of 3 μT perpendicular to its direction. An electric field E is applied perpendicular to the direction of velocity and magnetic field. The value of E, so that electron moves along the same path, is _____ NC^{-1}.

(Given, mass of electron = 9×10^{-31} kg, electric charge = 1.6×10^{-19}C)

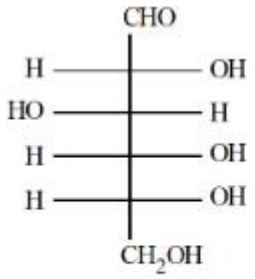
Question Type : **SA**
Question ID : **68019114390**

Q.60 A parallel beam of monochromatic light of wavelength 600 nm passes through single slit of 0.4 mm width. Angular divergence corresponding to second order minima would be _____ $\times 10^{-3}$ rad.

Question Type : **SA**
Question ID : **68019114392**

Section : **Chemistry Section A**

Q.61



The **incorrect** statement regarding the given structure is

Options
1. has 4 asymmetric carbon atom
2. despite the presence of –CHO does not give Schiff's test
3. can be oxidized to a dicarboxylic acid with Br_2 water
4. will coexist in equilibrium with 2 other cyclic structure

Question Type : **MCQ**
Question ID : **68019114413**
Option 1 ID : **68019156247**
Option 2 ID : **68019156249**
Option 3 ID : **68019156248**
Option 4 ID : **68019156250**

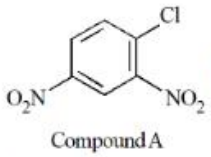
Q.62 Number of Complexes with even number of electrons in t_{2g} orbitals is -

$[Fe(H_2O)_6]^{2+}$, $[Co(H_2O)_6]^{2+}$, $[Co(H_2O)_6]^{3+}$, $[Cu(H_2O)_6]^{2+}$, $[Cr(H_2O)_6]^{2+}$

Options
1. 2
2. 1
3. 5
4. 3

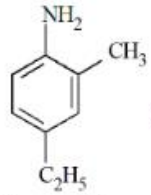
Question Type : **MCQ**
Question ID : **68019114404**
Option 1 ID : **68019156211**
Option 2 ID : **68019156214**
Option 3 ID : **68019156212**
Option 4 ID : **68019156213**

Q.63 Given below are two statements:

Statement I:  IUPAC name of Compound A is

Compound A

4-chloro-1,3-dinitrobenzene.

Statement II:  IUPAC name of Compound B is

Compound B

4-ethyl-2-methylaniline.

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

Question Type : **MCQ**
Question ID : **68019114407**
Option 1 ID : **68019156223**
Option 2 ID : **68019156225**
Option 3 ID : **68019156224**
Option 4 ID : **68019156226**

Q.64 Match **List I** with **List II**

LIST I (Elements)		**LIST II (Properties in their respective groups)**	
A.	Cl, S	I.	Elements with highest electronegativity
B.	Ge, As	II.	Elements with largest atomic size
C.	Fr, Ra	III.	Elements which show properties of both metals and non-metal
D.	F, O	IV.	Elements with highest negative electron gain enthalpy

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

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

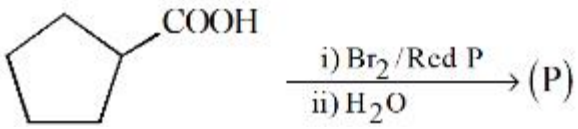
Question Type : **MCQ**
Question ID : **68019114401**
Option 1 ID : **68019156199**
Option 2 ID : **68019156202**
Option 3 ID : **68019156200**
Option 4 ID : **68019156201**

Q.65 An octahedral complex with the formula $CoCl_3.nNH_3$ upon reaction with excess of $AgNO_3$ solution gives 2 moles of AgCl. Consider the oxidation state of Co in the complex is 'x'. The value of "x + n" is _____.

Options
1. 6
2. 5
3. 8
4. 3

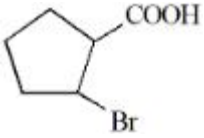
Question Type : **MCQ**
Question ID : **68019114403**
Option 1 ID : **68019156208**
Option 2 ID : **68019156209**
Option 3 ID : **68019156210**
Option 4 ID : **68019156207**

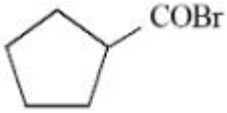
Q.66 Identify the product (P) in the following reaction:

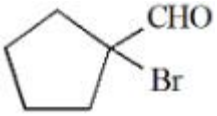


Options

1. 

