**Q:1**

**Topic Name:** Mathematics-Section A

**ItemCode:** 101561

**Question:** Let $S_1 = \left\{ x \in \mathbf{R} - \{1, 2\} : \dfrac{(x + 2)(x^2 + 3x + 5)}{-2 + 3x - x^2} \geq 0 \right\}$ and $S_2 = \{ x \in \mathbf{R} : 3^{2x} - 3^{x+1} - 3^{x+2} + 27 \leq 0 \}$. Then, $S_1 \cup S_2$ is equal to :

A $(-\infty, -2] \cup (1, 2)$

B $(-\infty, -2] \cup [1, 2]$

C $(-2, 1] \cup [2, \infty)$

D $(-\infty, 2]$

**Q:2**

**Topic Name:** Mathematics-Section A

**ItemCode:** 101562

**Question:** The real part of the complex number $\dfrac{(1 + 2i)^8 \cdot \overline{(1 - 2i)^2}}{(3 + 2i) \cdot (4 - 6i)}$ is equal to :

A $\dfrac{500}{13}$

B $\dfrac{110}{13}$

C $\dfrac{55}{6}$

D $\dfrac{550}{13}$

**Q:3**

**Topic Name:** Mathematics-Section A

**ItemCode:** 101563

**Question:** Let S be the set of all integral values of $\alpha$ for which the sum of squares of two real roots of the quadratic equation $3x^2 + (\alpha - 6)x + (\alpha + 3) = 0$ is minimum. Then S :

A is an empty set

B is a singleton

C contains exactly two elements

D contains more than two elements

**Q:4**

**ItemCode:101564**

Question: Let $A = \begin{bmatrix} 1 & -2 & \alpha \\ \alpha & 2 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & \alpha \\ -1 & 2 \\ 4 & -5 \end{bmatrix}$, $\alpha \in C$. Then the absolute value of the sum of all values of $\alpha$ for which $\det(AB) = 0$ is :

A 3

B 4

C 2

D 5

**Q:5**
Topic Name:Mathematics-Section A

**ItemCode:101565**

Question: Let A and B be two square matrices of order 2. If $\det(A) = 2$, $\det(B) = 3$ and $\det\big(\big(\det(5(\det A)B)\big)A^2\big) = 2^a 3^b 5^c$ for some a, b, c $\in$ **N**, then a $+$ b $+$ c is equal to :

A 10

B 12

C 13

D 14

**Q:6**
Topic Name:Mathematics-Section A

**ItemCode:101566**

Question: For two positive real numbers a and b such that $\dfrac{1}{a^2} + \dfrac{1}{b^3} = 4$, the minimum value of the constant term in the expansion of $\left(ax^{\frac{1}{8}} + bx^{-\frac{1}{12}}\right)^{10}$ is :

A $\dfrac{105}{2}$

B $\dfrac{105}{4}$

C $\dfrac{105}{8}$

D $\dfrac{105}{16}$

**Q:7**
Topic Name:Mathematics-Section A

The value of

$$1 + \frac{1}{1+2} + \frac{1}{1+2+3} + \ldots + \frac{1}{1+2+3+\ldots+11}$$

Question: is equal to :

A
$$\frac{20}{11}$$

B
$$\frac{11}{6}$$

C
$$\frac{241}{132}$$

D
$$\frac{21}{11}$$

**Q:8**
**Topic Name:** Mathematics-Section A

Question: If $xy^4$ attains maximum value at the point $(x, y)$ on the line passing through the points $(50+\alpha, 0)$ and $(0, 50+\alpha)$, $\alpha > 0$, then $(x, y)$ also lies on the line :

A $y = 4x$

B $x = 4y$

C $y = 4x + \alpha$

D $x = 4y - \alpha$

**Q:9**
**Topic Name:** Mathematics-Section A

Question: Let $f(x) = 4x^3 - 11x^2 + 8x - 5$, $x \in \mathbf{R}$. Then $f$ :

A
has a local minima at $x = \dfrac{1}{2}$

B
has a local minima at $x = \dfrac{3}{4}$

C
is increasing in $\left(\dfrac{1}{2}, \dfrac{3}{4}\right)$

D
is decreasing in $\left(\dfrac{1}{2}, \dfrac{4}{3}\right)$

**Q:10**
**Topic Name:** Mathematics-Section A

Let m and M respectively be the minimum and the maximum values of

**Question:** $f(x) = \sin^{-1}2x + \sin 2x + \cos^{-1}2x + \cos 2x, \ x \in \left[0, \dfrac{\pi}{8}\right]$. Then m + M is equal to :

A $\quad 1 + \sqrt{2} + \pi$

B $\quad (1 + \sqrt{2})\,\pi$

C $\quad \pi + \sqrt{2}$

D $\quad 1 + \pi$

---

**Q:11**
Topic Name:Mathematics-Section A

ItemCode:101571

**Question:** $\displaystyle \lim_{n \to \infty} \sum_{r=1}^{n} \frac{r}{2r^2 - 7rn + 6n^2}$ is equal to :

A $\quad \log_e\left(\dfrac{\sqrt{3}}{2}\right)$

B $\quad \log_e\left(\dfrac{3\sqrt{3}}{4}\right)$

C $\quad \log_e\left(\dfrac{27}{4}\right)$

D $\quad \log_e\left(\dfrac{4}{3}\right)$

---

**Q:12**
Topic Name:Mathematics-Section A

ItemCode:101572

Let $\dfrac{dy}{dx} = \dfrac{ax - by + a}{bx + cy + a}$, a, b, c $\in$ **R**, represents a circle with center ($\alpha$, $\beta$). Then, $\alpha + 2\beta$ is equal

**Question:** to :

A $\quad -1$

B $\quad 0$

C $\quad 1$

D $\quad 2$

---

**Q:13**
Topic Name:Mathematics-Section A

Let $\alpha_1, \alpha_2$ $(\alpha_1 < \alpha_2)$ be the values of $\alpha$ for the points $(\alpha, -3)$, $(2, 0)$ and $(1, \alpha)$ to be collinear.

