

Central Board of Secondary Education

Question Paper Name :	B Tech 9 Apr 2013 Single slot
Subject Name :	B. Tech
Duration :	180
Total Marks :	360
Display Marks:	Yes

B. Tech

Group Number :	1
Group Maximum Duration :	0
Group Minimum Duration :	180
Show Attended Group? :	No
Edit Attended Group? :	No
Break time :	0
Group Marks :	360

Mathematics Section A

Section Number :	1
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 1 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

The values of 'a' for which one root of the equation $x^2 - (a + 1)x + a^2 + a - 8 = 0$ exceeds 2 and the other is lesser than 2, are given by :

- | | |
|------------------|-----------------|
| (1) $3 < a < 10$ | (2) $a \geq 10$ |
| (3) $-2 < a < 3$ | (4) $a \leq -2$ |

Question Number : 2 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

If $Z_1 \neq 0$ and Z_2 be two complex numbers such that $\frac{Z_2}{Z_1}$ is a purely imaginary number, then $\left| \frac{2Z_1 + 3Z_2}{2Z_1 - 3Z_2} \right|$ is equal to:

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

Question Number : 3 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

A committee of 4 persons is to be formed from 2 ladies, 2 old men and 4 young men such that it includes at least 1 lady, at least 1 old man and at most 2 young men. Then the total number of ways in which this committee can be formed is :

- | | |
|--------|--------|
| (1) 40 | (2) 41 |
| (3) 16 | (4) 32 |

Question Number : 4 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let $a_1, a_2, a_3, \dots$ be an A.P, such that $\frac{a_1+a_2+\dots+a_p}{a_1+a_2+a_3+\dots+a_q} = \frac{p^3}{q^3}; p \neq q$. Then $\frac{a_6}{a_{21}}$ is equal to:

- | | |
|---------------------|------------------------|
| (1) $\frac{41}{11}$ | (2) $\frac{31}{121}$ |
| (3) $\frac{11}{41}$ | (4) $\frac{121}{1861}$ |

Question Number : 5 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The sum of the series: $1 + \frac{1}{1+2} + \frac{1}{1+2+3} + \dots$ upto 10 terms, is:

- | | |
|---------------------|---------------------|
| (1) $\frac{18}{11}$ | (2) $\frac{22}{13}$ |
| (3) $\frac{20}{11}$ | (4) $\frac{16}{9}$ |

Question Number : 6 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The ratio of the coefficient of x^{15} to the term independent of x in the expansion of $\left(x^2 + \frac{2}{x}\right)^{15}$ is:

- | | |
|------------|------------|
| (1) 7 : 16 | (2) 7 : 64 |
| (3) 1 : 4 | (4) 1 : 32 |

Question Number : 7 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A value of x for which $\sin(\cot^{-1}(1+x)) = \cos(\tan^{-1}x)$, is :

- | | |
|--------------------|-------------------|
| (1) $-\frac{1}{2}$ | (2) 1 |
| (3) 0 | (4) $\frac{1}{2}$ |

Question Number : 8 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A light ray emerging from the point source placed at $P(1, 3)$ is reflected at a point Q in the axis of x . If the reflected ray passes through the point $R(6, 7)$, then the abscissa of Q is:

- | | |
|-------------------|-------------------|
| (1) 1 | (2) 3 |
| (3) $\frac{7}{2}$ | (4) $\frac{5}{2}$ |

Question Number : 9 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the three lines $x - 3y = p$, $ax + 2y = q$ and $ax + y = r$ form a right-angled triangle then :

- | | |
|-------------------------|-------------------------|
| (1) $a^2 - 9a + 18 = 0$ | (2) $a^2 - 6a - 12 = 0$ |
| (3) $a^2 - 6a - 18 = 0$ | (4) $a^2 - 9a + 12 = 0$ |

Question Number : 10 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If each of the lines $5x + 8y = 13$ and $4x - y = 3$ contains a diameter of the circle $x^2 + y^2 - 2(a^2 - 7a + 11)x - 2(a^2 - 6a + 6)y + b^3 + 1 = 0$, then :

- | | |
|---|--------------------------------------|
| (1) $a = 5$ and $b \notin (-1, 1)$ | (2) $a = 1$ and $b \notin (-1, 1)$ |
| (3) $a = 2$ and $b \notin (-\infty, 1)$ | (4) $a = 5$ and $b \in (-\infty, 1)$ |

Question Number : 11 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Statement-1: The slope of the tangent at any point P on a parabola, whose axis is the axis of x and vertex is at the origin, is inversely proportional to the ordinate of the point P . Statement-2: The system of parabolas $y^2 = 4ax$ satisfies a differential equation of degree 1 and order 1.