2. 

3. 

4. 

Question Type : **MCQ**
Question ID : **68019114412**
Option 1 ID : **68019156243**
Option 2 ID : **68019156245**
Option 3 ID : **68019156244**
Option 4 ID : **68019156246**

Q.67 Combustion of glucose ($C_6H_{12}O_6$) produces CO_2 and water. The amount of oxygen (in g) required for the complete combustion of 900 g of glucose is :

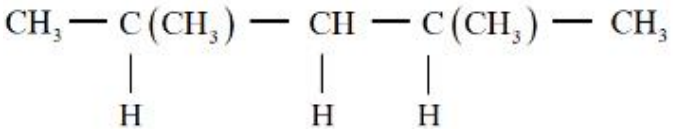
[Molar mass of glucose in g mol^{-1} = 180]

Options

1. 32
2. 960
3. 800
4. 480

Question Type : **MCQ**
Question ID : **68019114394**
Option 1 ID : **68019156171**
Option 2 ID : **68019156173**
Option 3 ID : **68019156172**
Option 4 ID : **68019156174**

Q.68 In the given compound, the number of 2° carbon atom/s is _____.



Options
1. Two
2. Four
3. Three
4. One

Question Type : **MCQ**
Question ID : **68019114408**
Option 1 ID : **68019156229**
Option 2 ID : **68019156227**
Option 3 ID : **68019156228**
Option 4 ID : **68019156230**

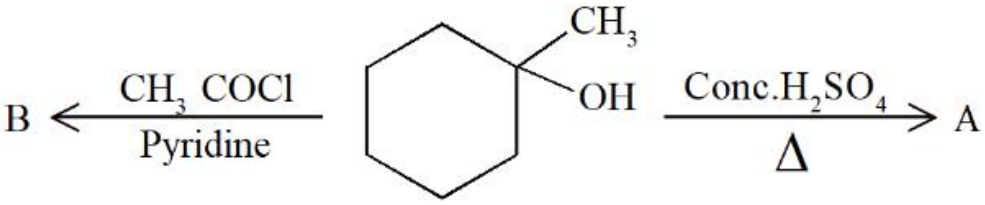
Q.69 Give below are two statements: One is labelled as **Assertion A** and the other is labelled as **Reason R**:
Assertion A: The stability order of +1 oxidation state of Ga, In and Tl is Ga < In < Tl.
Reason R: The inert pair effect stabilizes the lower oxidation state down the group.

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

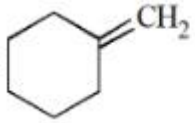
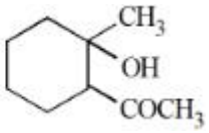
Options
1. Both **A** and **R** are true but **R** is NOT the correct explanation of **A**.
2. Both **A** and **R** are true and **R** is the correct explanation of **A**.
3. **A** is false but **R** is true.
4. **A** is true but **R** is false.

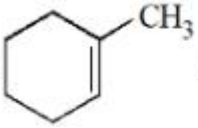
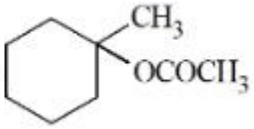
Question Type : **MCQ**
Question ID : **68019114399**
Option 1 ID : **68019156192**
Option 2 ID : **68019156191**
Option 3 ID : **68019156194**
Option 4 ID : **68019156193**

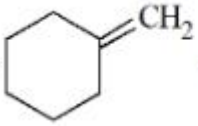
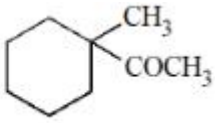
Q.70 Identify the major products A and B respectively in the following set of reactions.