Then the equation of the line, passing through $(\alpha_1, \alpha_2)$ and making an angle of $\dfrac{\pi}{3}$ with the

positive direction of the $x$-axis, is :

**Question:**

A $\quad x - \sqrt{3}y - 3\sqrt{3} + 1 = 0$

B $\quad \sqrt{3}x - y + \sqrt{3} + 3 = 0$

C $\quad x - \sqrt{3}y + 3\sqrt{3} + 1 = 0$

D $\quad \sqrt{3}x - y + \sqrt{3} - 3 = 0$

**Q:14**
**Topic Name:** Mathematics-Section A

Consider three circles :
$$C_1 : x^2 + y^2 = r^2$$
$$C_2 : (x-1)^2 + (y-1)^2 = r^2$$
$$C_3 : (x-2)^2 + (y-1)^2 = r^2$$

If a line $L : y = mx + c$ be a common tangent to $C_1$, $C_2$ and $C_3$ such that $C_1$ and $C_3$ lie on one side of line L while $C_2$ lies on other side, then the value of $20(r^2 + c)$ is equal to :

**Question:**

A 23

B 15

C 12

D 6

**Q:15**
**Topic Name:** Mathematics-Section A

Let the eccentricity of the ellipse $x^2 + a^2y^2 = 25a^2$ be b times the eccentricity of the hyperbola $x^2 - a^2y^2 = 5$, where a is the minimum distance between the curves $y = e^x$ and $y = \log_e x$. Then

$a^2 + \dfrac{1}{b^2}$ is equal to :

**Question:**

A $\quad \dfrac{3}{2}$

B $\quad \dfrac{5}{2}$

C 3

D 5

**Q:16**
**Topic Name:** Mathematics-Section A

Question: The distance of the point $(3, 2, -1)$ from the plane $3x - y + 4z + 1 = 0$ along the line

$$\frac{2-x}{2} = \frac{y-3}{2} = \frac{z+1}{1}$$ is equal to :

A  9

B  6

C  3

D  2

**Q:17**
**Topic Name:**Mathematics-Section A

Question: Let a vector $\vec{c}$ be coplanar with the vectors $\vec{a} = -\hat{i} + \hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} + \hat{j} - \hat{k}$. If the

vector $\vec{c}$ also satisfies the conditions $\vec{c} \cdot \left[ \left( \vec{a} + \vec{b} \right) \times \left( \vec{a} \times \vec{b} \right) \right] = -42$ and

$\left( \vec{c} \times \left( \vec{a} - \vec{b} \right) \right) \cdot \hat{k} = 3$, then the value of $\left| \vec{c} \right|^2$ is equal to :

A  24

B  29

C  35

D  42

**Q:18**
**Topic Name:**Mathematics-Section A

Question: If a random variable X follows the Binomial distribution $B(5, p)$ such that $P(X=0) = P(X=1)$,

then $\dfrac{P(X = 2)}{P(X = 3)}$ is equal to :

A  1

B  10

C  25

D  5

**Q:19**
**Topic Name:**Mathematics-Section A

Let $\alpha = \tan\left(\dfrac{5\pi}{16} \sin\left(2\cos^{-1}\left(\dfrac{1}{\sqrt{5}}\right)\right)\right)$ and

$\beta = \cos\left(\sin^{-1}\left(\dfrac{4}{5}\right) + \sec^{-1}\left(\dfrac{5}{3}\right)\right)$

where the inverse trigonometric functions take principal values.  Then, the equation whose

**Question:** roots are $\alpha$ and $\beta$ is :

A  $15x^2 - 8x - 7 = 0$

B  $5x^2 - 12x + 7 = 0$

C  $25x^2 - 18x - 7 = 0$

D  $25x^2 - 32x + 7 = 0$

**Q:20**
**Topic Name:** Mathematics-Section A

The conditional statement

**Question:** $((p \wedge q) \to ((\sim p) \vee r)) \vee (((\sim p) \vee r) \to (p \wedge q))$ is :

A  a tautology

B  a contradiction

C  equivalent to $p \wedge q$

D  equivalent to $(\sim p) \vee r$

**Q:21**
**Topic Name:** Mathematics-Section B

**Question:** The number of 6-digit numbers made by using the digits 1, 2, 3, 4, 5, 6, 7, without repetition and which are multiple of 15 is _____.

**Q:22**
**Topic Name:** Mathematics-Section B

**Question:** Let for $f(x) = a_0 x^2 + a_1 x + a_2$, $f'(0) = 1$ and $f'(1) = 0$.  If $a_0, a_1, a_2$ are in an arithmatico-geometric progression, whose corresponding A.P. has common difference 1 and corresponding G.P. has common ratio 2, then $f(4)$ is equal to _____.

**Q:23**
**Topic Name:** Mathematics-Section B

Suppose $\lim\limits_{x \to 0} \dfrac{F(x)}{x^3}$ exists and is equal to L, where

$$F(x) = \begin{vmatrix} a + \sin\dfrac{x}{2} & -b\cos x & 0 \\ -b\cos x & 0 & a + \sin\dfrac{x}{2} \\ 0 & a + \sin\dfrac{x}{2} & -b\cos x \end{vmatrix}.$$

**Question:** Then, $-112\ L$ is equal to _____.

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**Q:24**
**Topic Name:** Mathematics-Section B

If for some $\alpha > 0$, the area of the region

$$\{(x, y) : |x + \alpha| \le y \le 2 - |x|\}$$

is equal to $\dfrac{3}{2}$, then the area of the region

$$\{(x, y) : 0 \le y \le x + 2\alpha,\ |x| \le 1\}$$

**Question:** is equal to _____.

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**Q:25**
**Topic Name:** Mathematics-Section B

Let $f(t) = \displaystyle\int_0^t e^{x^3}\left(\dfrac{x^8}{(x^6 + 2x^3 + 2)^2}\right) dx$. If $f(1) + f'(1) = \alpha e - \dfrac{1}{6}$, then the value of $150\alpha$ is equal

**Question:** to _____.

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**Q:26**
**Topic Name:** Mathematics-Section B

A hostel has 100 students. On a certain day (consider it day zero) it was found that two students are infected with some virus. Assume that the rate at which the virus spreads is directly proportional to the product of the number of infected students and the number of non-infected students. If the number of infected students on $4^{\text{th}}$ day is 30, then number of infected students on $8^{\text{th}}$ day will be _____.

**Question:**

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**Q:27**
**Topic Name:** Mathematics-Section B

Question: Let PQ be a focal chord of length 6.25 units of the parabola $y^2 = 4x$. If O is the vertex of the parabola, then 10 times the area (in sq. units) of $\triangle POQ$ is equal to _____.

**Q:28**
Topic Name:Mathematics-Section B

Question: Consider a triangle ABC whose vertices are A(0, $\alpha$, $\alpha$), B($\alpha$, 0, $\alpha$) and C($\alpha$, $\alpha$, 0), $\alpha > 0$. Let D be a point moving on the line $x + z - 3 = 0 = y$ and G be the centroid of $\triangle$ABC. If the minimum length of GD is $\sqrt{\dfrac{57}{2}}$, then $\alpha$ is equal to _____.

**Q:29**
Topic Name:Mathematics-Section B

The probability distribution of X is :

| X | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| P(X) | $\dfrac{1-d}{4}$ | $\dfrac{1+2d}{4}$ | $\dfrac{1-4d}{4}$ | $\dfrac{1+3d}{4}$ |

Question: For the minimum possible value of d, sixty times the mean of X is equal to _____.