- | | |
|---|---|
| (1) Statement-1 is true; Statement- 2 is true;
Statement-2 is a correct explanation for statement-1. | (2) Statement-1 is true; Statement-2 is true;
Statement- 2 is not a correct explanation for statement-1. |
| (3) Statement-1 is true; Statement- 2 is false. | (4) Statement-1 is false; Statement- 2 is true. |

Question Number : 12 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Equation of the line passing through the points of intersection of the parabola $x^2 = 8y$ and the ellipse

$\frac{x^2}{3} + y^2 = 1$ is :

(1) $y - 3 = 0$

(2) $y + 3 = 0$

(3) $3y + 1 = 0$

(4) $3y - 1 = 0$

Question Number : 13 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If a and c are positive real numbers and the ellipse $\frac{x^2}{4c^2} + \frac{y^2}{c^2} = 1$ has four distinct points in common with the circle $x^2 + y^2 = 9a^2$, then

(1) $9ac - 9a^2 - 2c^2 < 0$

(2) $6ac + 9a^2 - 2c^2 < 0$

(3) $9ac - 9a^2 - 2c^2 > 0$

(4) $6ac + 9a^2 - 2c^2 > 0$

Question Number : 14 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The value of $\lim_{x \rightarrow 0} \frac{1}{x} [\tan^{-1}(\frac{x+1}{2x+1}) - \frac{\pi}{4}]$ is :

(1) 1

(2) $-\frac{1}{2}$

(3) 2

(4) 0

Question Number : 15 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Statement-1: The statement $A \rightarrow (B \rightarrow A)$ is equivalent to $A \rightarrow (A \vee B)$. Statement-2: The statement $\sim [(A \wedge B) \rightarrow (\sim A \vee B)]$ is a Tautology.

(1) Statement-1 is false; Statement-2 is true.

(2) Statement-1 is true; Statement-2 is true;
Statement-2 is not correct explanation for
Statement-1.

(3) Statement-1 is true; Statement-2 is false.

(4) Statement-1 is true; Statement-2 is true;
Statement-2 is the correct explanation for
Statement-1.

Question Number : 16 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The mean of a data set consisting of 20 observations is 40. If one observation 53 was wrongly recorded as 33, then the correct mean will be:

(1) 41

(2) 49

(3) 40.5

(4) 42.5

Question Number : 17 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The matrix $A^2 + 4A - 5I$, where I is identity matrix and $A = \begin{bmatrix} 1 & 2 \\ 4 & -3 \end{bmatrix}$, equals :

(1) $4 \begin{bmatrix} 2 & 1 \\ 2 & 0 \end{bmatrix}$

(2) $4 \begin{bmatrix} 0 & -1 \\ 2 & 2 \end{bmatrix}$

(3) $32 \begin{bmatrix} 2 & 1 \\ 2 & 0 \end{bmatrix}$

(4) $32 \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$

Question Number : 18 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If a, b, c are sides of a scalene triangle, then the value of $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ is :

(1) non-negative

(2) negative

(3) positive

(4) non-positive

Question Number : 19 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let $A = \{1, 2, 3, 4\}$ and $R : A \rightarrow A$ be the relation defined by $R = \{(1, 1), (2, 3), (3, 4), (4, 2)\}$. The correct statement is :

- (1) R does not have an inverse.
- (2) R is not a one to one function.
- (3) R is an onto function.
- (4) R is not a function.

Question Number : 20 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let $f(x) = \frac{x^2-x}{x^2+2x} x \neq 0, -2$. Then $\frac{d}{dx} [f^{-1}(x)]$ (wherever it is defined) is equal to:

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

Question Number : 21 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Statement-1: The equation $x \log x = 2 - x$ is satisfied by at least one value of x lying between 1 and 2.

Statement-2: The function $f(x) = x \log x$ is an increasing function in $[1, 2]$ and $g(x) = 2 - x$ is a decreasing function in $[1, 2]$ and the graphs represented by these functions intersect at a point in $[1, 2]$

- (1) Statement-1 is true; Statement-2 is true;
Statement-2 is a correct explanation for Statement-1.
- (2) Statement-1 is true; Statement-2 is true;
Statement-2 is not correct explanation for Statement-1.
- (3) Statement-1 is false, Statement-2 is true.
- (4) Statement-1 is true, Statement-2 is false.

Question Number : 22 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the surface area of a sphere of radius r is increasing uniformly at the rate $8 \text{ cm}^2/\text{s}$, then the rate of change of its volume is:

- (1) constant
- (2) proportional to $\sqrt{r}$
- (3) proportional to r^2
- (4) proportional to r

Question Number : 23 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $\int \frac{dx}{x+x^7} = p(x)$ then, $\int \frac{x^6}{x+x^7} dx$ is equal to:

- (1) $\ln |x| - p(x) + c$
- (2) $\ln |x| + p(x) + c$
- (3) $x - p(x) + c$
- (4) $x + p(x) + c$

Question Number : 24 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $x = \int_0^y \frac{dt}{\sqrt{1+t^2}}$, then $\frac{d^2y}{dx^2}$ is equal to :

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

Question Number : 25 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The area bounded by the curve $y = \ln(x)$ and the lines $y = 0, y = \ln(3)$ and $x = 0$ is equal to:

- (1) 3
- (2) $3 \ln(3) - 2$
- (3) $3 \ln(3) + 2$
- (4) 2

Question Number : 26 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Let $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$ and $\vec{c} = \hat{i} + \hat{j} - 2\hat{k}$ be three vectors. A vector of the type $\vec{b} + \lambda\vec{c}$ for some scalar λ , whose projection on $\vec{a}$ is of magnitude $\sqrt{\frac{2}{3}}$ is :

- (1) $2\hat{i} + \hat{j} + 5\hat{k}$ (2) $2\hat{i} + 3\hat{j} - 3\hat{k}$
(3) $2\hat{i} - \hat{j} + 5\hat{k}$ (4) $2\hat{i} + 3\hat{j} + 3\hat{k}$