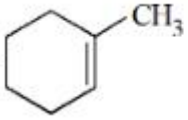
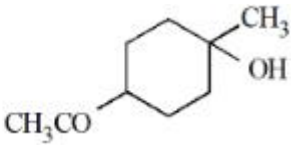


Options

1. A =  and B = 

2. A =  and B = 

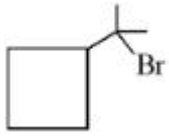
3. A =  and B = 

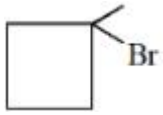
4. A =  and B = 

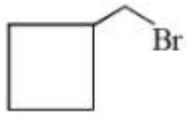
Question Type : **MCQ**
Question ID : **68019114411**
Option 1 ID : **68019156239**
Option 2 ID : **68019156240**
Option 3 ID : **68019156242**
Option 4 ID : **68019156241**

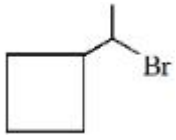
Q.71 Which among the following compounds will undergo fastest S_N2 reaction.

Options

1. 

2. 

3. 

4. 

Question Type : **MCQ**
Question ID : **68019114410**
Option 1 ID : **68019156236**
Option 2 ID : **68019156235**
Option 3 ID : **68019156237**
Option 4 ID : **68019156238**

Q.72 Match **List I** with **List II**

	LIST I (Molecule)		LIST II (Shape)
A.	NH_3	I.	Square pyramid
B.	BrF_5	II.	Tetrahedral
C.	PCl_5	III.	Trigonal pyramidal
D.	CH_4	IV.	Trigonal bipyramidal

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

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

Question Type : **MCQ**
Question ID : **68019114395**
Option 1 ID : **68019156178**
Option 2 ID : **68019156176**
Option 3 ID : **68019156177**
Option 4 ID : **68019156175**

Q.73 Match **List I** with **List II**

	LIST I (Compound)		LIST II (Colour)
A.	$Fe_4[Fe(CN)_6]_3 \cdot xH_2O$	I.	Violet
B.	$[Fe(CN)_5NOS]^{4-}$	II.	Blood Red
C.	$[Fe(SCN)]^{2+}$	III.	Prussian Blue
D.	$(NH_4)_3PO_4 \cdot 12MoO_3$	IV.	Yellow

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

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

Question Type : **MCQ**
Question ID : **68019114406**
Option 1 ID : **68019156222**
Option 2 ID : **68019156220**
Option 3 ID : **68019156221**
Option 4 ID : **68019156219**

Q.74 For the given hypothetical reactions, the equilibrium constants are as follows :

$X \rightleftharpoons Y;\ K_1 = 1.0$

$Y \rightleftharpoons Z;\ K_2 = 2.0$

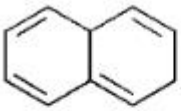
$Z \rightleftharpoons W;\ K_3 = 4.0$

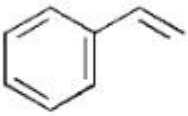
The equilibrium constant for the reaction $X \rightleftharpoons W$ is

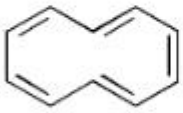
Options
1. 6.0
2. 8.0
3. 7.0
4. 12.0

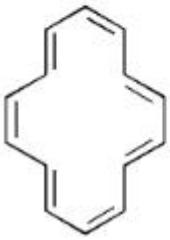
Question Type : **MCQ**
Question ID : **68019114396**
Option 1 ID : **68019156182**
Option 2 ID : **68019156180**
Option 3 ID : **68019156179**
Option 4 ID : **68019156181**

Q.75 Which of the following are aromatic?

A. 

B. 

C. 

D. 

Options
1. B and D only
2. A and C only
3. C and D only
4. A and B only

Question Type : **MCQ**
Question ID : **68019114409**
Option 1 ID : **68019156234**
Option 2 ID : **68019156233**
Option 3 ID : **68019156232**
Option 4 ID : **68019156231**

Q.76 Match **List I** with **List II**

	LIST I (Name of the test)		**LIST II (Reaction sequence involved)[M is metal]**
A.	Borax bead test	I.	$MCO_3 \rightarrow MO \xrightarrow[+\Delta]{Co(NO_3)_2} CoO \cdot MO$
B.	Charcoal cavity test	II.	$MCO_3 \rightarrow MCl_2 \rightarrow M^{2+}$
C.	Cobalt nitrate test	III.	$MSO_4 \xrightarrow[\Delta]{Na_2B_4O_7} M(BO_2)_2 \rightarrow MBO_2 \rightarrow M$
D.	Flame test	IV.	$MSO_4 \xrightarrow[\Delta]{Na_2CO_3} MCO_3 \rightarrow MO \rightarrow M$