**Q:30**
Topic Name:Mathematics-Section B

Let $S_1 = \{x \in [0, 12\pi] : \sin^5 x + \cos^5 x = 1\}$

and $S_2 = \{x \in [0, 8\pi] : \sin^7 x + \cos^7 x = 1\}$

Question: Then $n(S_1) - n(S_2)$ is equal to _____.

**Q:31**
Topic Name:Physics-Section A

Question: At t=0, truck, starting from rest, moves in the positive x-direction at uniform acceleration of $5\ ms^{-2}$. At t=20 s, a ball is released from the top of the truck. The ball strikes the ground in 1 s after the release. The velocity of the ball, when it strikes the ground, will be :
(Given $g = 10\ ms^{-2}$)

A    $100\,\hat{i} - 10\,\hat{j}$

B    $10\,\hat{i} - 100\,\hat{j}$

C    $100\,\hat{i}$

D    $-10\,\hat{j}$

**Q:32**
Topic Name:Physics-Section A

**ItemCode:101502**

**Question:** If n main scale divisions coincide with (n+1) vernier scale divisions. The least count of vernier callipers, when each centimetre on the main scale is divided into five equal parts, will be :

A   $\dfrac{2}{n+1}$ mm

B   $\dfrac{5}{n+1}$ mm

C   $\dfrac{1}{2n}$ mm

D   $\dfrac{1}{5n}$ mm

**Q:33**
Topic Name:Physics-Section A

**ItemCode:101503**

**Question:** The radii of two planets A and B are in the ratio 2 : 3. Their densities are $3\rho$ and $5\rho$ respectively. The ratio of their acceleration due to gravity is :

A   9 : 4

B   9 : 8

C   9 : 10

D   2 : 5

**Q:34**
Topic Name:Physics-Section A

**ItemCode:101504**

**Question:** Two projectiles $P_1$ and $P_2$ thrown with speed in the ratio $\sqrt{3} : \sqrt{2}$, attain the same height during their motion. If $P_2$ is thrown at an angle of 60° with the horizontal, the angle of projection of $P_1$ with horizontal will be :

A   15°

B   30°

C   45°

D   60°

**Q:35**
Topic Name:Physics-Section A

**ItemCode:101505**

**Question:** An air bubble of negligible weight having radius r rises steadily through a solution of density $\sigma$ at speed $v$. The coefficient of viscosity of the solution is given by :

A   $\eta = \dfrac{4r\sigma g}{9\,v}$

**B**

$$\eta = \frac{2r^2 \sigma g}{9v}$$

**C**

$$\eta = \frac{2\pi r^2 \sigma g}{9v}$$

**D**

$$\eta = \frac{2r^2 \sigma g}{3\pi v}$$

**Q:36**
**Topic Name:** Physics-Section A

ItemCode: 101506

A 2 kg block is pushed against a vertical wall by applying a horizontal force of 50 N. The coefficient of static friction between the block and the wall is 0.5. A force F is also applied on the block vertically upward (as shown in figure). The maximum value of F applied, so that the block does not move upward, will be :

(Given : $g = 10$ ms$^{-2}$)
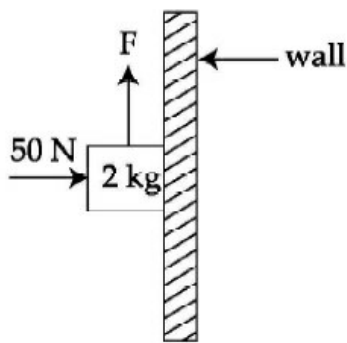


**Question:**

A   10 N

B   20 N

C   25 N

D   45 N

**Q:37**
**Topic Name:** Physics-Section A

ItemCode: 101507

Two bodies A and B of masses 5 kg and 8 kg are moving such that the momentum of body B is twice that of the body A. The ratio of their kinetic energies will be :

**Question:**

A   4 : 5

B   2 : 5

C   5 : 4

D   5 : 2

**Q:38**
**Topic Name:** Physics-Section A

Question: The pressure of the gas in a constant volume gas thermometer is 100 cm of mercury when placed in melting ice at 1 atm. When the bulb is placed in a liquid, the pressure becomes 180 cm of mercury. Temperature of the liquid is :
(Given 0°C = 273 K)

A    300 K

B    400 K

C    600 K

D    491 K

Q:39
Topic Name:Physics-Section A

ItemCode:101509

Question: A coil of n number of turns wound tightly in the form of a spiral with inner and outer radii $r_1$ and $r_2$ respectively. When a current of strength I is passed through the coil, the magnetic field at its centre will be :

A
$$\frac{\mu_0 nI}{2(r_2 - r_1)}$$

B
$$\frac{\mu_0 nI}{r_2}$$

C
$$\frac{\mu_0 nI}{r_2 - r_1} \log_e \frac{r_1}{r_2}$$

D
$$\frac{\mu_0 nI}{2(r_2 - r_1)} \log_e \frac{r_2}{r_1}$$

Q:40
Topic Name:Physics-Section A

ItemCode:101510

Question: $C_o$ is the capacitance of a parallel plate capacitor with air as a medium between the plates (as shown in Fig. 1). If half space between the plates is filled with a dielectric of relative permittivity $\varepsilon_r$ (as shown in Fig. 2), the new capacitance of the capacitor will be :

Fig. 1          Fig. 2

A
$$\frac{C_o}{2}(1 + \varepsilon_r)$$

B    $C_o + \varepsilon_r$

C
$$\frac{C_o \, \varepsilon_r}{2}$$

D    $C_o(1 + \varepsilon_r)$

**Q:41**

ItemCode:101511

Question: A sample of monoatomic gas is taken at initial pressure of 75 kPa. The volume of the gas is then compressed from 1200 cm³ to 150 cm³ adiabatically. In this process, the value of workdone on the gas will be :

A  79 J

B  405 J

C  4050 J

D  9590 J

**Q:42**

ItemCode:101512

Question: Which of the following equations correctly represents a travelling wave having wavelength $\lambda = 4.0$ cm, frequency $v = 100$ Hz and travelling in positive $x$-axis direction ?