Question Number : 27 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

The vector $(\hat{i} \times \vec{a} \cdot \vec{b})\hat{i} + (\hat{j} \times \vec{a} \cdot \vec{b})\hat{j} + (\hat{k} \times \vec{a} \cdot \vec{b})\hat{k}$ is equal to:

- (1) $\vec{b} \times \vec{a}$ (2) $\vec{a}$
(3) $\vec{a} \times \vec{b}$ (4) $\vec{b}$

Question Number : 28 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

A vector $\vec{n}$ is inclined to x -axis at 45° , to y -axis at 60° and at an acute angle to z -axis. If $\vec{n}$ is a normal to a plane passing through the point $(\sqrt{2}, -1, 1)$ then the equation of the plane is :

- (1) $4\sqrt{2}x + 7y + z - 2$ (2) $2x + y + 2z = 2\sqrt{2} + 1$
(3) $3\sqrt{2}x - 4y - 3z = 7$ (4) $\sqrt{2}x - y - z = 2$

Question Number : 29 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

If the lines $\frac{x+1}{2} = \frac{y-1}{1} = \frac{z+1}{3}$ and $\frac{x+2}{2} = \frac{y-k}{3} = \frac{z}{4}$ are coplanar, then the value of k is :

- (1) $\frac{11}{2}$ (2) $-\frac{11}{2}$
(3) $\frac{9}{2}$ (4) $-\frac{9}{2}$

Question Number : 30 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

The probability of a man hitting a target is $\frac{2}{5}$. He fires at the target k times (k , a given number). Then the minimum k , so that the probability of hitting the target at least once is more than $\frac{7}{10}$, is :

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

Physics Section A

Section Number :	2
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 31 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

From the following, the quantity (constructed from the basic constants of nature), that has the dimensions, as well as correct order of magnitude, vis-a-vis typical atomic size, is:

- (1) $\frac{e^2}{4\pi\epsilon_0 mc^2}$ (2) $\frac{4\pi\epsilon_0 e^2}{me^2}$
(3) $\frac{me^2}{4\pi\epsilon_0 b^2}$ (4) $\frac{4\pi\epsilon_0 mc^2}{e^2}$

Question Number : 32 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Two springs of force constants 300 N/m (Spring A) and 400 N/m (Spring B) are joined together in series. The combination is compressed by 8.75 cm. The ratio of energy stored in A and B is $\frac{E_A}{E_B}$. Then $\frac{E_A}{E_B}$ is equal to:

- (1) $\frac{4}{3}$ (2) $\frac{16}{9}$
(3) $\frac{3}{4}$ (4) $\frac{9}{16}$

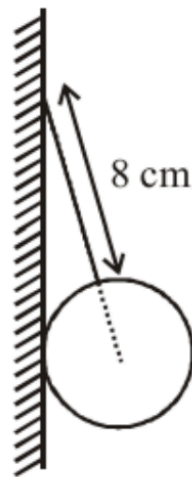
Question Number : 33 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

A bullet of mass 10 g and speed 500 m/s is fired into a door and gets embedded exactly at the centre of the door. The door is 1.0 m wide and weighs 12 kg. It is hinged at one end and rotates about a vertical axis practically without friction. The angular speed of the door just after the bullet embeds into it will be :

- (1) 6.25rad/sec (2) 0.625rad/sec
(3) 3.35rad/sec (4) 0.335rad/sec

Question Number : 34 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

A uniform sphere of weight W and radius 5 cm is being held by a string as shown in the figure. The tension in

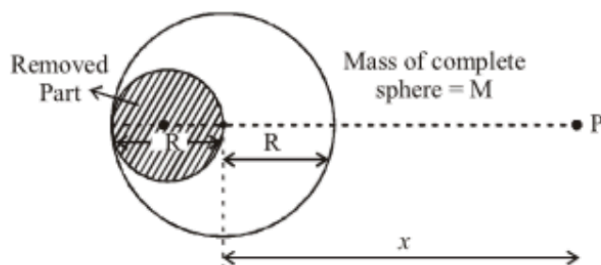


the string will be :

- (1) $12\frac{W}{5}$ (2) $5\frac{W}{12}$
(3) $13\frac{W}{5}$ (4) $13\frac{W}{12}$

Question Number : 35 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

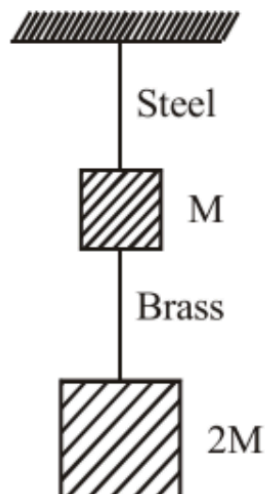
The gravitational field, due to the 'left over part' of a uniform sphere (from which a part as shown, has been 'removed out'), at a very far off point, P, located as shown, would be (nearly) :



- (1) $\frac{5}{6} \frac{GM}{x^2}$ (2) $\frac{8}{9} \frac{GM}{x^2}$
(3) $\frac{7}{8} \frac{GM}{x^2}$ (4) $\frac{6}{7} \frac{GM}{x^2}$

Question Number : 36 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

If the ratio of lengths, radii and Young's moduli of steel and brass wires in the figure are a, b and c respectively,



then the corresponding ratio of increase in their lengths is :

- | | |
|------------------------|-----------------------|
| (1) $\frac{3c}{2ab^2}$ | (2) $\frac{2a^2c}{b}$ |
| (3) $\frac{3a}{2b^2c}$ | (4) $\frac{2ac}{b^2}$ |

Question Number : 37 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

This question has Statement-1 and Statement-2 . Of the four choices given after the Statements, choose the one that best describes the two Statetnents. Statement-1: A capillary is dipped in a liquid and liquid rises to a height h in it. As the temperature of the liquid is raised, the height h increases (if the density of the liquid and the angle of contact remain the same). Statement-2: Surface tension of a liquid decreases with the rise in its temperature.