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

Options

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

Question Type : **MCQ**
Question ID : **68019114405**
Option 1 ID : **68019156217**
Option 2 ID : **68019156215**
Option 3 ID : **68019156216**
Option 4 ID : **68019156218**

Q.77 Thiosulphate reacts differently with iodine and bromine in the reactions given below:

$$2S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2I^-$$
$$S_2O_3^{2-} + 5Br_2 + 5H_2O \rightarrow 2SO_4^{2-} + 4Br^- + 10H^+$$

Which of the following statement justifies the above dual behaviour of thiosulphate?

Options

1. Bromine is a stronger oxidant than iodine
2. Thiosulphate undergoes oxidation by bromine and reduction by iodine in these reactions
3. Bromine is a weaker oxidant than iodine
4. Bromine undergoes oxidation and iodine undergoes reduction in these reactions

Question Type : **MCQ**
Question ID : **68019114397**
Option 1 ID : **68019156183**
Option 2 ID : **68019156185**
Option 3 ID : **68019156184**
Option 4 ID : **68019156186**

Q.78 Given below are two statements:

Statement I: $N(CH_3)_3$ and $P(CH_3)_3$ can act as ligands to form transition metal complexes.

Statement II: As N and P are from same group, the nature of bonding of $N(CH_3)_3$ and $P(CH_3)_3$ is always same with transition metals.

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 Type : **MCQ**
Question ID : **68019114400**
Option 1 ID : **68019156196**
Option 2 ID : **68019156197**
Option 3 ID : **68019156195**
Option 4 ID : **68019156198**

Q.79 Iron (III) catalyses the reaction between iodide and persulphate ions, in which

A. Fe^{3+} oxidises the iodide ion
B. Fe^{3+} oxidises the persulphate ion
C. Fe^{2+} reduces the iodide ion
D. Fe^{2+} reduces the persulphate ion

Choose the **most appropriate** answer from the options given below:

Options
1. A and D only
2. B and C only
3. A only
4. B only

Question Type : **MCQ**
Question ID : **68019114402**
Option 1 ID : **68019156205**
Option 2 ID : **68019156206**
Option 3 ID : **68019156203**
Option 4 ID : **68019156204**

Q.80 Among the following halogens

F_2, Cl_2, Br_2 and I_2

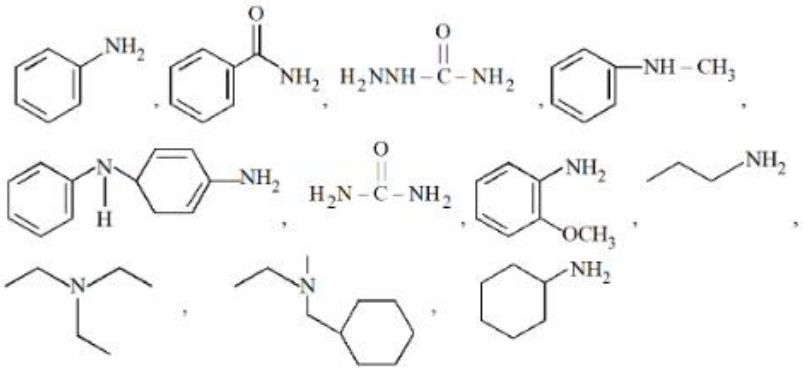
Which can undergo disproportionation reactions?

Options
1. Only I_2
2. Cl_2 , Br_2 and I_2
3. F_2, Cl_2 and Br_2
4. F_2 and Cl_2

Question Type : **MCQ**
Question ID : **68019114398**
Option 1 ID : **68019156187**
Option 2 ID : **68019156189**
Option 3 ID : **68019156190**
Option 4 ID : **68019156188**

Section : **Chemistry Section B**

Q.81 Number of amine compounds from the following giving solids which are soluble in NaOH upon reaction with Hinsberg's reagent is _____.