A  $y = A \sin[(0.50\ \pi\ \mathrm{cm}^{-1})\ x - (100\ \pi\ \mathrm{s}^{-1})t]$

B  $y = A \sin 2\pi\ [(0.25\ \mathrm{cm}^{-1})\ x - (50\ \mathrm{s}^{-1})t]$

C  $y = A \sin\left[\left(\dfrac{2\pi}{4}\ \mathrm{cm}^{-1}\right) x - \left(\dfrac{2\pi}{100}\ \mathrm{s}^{-1}\right)t\right]$

D  $y = A \sin\pi\ [(0.5\ \mathrm{cm}^{-1})\ x - (200\ \mathrm{s}^{-1})t]$

**Q:43**

ItemCode:101513

Question: A cyclotron is working at a frequency of 10 MHz. If the radius of its dees is 60 cm. The maximum kinetic energy of accelerated proton will be :

(Take : $e = 1.6 \times 10^{-19}$ C, $m_p = 1.67 \times 10^{-27}$ kg)

A  7.4 MeV

B  14.86 MeV

C  7.4 GeV

D  704 GeV

**Q:44**

ItemCode:101514

Question: An expression for oscillating electric field in a plane electromagnetic wave is given as

$E_z = 300 \sin(5\pi \times 10^3 x - 3\pi \times 10^{11} t)$ Vm$^{-1}$

Then, the value of magnetic field amplitude will be :

(Given : speed of light in Vacuum $c = 3 \times 10^8$ ms$^{-1}$)

A  $1 \times 10^{-6}$ T

| B | $5 \times 10^{-6}$ T |
|---|---|
| C | $18 \times 10^9$ T |
| D | $21 \times 10^9$ T |

**Q:45**
Topic Name:Physics-Section A

ItemCode:101515

Question: An electric cable of copper has just one wire of radius 9 mm. Its resistance is 14 Ω. If this single copper wire of the cable is replaced by seven identical well insulated copper wires each of radius 3 mm connected in parallel, then the new resistance of the combination will be :

| A | 9 Ω |
|---|---|
| B | 18 Ω |
| C | 28 Ω |
| D | 126 Ω |

**Q:46**
Topic Name:Physics-Section A

ItemCode:101516

Question: In series RLC resonator, if the self inductance and capacitance become double, the new resonant frequency ($f_2$) and new quality factor ($Q_2$) will be :
($f_1$ = original resonant frequency, $Q_1$ = original quality factor)

| A | $f_2 = \dfrac{f_1}{2}$ and $Q_2 = Q_1$ |
|---|---|
| B | $f_2 = f_1$ and $Q_2 = \dfrac{Q_1}{2}$ |
| C | $f_2 = 2f_1$ and $Q_2 = Q_1$ |
| D | $f_2 = f_1$ and $Q_2 = 2Q_1$ |

**Q:47**
Topic Name:Physics-Section A

ItemCode:101517

Question: Find the ratio of maximum intensity to the minimum intensity in the interference pattern if the widths of the two slits in Young's experiment are in the ratio of 9 : 16.
(Assuming intensity of light is directly proportional to the width of slits)

| A | 3 : 4 |
|---|---|
| B | 4 : 3 |
| C | 7 : 1 |
| D | 49 : 1 |

**Q:48**
Topic Name:Physics-Section A

**Question:** A source of monochromatic light liberates $9 \times 10^{20}$ photon per second with wavelength 600 nm when operated at 400 W. The number of photons emitted per second with wavelength of 800 nm by the source of monochromatic light operating at same power will be :

A  $12 \times 10^{20}$

B  $6 \times 10^{20}$

C  $9 \times 10^{20}$

D  $24 \times 10^{20}$

**Q:49**
**Topic Name:** Physics-Section A

ItemCode:**101519**

**Question:** A speech signal given by 11 sin (2200 πt)V is used for amplitude modulation with a carrier signal given by 44 sin(6600 πt)V. The minimum amplitude of modulated wave will be :

A  33 V

B  55 V

C  8.25 V

D  13.75 V

**Q:50**
**Topic Name:** Physics-Section A

ItemCode:**101520**

**Question:** A hydrogen atom in ground state absorbs 12.09 eV of energy. The orbital angular momentum of the electron is increased by :

A  $1.05 \times 10^{-34}$ Js

B  $2.11 \times 10^{-34}$ Js

C  $3.16 \times 10^{-34}$ Js

D  $4.22 \times 10^{-34}$ Js

**Q:51**
**Topic Name:** Physics-Section B

A person starts his journey from centre 'O' of the park and comes back to the same position following path OPQO as shown in the figure. The radius of path taken by the person is 200 m and he takes 3 min 58 sec to complete his journey. The average speed of the person is _____ ms$^{-1}$.

(take $\pi = 3.14$)
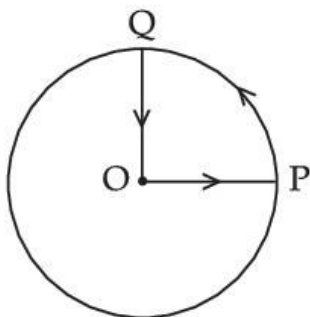


**Question:**

**Q:52**
**Topic Name:**Physics-Section B

An employee of a factory moving away from his workplace by a car listens to the siren of the factory. He drives the car at the speed of 72 kmh$^{-1}$ in the direction of wind which is blowing at 72 kmh$^{-1}$ speed. Frequency of siren is 720 Hz. The employee hears an apparent frequency of _____ Hz.

**Question:** (Assume speed of sound to be 340 ms$^{-1}$)

**Q:53**
**Topic Name:**Physics-Section B

Four particles with a mass of 1 kg, 2 kg, 3 kg and 4 kg are situated at the corners of a square with side 1 m (as shown in the figure). The moment of inertia of the system, about an axis passing through the point O and perpendicular to the plane of the square, is _____ kg m$^2$.
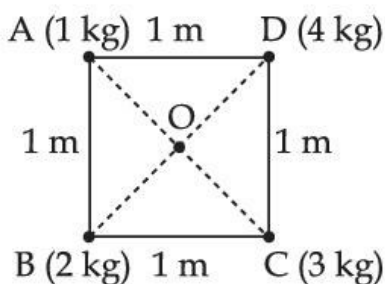


**Question:**

**Q:54**
**Topic Name:**Physics-Section B

The excess pressure inside a liquid drop is 500 Nm$^{-2}$. If the radius of the drop is 2 mm, the surface tension of liquid is $x \times 10^{-3}$ Nm$^{-1}$. The value of $x$ is _____.

**Question:**

**Q:55**
**Topic Name:**Physics-Section B

Question: Eight similar drops of mercury are maintained at 12 V each. All these spherical drops combine into a single big drop. The potential energy of bigger drop will be _____ E.

Where E is the potential energy of a single smaller drop.

**Q:56**
Topic Name:Physics-Section B

ItemCode:101526

Question: The circuit diagram of potentiometer used to measure the internal resistance of a cell (E) is shown in figure. The key 'K' is kept closed so as to send constant current through potentiometer wire. When key '$K_1$' is kept open the null point is found to be at 120 cm on the potentiometer wire. When the key '$K_1$' is closed the null point is shifted at 80 cm at the potentiometre wire. The internal resistance of the given cell is _____ $\Omega$.
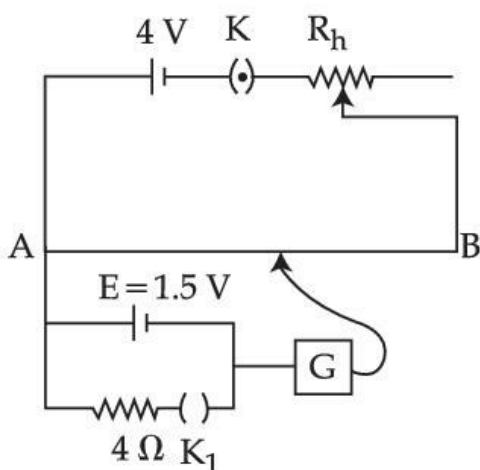


**Q:57**
Topic Name:Physics-Section B

ItemCode:101527

Question: A series LCR circuit with $R = \dfrac{250}{11}$ $\Omega$ and $X_L = \dfrac{70}{11}$ $\Omega$ is connected across a 220 V, 50 Hz supply. The value of capacitance needed to maximize the average power of the circuit will be _____ μF. (Take : $\pi = \dfrac{22}{7}$)

**Q:58**
Topic Name:Physics-Section B

ItemCode:101528

Question: The refractive index of an equilateral prism is $\sqrt{2}$. The angle of emergence under minimum deviation position of prism, in degree, is _____.