- | | |
|---|---|
| (1) Statement-1 is true, Statement-2 is true; | (2) Statement-1 is false, Statement- 2 is true. |
|---|---|

Statement-2 is not the correct explanation for
Statement-1.

- | | |
|---|---|
| (3) Statement-1 is true, Statement- 2 is false. | (4) Statement-1 is true, Statement-2 is true;
Statement-2 is the correct explanation for
Statement-1. |
|---|---|

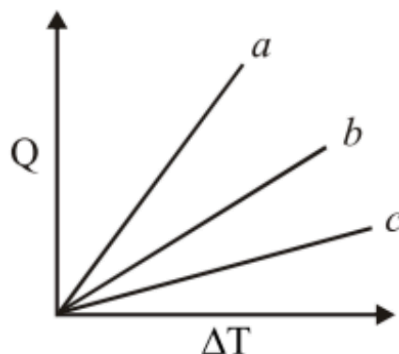
Question Number : 38 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

On a linear temperature scale Y, water freezes at -160°Y and boils at -50°Y . On this Y scale, a temperature of 340 K would be read as : (water freezes at 273 K and boils at 373 K)

- | | |
|---------------------------|----------------------------|
| (1) -73.7°Y | (2) -233.7°Y |
| (3) -86.3°Y | (4) -106.3°Y |

Question Number : 39 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

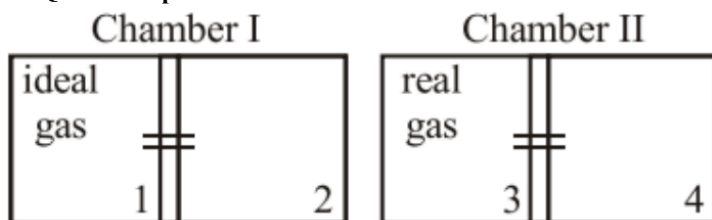
Figure shows the variation in temperature (ΔT) with the amount of heat supplied (Q) in an isobaric process corresponding to a monoatomic (M), diatomic (D) and a polyatomic (P) gas. The initial state of all the gases are the same and the scales for the two axes coincide. Ignoring vibrational degrees of freedom, the lines a , b and



c respectively correspond to :

- | | |
|----------------|----------------|
| (1) P, M and D | (2) M, D and P |
| (3) P, D and M | (4) D, M and P |

Question Number : 40 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No



There are two identical chambers, completely thermally insulated from surroundings. Both chambers have a partition wall dividing the chambers in two compartments. Compartment 1 is filled with an ideal gas and Compartment 3 is filled with a real gas. Compartments 2 and 4 are vacuum. A small hole (orifice) is made in the partition walls and the gases are allowed to expand in vacuum. Statement – 1 : No change in the temperature of the gas takes place when ideal gas expands in vacuum. However, the temperature of real gas goes down (cooling) when it expands in vacuum. Statement – 2 : The internal energy of an ideal gas is only kinetic. The internal energy of a real gas is kinetic as well as potential.

- | | |
|--|---|
| (1) Statement-1 is false and Statement-2 is true. | (2) Statement-1 and Statement-2 both are true.
Statement-2 is the correct explanation of
Statement-1. |
| (3) Statement-1 is true and Statement- 2 is false. | (4) Statement-1 and Statement-2 both are true.
Statement-2 is not correct explanation of
Statement-1. |

Question Number : 41 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Two simple pendulums of length 1 m and 4 m respectively are both given small displacement in the same direction at the same instant. They will be again in phase after the shorter pendulum has completed number of oscillations equal to:

- | | |
|-------|-------|
| (1) 2 | (2) 7 |
| (3) 5 | (4) 3 |

Question Number : 42 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

When two sound waves travel in the same direction in a medium, the displacements of a particle located at ' x ' at time ' t ' is given by : $y_1 = 0.05 \cos(0.50\pi x - 100\pi t)$ $y_2 = 0.05 \cos(0.46\pi x - 92\pi t)$ where y_1, y_2 and x are in meters and t in seconds. The speed of sound in the medium is :

- (1) 92 m/s (2) 200 m/s
(3) 100 m/s (4) 332 m/s

Question Number : 43 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

An engine approaches a hill with a constant speed. When it is at a distance of 0.9 km, it blows a whistle whose echo is heard by the driver after 5 seconds. If the speed of sound in air is 330 m/s, then the speed of the engine is :

- (1) 32 m/s (2) 27.5 m/s
(3) 60 m/s (4) 30 m/s

Question Number : 44 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Two point dipoles of dipole moment $\vec{p}_1$ and $\vec{p}_2$ are at a distance x from each other and $\vec{p}_1 \parallel \vec{p}_2$. The force between the dipoles is :

- (1) $\frac{1}{4\pi\epsilon_0} \frac{4p_1p_2}{x^4}$ (2) $\frac{1}{4\pi\epsilon_0} \frac{3p_1p_2}{x^3}$
(3) $\frac{1}{4\pi\epsilon_0} \frac{6p_1p_2}{x^4}$ (4) $\frac{1}{4\pi\epsilon_0} \frac{8p_1p_2}{x^4}$