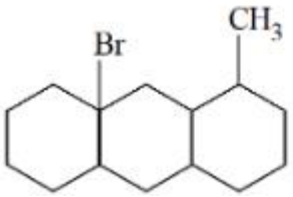
Question Type : **SA**
Question ID : **68019114423**

Q.82 If 279 g of aniline is reacted with one equivalent of benzenediazonium chloride, the maximum amount of aniline yellow formed will be _____ g. (nearest integer)

(consider complete conversion).

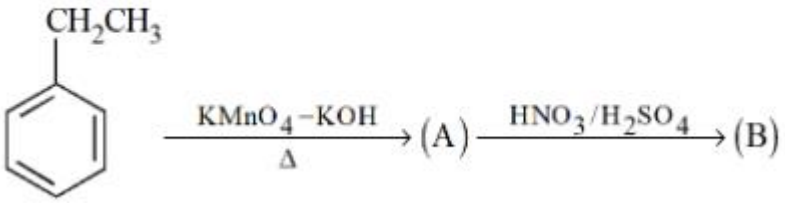
Question Type : **SA**
Question ID : **68019114420**

Q.83 The number of optical isomers in following compound is:_____



Question Type : **SA**
Question ID : **68019114421**

Q.84 Major product B of the following reaction has _____ π-bond.



Question Type : **SA**
Question ID : **68019114422**

Q.85 A solution containing 10 g of an electrolyte AB_2 in 100 g of water boils at 100.52°C. The degree of ionization of the electrolyte (α) is _____ $\times 10^{-1}$. (nearest integer)

[Given : Molar mass of AB_2 = 200 g mol^{-1}, K_b (molal boiling point elevation const. of water) = 0.52 K kg mol^{-1}, boiling point of water = 100°C ; AB_2 ionises as $AB_2 \rightarrow A^{2+} + 2B^-$]

Question Type : **SA**
Question ID : **68019114417**

Q.86 Consider the following reaction

$A + B \rightarrow C$

The time taken for A to become $1/4^{th}$ of its initial concentration is twice the time taken to become 1/2 of the same. Also, when the change of concentration of B is plotted against time, the resulting graph gives a straight line with a negative slope and a positive intercept on the concentration axis.

The overall order of the reaction is _____.

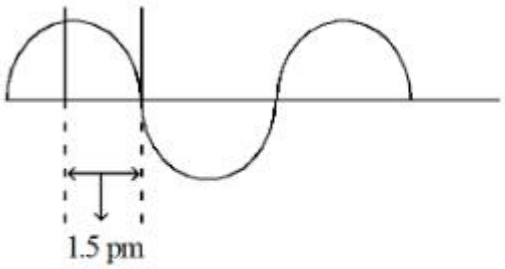
Question Type : **SA**
Question ID : **68019114418**

Q.87 The 'spin only' magnetic moment value of MO_4^{2-} is _____ BM. (Where M is a metal having least metallic radii. among Sc, Ti, V, Cr, Mn and Zn).

(Given atomic number: Sc = 21, Ti = 22, V = 23, Cr = 24, Mn = 25 and Zn = 30)

Question Type : **SA**
Question ID : **68019114419**

Q.88 A hypothetical electromagnetic wave is show below.



The frequency of the wave is $x \times 10^{19}$ Hz.

x = _____ (nearest integer)

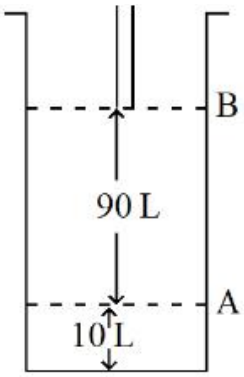
Question Type : **SA**
Question ID : **68019114414**

Q.89 Number of molecules from the following which are exceptions to octet rule is _____.

CO_2, NO_2, H_2SO_4, BF_3, CH_4, SiF_4, ClO_2, PCl_5, BeF_2, C_2H_6, $CHCl_3$, CBr_4

Question Type : **SA**
Question ID : **68019114415**

Q.90



Consider the figure provided.

1 mol of an ideal gas is kept in a cylinder, fitted with a piston, at the position A, at 18° C. If the piston is moved to position B, keeping the temperature unchanged, then 'x' L atm work is done in this reversible process.

x = _____ L atm. (nearest integer)

[Given : Absolute temperature = °C + 273.15, R = 0.08206 L atm mol^{-1} K^{-1}]

Question Type : **SA**
Question ID : **68019114416**