**Q:59**
Topic Name:Physics-Section B

ItemCode:101529

Question: A hydrogen atom in its first excited state absorbs a photon of energy $x \times 10^{-2}$ eV and excited to a higher energy state where the potential energy of electron is $-1.08$ eV. The value of $x$ is _____.

**Q:60**
Topic Name:Physics-Section B

The circuit diagram used to study the characteristic curve of a zener diode is connected to variable power supply $(0-15 \text{ V})$ as shown in figure. A zener diode with maximum potential $V_z = 10$ V and maximum power dissipation of 0.4 W is connected across a potential divider arrangement. The value of resistance $R_p$ connected in series with the zener diode to protect it from the damage is _____ $\Omega$.
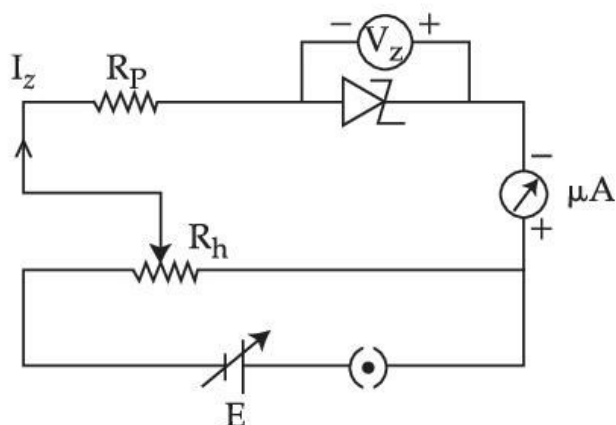


Question:

Q:61
Topic Name:Chemistry-Section A

An element X has a body centred cubic (bcc) structure with a cell edge of 200 pm. The density of the element is $5 \text{ g cm}^{-3}$. The number of atoms present in 300 g of the element X is _____.

Given : Avogadro constant, $N_A = 6.0 \times 10^{23} \text{ mol}^{-1}$.

Question:

A   $5 \text{ N}_A$

B   $6 \text{ N}_A$

C   $15 \text{ N}_A$

D   $25 \text{ N}_A$

Q:62
Topic Name:Chemistry-Section A

Question: The number of radial nodes and total number of nodes in 4p orbital respectively are :

A   2 and 3

B   2 and 2

C   3 and 4

D   4 and 4

Q:63
Topic Name:Chemistry-Section A

**ItemCode:101533**

For a solution of the gases A, B, C and D in water at 298 K, the values of Henry's law constant ($K_H$) are 30.40, 2.34, $1.56 \times 10^{-5}$ and 0.513 k bar respectively. In the given graph, the lines marked as 'p' and 's' correspond respectively to :
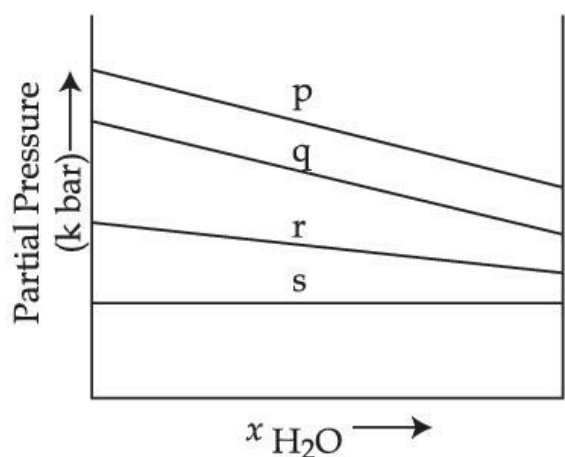


**Question:**

| A | A and C |
|---|---------|
| B | B and A |
| C | D and A |
| D | C and D |

**Q:64**
**Topic Name:**Chemistry-Section A

**ItemCode:101534**

The equilibrium constant for the reversible reaction

$2A(g) \rightleftharpoons 2B(g) + C(g)$ is $K_1$
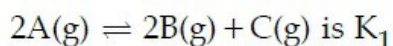
and for the reaction

$$\frac{3}{2}A(g) \rightleftharpoons \frac{3}{2}B(g) + \frac{3}{4}C(g) \text{ is } K_2.$$
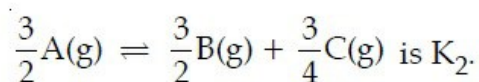
$K_1$ and $K_2$ are related as :

**Question:**

| A | $K_1 = \sqrt{K_2}$ |
|---|---------|
| B | $K_2 = \sqrt{K_1}$ |
| C | $K_2 = K_1^{3/4}$ |
| D | $K_1 = K_2^{3/4}$ |

**Q:65**
**Topic Name:**Chemistry-Section A

**ItemCode:101535**

**Question:** In which of the following half cells, electrochemical reaction is pH dependent ?

| A | $Pt \mid Fe^{3+}, Fe^{2+}$ |
|---|---------|
| B | $MnO_4^- \mid Mn^{2+}$ |
| C | $Ag \mid AgCl \mid Cl^-$ |

| D | $\dfrac{1}{2}F_2 \mid F^-$ |
|---|---|
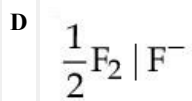
**Q:66**

Topic Name:Chemistry-Section A

ItemCode:101536

Question: The **correct** order of electron gain enthalpy ($-$ve value) is :

A  $O > S > Se > Te$

B  $O < S < Se < Te$

C  $O < S > Se > Te$

D  $O < S > Se < Te$

**Q:67**

Topic Name:Chemistry-Section A

ItemCode:101537

Question: $\Delta G°$ vs T plot for the formation of MgO, involving reaction $2Mg + O_2 \rightarrow 2MgO$, will look like :