Question Number : 45 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Two balls of same mass and carrying equal charge are hung from a fixed support of length l . At electrostatic equilibrium, assuming that angles made by each thread is small, the separation, x between the balls is proportional to :

- (1) l (2) l^2
(3) $l^{2/3}$ (4) $l^{1/3}$

Question Number : 46 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In a metre bridge experiment null point is obtained at 40 cm from one end of the wire when resistance X is balanced against another resistance Y . If $X < Y$, then the new position of the null point from the same end, if one decides to balance a resistance of $3X$ against Y , will be close to :

- (1) 80 cm (2) 75 cm
(3) 67 cm (4) 50 cm

Question Number : 47 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A letter 'A' is constructed of a uniform wire with resistance 1.0Ω per cm, The sides of the letter are 20 cm and the cross piece in the middle is 10 cm long. The apex angle is 60° . The resistance between the ends of the legs is close to:

- (1) 50.0Ω (2) 10Ω
(3) 36.7Ω (4) 26.7Ω

Question Number : 48 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A shunt of resistance $1\ \Omega$ is connected across a galvanometer of $120\ \Omega$ resistance. A current of 5.5 ampere gives full scale deflection in the galvanometer. The current that will give full scale deflection in the absence of the shunt is nearly :

- | | |
|------------------|------------------|
| (1) 5.5 ampere | (2) 0.5 ampere |
| (3) 0.004 ampere | (4) 0.045 ampere |

Question Number : 49 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A uniform electric field $\vec{E}$ exists between the plates of a charged condenser. A charged particle enters the space between the plates and perpendicular to $\vec{E}$. The path of the particle between the plates is a:

- | | |
|-------------------|---------------|
| (1) straight line | (2) hyperbola |
| (3) parabola | (4) circle |

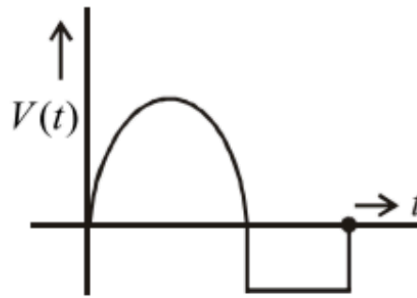
Question Number : 50 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

An electric current is flowing through a circular coil of radius R . The ratio of the magnetic field at the centre of the coil and that at a distance $2\sqrt{2}R$ from the centre of the coil and on its axis is :

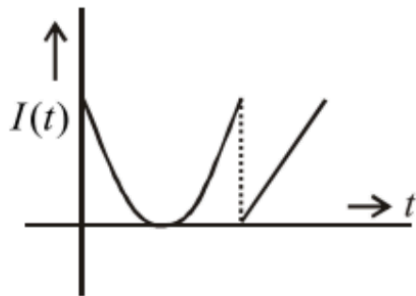
- | | |
|-----------------|--------|
| (1) $2\sqrt{2}$ | (2) 27 |
| (3) 36 | (4) 8 |

Question Number : 51 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

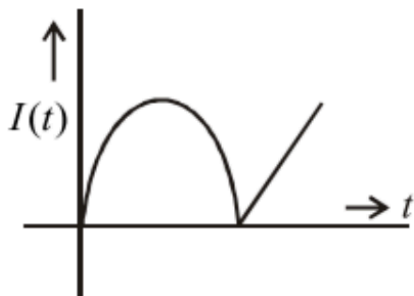
Two coils, X and Y, are kept in close vicinity of each other. When a varying current, $I(t)$, flows through coil X, the induced emf ($V(t)$) in coil Y, varies in the manner shown here. The variation of $I(t)$, with time, can then



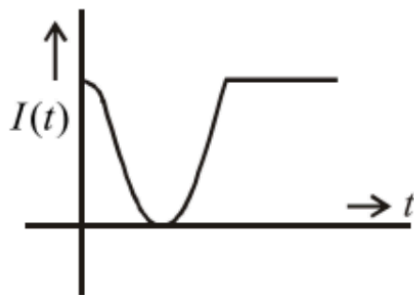
be represented by the graph labelled as graph :



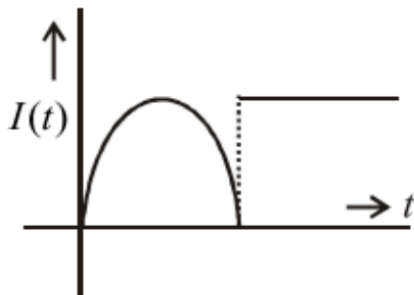
(A)



(B)



(C)



(D)

(1) A

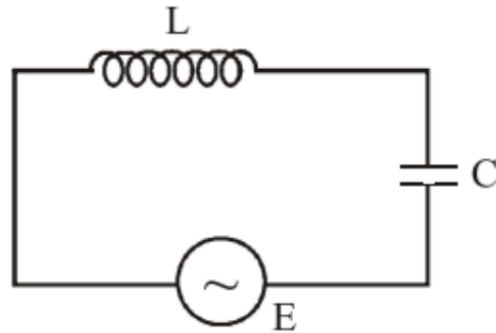
(3) B

(2) C

(4) D

Question Number : 52 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

In the circuit shown here, the voltage across E and C are respectively 300 V and 400 V. The voltage E of the



ac source is :

- | | |
|--------------|--------------|
| (1) 400 Volt | (2) 500 Volt |
| (3) 100 Volt | (4) 700 Volt |

Question Number : 53 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Photons of an electromagnetic radiation has an energy 11keV each. To which region of electromagnetic spectrum does it belong ?