A



B



C



D
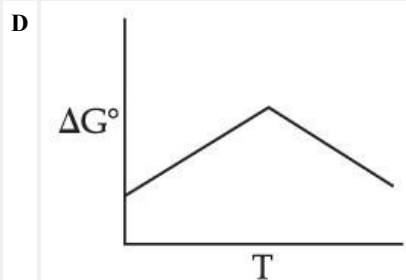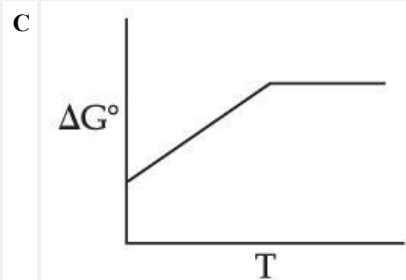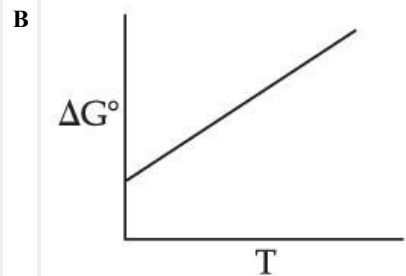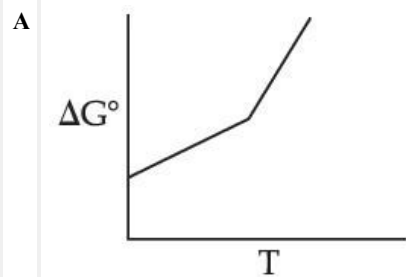


**Q:68**

Topic Name:Chemistry-Section A

Match **List - I** with **List - II** :

| | List - I | | List - II |
|---|---|---|---|
| (a) | Sodium hydride | (i) | Lewis acid |
| (b) | Silane | (ii) | Saline hydride |
| (c) | Vanadium hydride | (iii) | Molecular hydride |
| (d) | Aluminium hydride | (iv) | Non-stoichiometric hydride |

**Question:** **Correc**t answer is :

**A** (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

**B** (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)

**C** (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)

**D** (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)

**Q:69**
**Topic Name:**Chemistry-Section A

**Question:** **Correct** statement about alkali metal oxides is

**A** peroxides are colored.

**B** superoxides are paramagnetic.

**C** oxides are paramagnetic.

**D** peroxides are both colored and paramagnetic.

**Q:70**
**Topic Name:**Chemistry-Section A

$$A \xrightarrow{573\ K} \text{Red phosphorus} \xrightarrow[\text{under pressure}]{\text{heat ; 803 K}} B$$
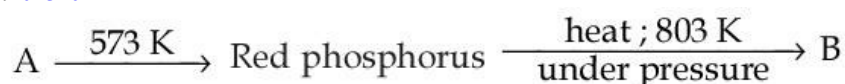
Red phosphorus is obtained by heating "A" at 573 K, and can be converted to "B" by heating at 803 K under pressure.

**Question:** A and B, respectively, are

**A** β-black phosphorus and white phosphorus.

**B** white phosphorus and β-black phosphorus.

**C** α-black phosphorus and white phosphorus.

**D** white phosphorus and α-black phosphorus.

**Q:71**
**Topic Name:**Chemistry-Section A

Correct formula of the compound which gives a white precipitate with $BaCl_2$ solution, but **not** with $AgNO_3$ solution, is

**Question:**

A   $[Co(NH_3)_5Br]SO_4$.

B   $[Co(NH_3)_5SO_4]Br$.

C   $[Pt(NH_3)_4Cl_2]Br_2$

D   $[Pt(NH_3)_4Br_2]Cl_2$.
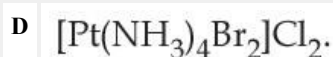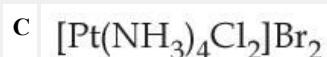
Q:72
Topic Name:Chemistry-Section A

ItemCode:101542

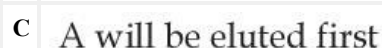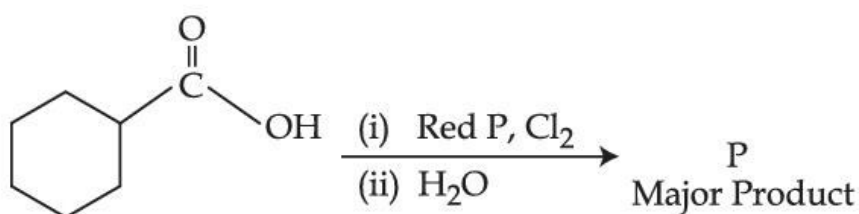Question: Which one of the following chemicals has **not** been used for the dry cleaning of clothes ?
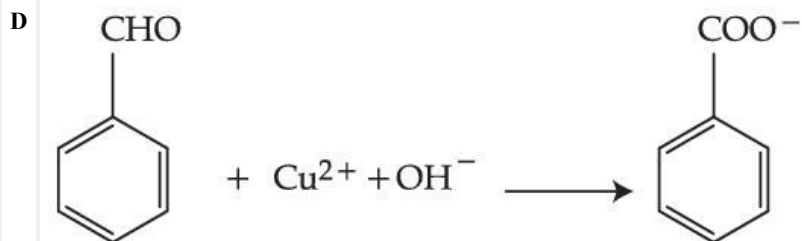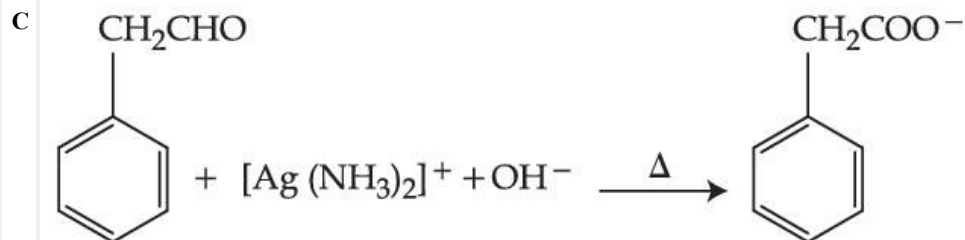
A   Tetrachloroethene

B   Liquid $CO_2$

C   Ethanol

D   $H_2O_2$
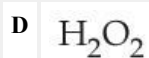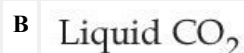
Q:73
Topic Name:Chemistry-Section A

ItemCode:101543

TLC analysis of a mixture having 3 components (A, B, C) using silica gel as the stationary phase gave following $R_f$ values; for A = 0.72, B = 0.48, C = 0.20.

Regarding the above observations, which one of the following statements is **not** correct for column chromatography of the mixture ?

Question:

A   A is the most non-polar component

B   C is the most soluble component in mobile phase

C   A will be eluted first

D   C is the most strongly absorbed component

Q:74
Topic Name:Chemistry-Section A

ItemCode:101544

Consider the given chemical reaction



OH    (i)   Red P, $Cl_2$
      ────────────────→    P
      (ii)  $H_2O$          Major Product

Question: Identify the product P.

A

**B**
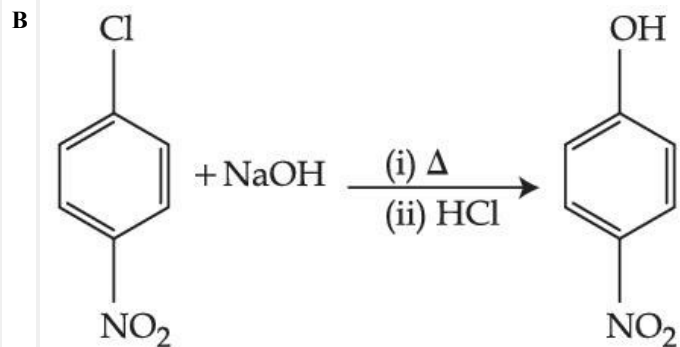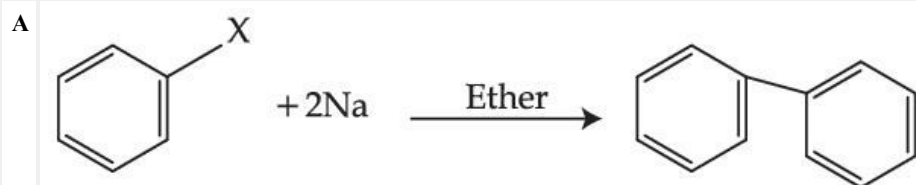


**C**



**D**
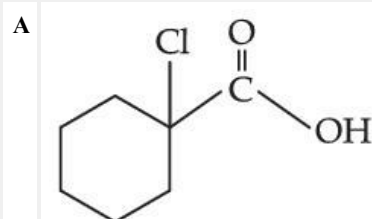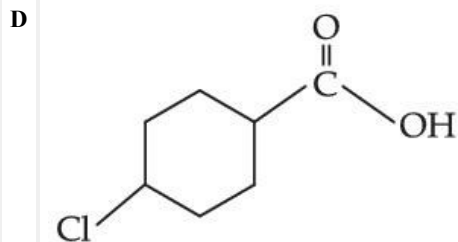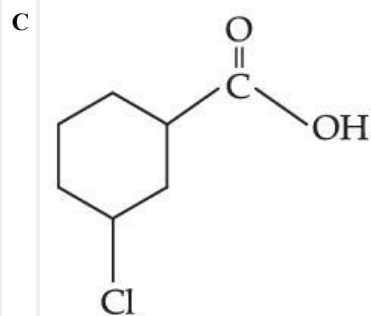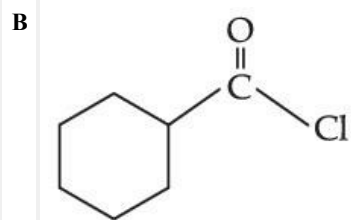


**Q:75**
**Topic Name:** Chemistry-Section A

**ItemCode:101545**

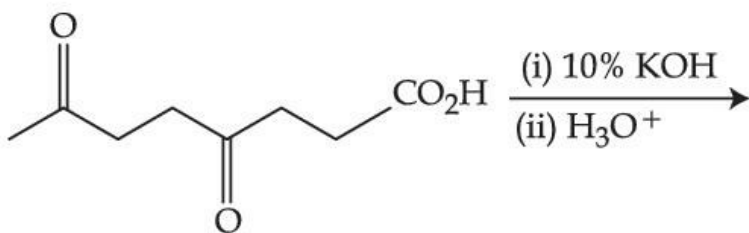**Question:** Choose the reaction which is **not** possible :

**A**



$+2Na \xrightarrow{\text{Ether}}$

**B**



$+NaOH \xrightarrow[\text{(ii) HCl}]{\text{(i) } \Delta}$

**C**

$CH_2CHO$



$+ [Ag(NH_3)_2]^+ + OH^- \xrightarrow{\Delta}$

$CH_2COO^-$

**D**

$CHO$



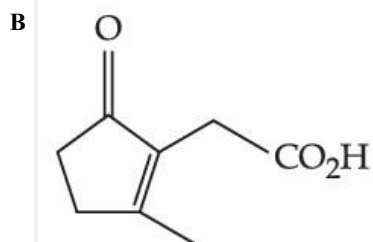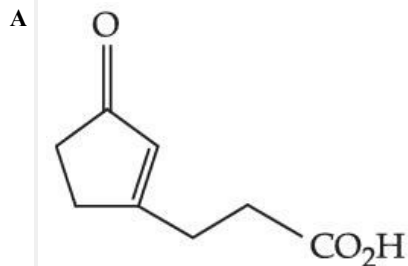$+ Cu^{2+} + OH^- \longrightarrow$

$COO^-$

**Q:76**

ItemCode:101546

Which among the following will be the major product of the given reaction ?



Question:

A



B



C



D



Q:77
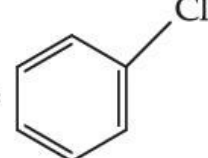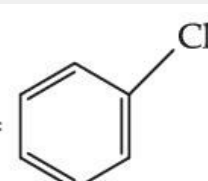Topic Name:Chemistry-Section A

ItemCode:101547

$A + CH_3CH_2OH \longrightarrow$  $\xrightarrow[\text{(ii) NaOH}]{\text{(i) } H_2SO_4 \text{ (oleum), } \Delta}$ B
(iii) HCl
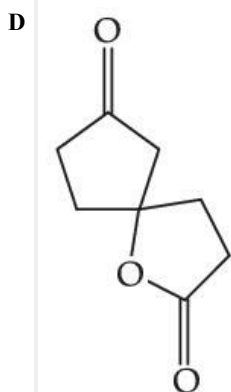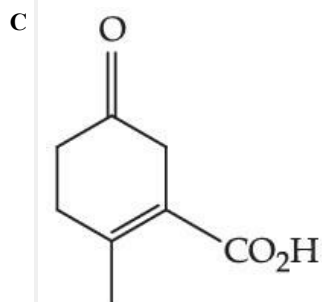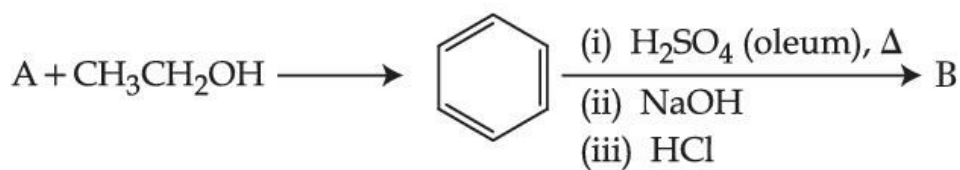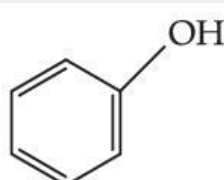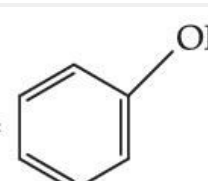
Question: Consider the above reaction sequence. Identify the component A and component B :