- | | |
|---------------------|-------------------------|
| (1) X-ray region | (2) Ultra violet region |
| (3) Infrared region | (4) Visible region |

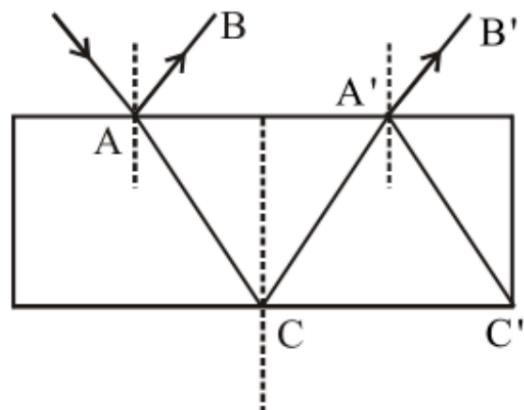
Question Number : 54 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Light is incident from a medium into air at two possible angles of incidence (A) 20° and (B) 40° . In the medium light travels 3.0 cm in 0.2 ns. The ray will :

- | | |
|--|---|
| (1) suffer total internal reflection in both cases (A) and (B) | (2) suffer total internal reflection in case (B) only |
| (3) have partial reflection and partial transmission in case (B) | (4) have 100% transmission in case (A) |

Question Number : 55 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

A ray of light of intensity I is incident on a parallel glass slab at point A as shown in diagram. It undergoes partial reflection and refraction. At each reflection, 25% of incident energy is reflected. The rays AB and A'B' undergo interference. The ratio of $I_{\max}$ and $I_{\min}$ is :

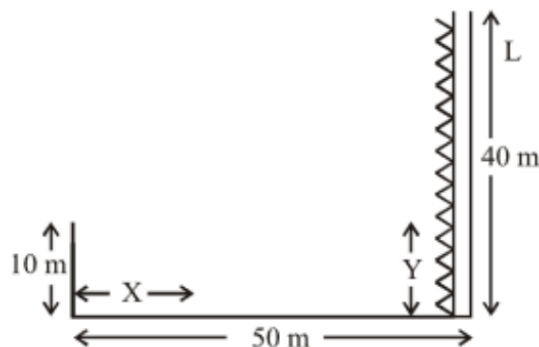


undergo interference. The ratio of $I_{\max}$ and $I_{\min}$ is :

- | | |
|------------|-----------|
| (1) 49 : 1 | (2) 7 : 1 |
| (3) 4 : 1 | (4) 8 : 1 |

Question Number : 56 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A person lives in a high-rise building on the bank of a river 50 m wide. Across the river is a well lit tower of height 40 m. When the person, who is at a height of 10 m, looks through a polarizer at an appropriate angle at light of the tower reflecting from the river surface, he notes that intensity of light coming from distance X from his building is the least and this corresponds to the light coming from light bulbs at height ' Y ' on the tower. The values of X and Y are respectively close to (refractive index of water $\simeq \frac{4}{3}$)



- | | |
|----------------|----------------|
| (1) 25 m, 10 m | (2) 13 m, 27 m |
| (3) 22 m, 13 m | (4) 17 m, 20 m |

Question Number : 57 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In the Bohr model an electron moves in a circular orbit around the proton. Considering the orbiting electron to be a circular current loop, the magnetic moment of the hydrogen atom, when the electron is in n^{th} excited state, is :

- | | |
|--|---|
| (1) $\left(\frac{e}{2m} \frac{n^2 h}{2\pi} \right)$ | (2) $\left(\frac{e}{m} \right) \frac{nh}{2\pi}$ |
| (3) $\left(\frac{e}{2m} \right) \frac{nh}{2\pi}$ | (4) $\left(\frac{e}{m} \right) \frac{n^2 h}{2\pi}$ |

Question Number : 58 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

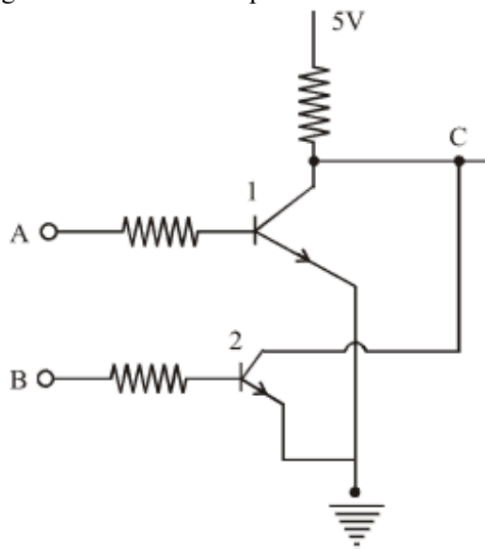
When Uranium is bombarded with neutrons, it undergoes fission. The fission reaction can be written as :

${}_{92}\text{U}^{235} + {}_0\text{n}^1 \rightarrow {}_{56}\text{Ba}^{141} + {}_{36}\text{Kr}^{92} + 3x + Q(\text{energy})$ where three particles named x are produced and energy Q is released. What is the name of the particle x ?

- | | |
|--------------|------------------------|
| (1) electron | (2) α -particle |
| (3) neutron | (4) neutrino |

Question Number : 59 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Consider two npn transistors as shown in figure. If 0 Volts corresponds to false and 5 Volts correspond to true



then the output at C corresponds to :

- | | |
|--------------|-------------|
| (1) A NAND B | (2) A OR B |
| (3) A AND B | (4) A NOR B |

Question Number : 60 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

If a carrier wave $c(t) = A \sin \omega_c t$ is amplitude modulated by a modulator signal $m(t) = A \sin \omega_m t$ then the equation of modulated signal $[C_m(t)]$ and its modulation index are respectively

- | | |
|---|---|
| (1) $C_m(t) = A(1 + \sin \omega_m t) \sin \omega_c t$ and 2 | (2) $C_m(t) = A(1 + \sin \omega_m t) \sin \omega_m t$ and 1 |
| (3) $C_m(t) = A(1 + \sin \omega_m t) \sin \omega_c t$ and 1 | (4) $C_m(t) = A(1 + \sin \omega_c t) \sin \omega_m t$ and 2 |

Chemistry Section A

Section Number :	3
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 61 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

In an atom how many orbital(s) will have the quantum numbers; $n = 3, l = 2$ and $m_l = +2$?

- | | |
|-------|-------|
| (1) 5 | (2) 3 |
| (3) 1 | (4) 7 |

Question Number : 62 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Electron gain enthalpy with negative sign of fluorine is less than that of chlorine due to :

- | | |
|--|---|
| (1) High ionization enthalpy of fluorine | (2) Smaller size of chlorine atom |
| (3) Smaller size of fluorine atom | (4) Bigger size of $2p$ orbital of fluorine |

Question Number : 63 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Which one of the following molecules is polar?

- (1) XeF_4 (2) IF_5
(3) SbF_5 (4) CF_4

Question Number : 64 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

In which of the following ionization processes the bond energy has increased and also the magnetic behaviour has changed from paramagnetic to diamagnetic ?

- (1) $\text{NO} \rightarrow \text{NO}^+$ (2) $\text{N}_2 \rightarrow \text{N}_2^+$
(3) $\text{C}_2 \rightarrow \text{C}_2^+$ (4) $\text{O}_2 \rightarrow \text{O}_2^+$

Question Number : 65 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

By how many folds the temperature of a gas would increase when the root mean square velocity of the gas molecules in a container of fixed volume is increased from $5 \times 10^4 \text{ cm/s}$ to $10 \times 10^4 \text{ cm/s}$?

- (1) Two (2) Three
(3) Six (4) Four

Question Number : 66 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Given: (I) $\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}); \Delta H^\circ_{298 \text{ K}} = -285.9 \text{ kJ mol}^{-1}$ (II) $\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{g}); \Delta H^\circ_{298 \text{ K}} = -241.8 \text{ kJ mol}^{-1}$ The molar enthalpy of vapourisation of water will be :

- (1) $241.8 \text{ kJ mol}^{-1}$ (2) 22.0 kJ mol^{-1}
(3) 44.1 kJ mol^{-1} (4) $527.7 \text{ kJ mol}^{-1}$

Question Number : 67 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

In reaction $\text{A} + 2\text{B} \rightleftharpoons 2\text{C} + \text{D}$, initial concentration of B was 1.5 times of [A], but at equilibrium the concentrations of A and B became equal. The equilibrium constant for the reaction is :

- (1) 8 (2) 4
(3) 12 (4) 6

Question Number : 68 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Solid $\text{Ba}(\text{NO}_3)_2$ is gradually dissolved in a $1.0 \times 10^{-4} \text{ M}$ Na_2CO_3 solution. At which concentration of Ba^{2+} , precipitate of BaCO_3 begins to form ? (K_{sp} for $\text{BaCO}_3 = 5.1 \times 10^{-9}$)

- (1) $5.1 \times 10^{-5} \text{ M}$ (2) $7.1 \times 10^{-8} \text{ M}$
(3) $4.1 \times 10^{-5} \text{ M}$ (4) $8.1 \times 10^{-7} \text{ M}$

Question Number : 69 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Given : $\text{XNa}_2\text{HAsO}_3 + \text{YNaBrO}_3 + \text{ZHCl} \rightarrow \text{NaBr} + \text{H}_3\text{AsO}_4 + \text{NaCl}$ The values of X, Y and Z in the above redox reaction are respectively :

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

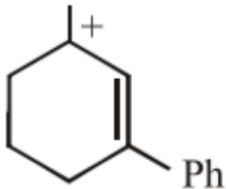
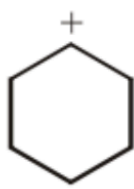
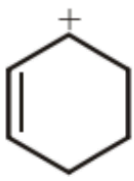
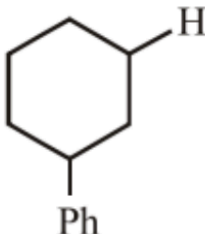
Question Number : 70 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Sodium Carbonate cannot be used in place of $(\text{NH}_4)_2\text{CO}_3$ for the identification of Ca^{2+} , Ba^{2+} and Sr^{2+} ions (in group V) during mixture analysis because :

- | | |
|--|--|
| (1) Mg^{2+} ions will also be precipitated. | (2) Concentration of CO_3^{2-} ions is very low. |
| (3) Sodium ions will react with acid radicals. | (4) Na^+ ions will interfere with the detection of Ca^{2+} , Ba^{2+} , Sr^{2+} ions. |

Question Number : 71 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Which one of the following is most stable ?