## A

$A = C_6H_5NH_2$
B =

Cl
(benzene ring with Cl)

## B

$A = C_6H_5N_2^+Cl^-$
B =

OH
(benzene ring with OH)

## C

Cl
(benzene ring with Cl)
A =

$B = C_6H_5NH_2$

## D

OH
(benzene ring with OH)
A =

$B = C_6H_5N_2^+Cl^-$

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**Q:78**
**Topic Name:** Chemistry-Section A

**ItemCode:** 101548

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

| List - I | | List - II |
|---|---|---|
| | Polymer | Repeat Unit |
| (a) | Acrilan | (i) $+CH_2-\underset{\underset{Cl}{\vert}}{C}=CH-CH_2 \rightarrow_n$ |
| (b) | Neoprene | (ii) $+CH_2-\underset{\underset{C_6H_5}{\vert}}{CH} \rightarrow_n$ |
| (c) | Polystyrene | (iii) $+CH_2-\underset{\underset{CN}{\vert}}{CH} \rightarrow_n$ |
| (d) | Buna-N | (iv) $+CH_2-CH=CH-CH_2-CH_2-\underset{\underset{CN}{\vert}}{CH} \rightarrow_n$ |

**Question:** Choose the **correct** match from the options given below :

A  (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

B  (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)

C  (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

D  (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

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**Q:79**
**Topic Name:** Chemistry-Section A

**ItemCode:** 101549

**Question:** The sugar produced after complete hydrolysis of DNA is

| A | a pentose sugar. |
| B | a hexose sugar. |
| C | a polysaccharide. |
| D | a disaccharide. |

**Q:80**
**Topic Name:** Chemistry-Section A

**ItemCode:101550**

**Question:** The reagent neutral ferric chloride is used to detect the presence of _____

| A | sulphide ion and alcoholic $-OH$ group |
| B | acetate ion and phenolic $-OH$ group. |
| C | sulphide ion and phenolic $-OH$ group. |
| D | acetate ion and alcoholic $-OH$ group. |

**Q:81**
**Topic Name:** Chemistry-Section B

**ItemCode:101551**

Blister copper is produced by reaction of copper oxide with copper sulphide.

$$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$$
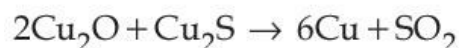
When $2.86 \times 10^3$ g of $Cu_2O$ and $4.77 \times 10^3$ g of $Cu_2S$ are used for reaction, the mass of copper produced is _____ g. (nearest integer)

(Atomic mass of $Cu = 63.5$ a.m. u

$S = 32.0$ a.m. u

$O = 16.0$ a.m. u)

**Question:**

**Q:82**
**Topic Name:** Chemistry-Section B

**ItemCode:101552**

Amongst the following, the number of molecule/(s) having net resultant dipole moment is _____.

$NF_3$, $BF_3$, $BeF_2$, $CHCl_3$, $H_2S$, $SiF_4$, $CCl_4$, $PF_5$

**Question:**

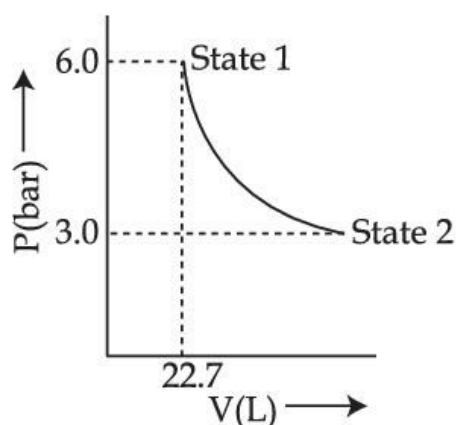**Q:83**
**Topic Name:** Chemistry-Section B

1.0 mol of monoatomic ideal gas is expanded from state 1 to state 2 as shown in the figure. The magnitude of the work done for the expansion of gas from state 1 to state 2 at 300 K is _____ J. (Nearest integer)

(Given : $R = 8.3$ J K$^{-1}$ mol$^{-1}$, ln10 = 2.3, log2 = 0.30)



Question:

Q:84
Topic Name:Chemistry-Section B

ItemCode:101554

For the reaction P → B, the values of frequency factor A and activation energy $E_A$ are $4 \times 10^{13}$ s$^{-1}$ and 8.3 kJ mol$^{-1}$ respectively. If the reaction is of first order, the temperature at which the rate constant is $2 \times 10^{-6}$ s$^{-1}$ is _____ $\times 10^{-1}$ K

(Given : ln 10 = 2.3, $R = 8.3$ J K$^{-1}$ mol$^{-1}$, log2 = 0.30)

Question:

Q:85
Topic Name:Chemistry-Section B

ItemCode:101555

100 mL of 0.3 M acetic acid is shaken with 0.8 g of wood charcoal. The final concentration of acetic acid in the solution after adsorption is 0.125 M. The mass of acetic acid adsorbed per gram of carbon is _____ $\times 10^{-4}$ g.
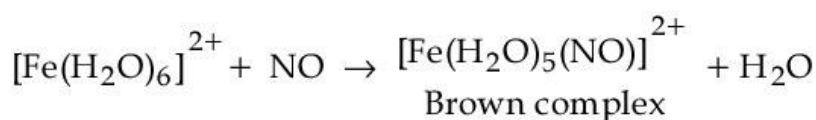
(Given : Molar mass of acetic acid = 60 g mol$^{-1}$)

Question:

Q:86
Topic Name:Chemistry-Section B

ItemCode:101556

In the following brown complex, the oxidation state of iron is + _____.

$$[Fe(H_2O)_6]^{2+} + NO \rightarrow \underset{\text{Brown complex}}{[Fe(H_2O)_5(NO)]^{2+}} + H_2O$$

Question:

Q:87
Topic Name:Chemistry-Section B

ItemCode:101557

Spin only magnetic moment ($\mu_s$) of $K_3[Fe(CN)_6]$ is _____ B.M. (Nearest integer).

Question:

Q:88
Topic Name:Chemistry-Section B

An organic compound with 51.6% sulfur is heated in a Carius tube. The amount of this compound which will form 0.752 g of barium sulphate is _____ $\times 10^{-1}$ g.

**Question:** (Given molar mass of barium sulphate 233 g mol$^{-1}$) (Nearest integer).

**Q:89**
**Topic Name:** Chemistry-Section B

A hydrocarbon 'X' is found to have molar mass of 80. A 10.0 mg of compound 'X' on hydrogenation consumed 8.40 mL of $H_2$ gas (measured at STP). Ozonolysis of compound 'X' yields only formaldehyde and dialdehyde. The total number of fragments/molecules produced from the ozonolysis of compound 'X' is _____.

**Question:**

**Q:90**
**Topic Name:** Chemistry-Section B

How many of the following drugs belong to the tranquilizer class _____ ?

Veronal, Luminal, Propanal, Seconal

**Question:**