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

Question Number : 72 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Rate of dehydration of alcohols follows the order:

- | | |
|--|--|
| (1) $2^\circ > 1^\circ > \text{CH}_3\text{OH} > 3^\circ$ | (2) $3^\circ > 2^\circ > 1^\circ > \text{CH}_3\text{OH}$ |
| (3) $2^\circ > 3^\circ > 1^\circ > \text{CH}_3\text{OH}$ | (4) $\text{CH}_3\text{OH} > 1^\circ > 2^\circ > 3^\circ$ |

Question Number : 73 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Which of the following compounds is not expected to show Lassaignes' test for nitrogen ?

- | | |
|--------------------|---------------------------------|
| (1) Propanenitrile | (2) Hydroxylamine hydrochloride |
| (3) Nitromethane | (4) Ethanamine |

Question Number : 74 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

The addition of HI in the presence of peroxide catalyst does not follow anti-Markovnikov's rule because :

- | | |
|--|---|
| (1) HI is a strong reducing agent. | (2) H – I bond is too strong to be broken homolytically. |
| (3) I atom combines with H atom to give back HI. | (4) Iodine atom is not reactive enough to add across a double bond. |

Question Number : 75 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

An element having an atomic radius of 0.14 nm crystallizes in an f_{cc} unit cell. What is the length of a side of the cell ?

- | | |
|-------------|-------------|
| (1) 0.56 nm | (2) 0.24 nm |
| (3) 0.96 nm | (4) 0.4 nm |

Question Number : 76 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

12 g of a nonvolatile solute dissolved in 108 g of water produces the relative lowering of vapour pressure of 0.1. The molecular mass of the solute is :

- (1) 80
- (2) 60
- (3) 20
- (4) 40

Question Number : 77 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Electrode potentials (E°) are given below : $\frac{1}{2}I_2(s)/I^- = +0.54 V$, Based on the above potentials, strongest oxidizing agent will be :

$Cu^+/Cu = +0.52 V$,
 $Fe^{3+}/Fe^{2+} = +0.77 V$,
 $Ag^+/Ag = +0.88 V$.

- (1) Cu^+
- (2) Fe^{3+}
- (3) Ag^+
- (4) I_2

Question Number : 78 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

The instantaneous rate of disappearance of MnO_4^- ion in the following reaction is $4.56 \times 10^{-3} Ms^{-1}$

$2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$ The rate of appearance I_2 is :

- (1) $4.56 \times 10^{-4} Ms^{-1}$
- (2) $1.14 \times 10^{-2} Ms^{-1}$
- (3) $1.14 \times 10^{-3} Ms^{-1}$
- (4) $5.7 \times 10^{-3} Ms^{-1}$

Question Number : 79 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

The migration of dispersion medium under the influence of an electric potential is called :

- (1) Cataphoresis
- (2) Electroosmosis
- (3) Electrophoresis
- (4) Sedimentation

Question Number : 80 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Calcination is the process in which:

- (1) ore is heated above its melting point to expel H_2O or CO_2 or SO_2
- (2) ore is heated below its melting point to expel volatile impurities
- (3) ore is heated above its melting point to remove S, As and Sb as SO_2 , As_2O_3 and Sb_2O_3 respectively
- (4) ore is heated below its melting point to expel H_2O or CO_2

Question Number : 81 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Trigonal bipyramidal geometry is shown by:

- (1) $XeOF_2$
- (2) XeO_3F_2
- (3) $FXeOSO_2F$
- (4) $[XeF_8]^{2-}$

Question Number : 82 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Potassium dichromate when heated with concentrated sulphuric acid and a soluble chloride, gives brown-red vapours of :

- (1) CrO_3
- (2) $CrCl_3$
- (3) CrO_2Cl_2
- (4) Cr_2O_3

Question Number : 83 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

The element with which of the following outer electron configuration may exhibit the largest number of oxidation states in its compounds :

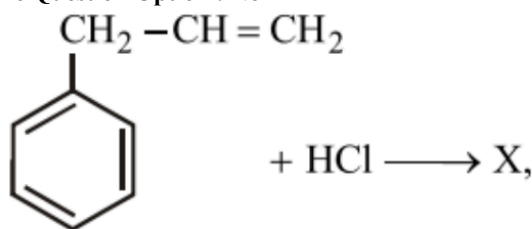
- (1) $3d^5 4s^2$ (2) $3d^8 4s^2$
(3) $3d^7 4s^2$ (4) $3d^6 4s^2$

Question Number : 84 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

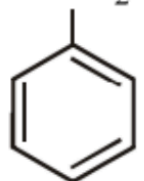
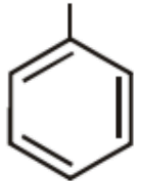
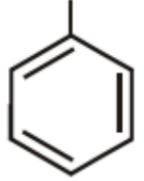
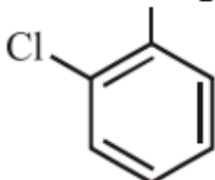
Type of isomerism which exists between $[\text{Pd}(\text{C}_6\text{H}_5)_2(\text{SCN})_2]$ and $[\text{Pd}(\text{C}_6\text{H}_5)_2(\text{NCS})_2]$ is :

- (1) Linkage isomerism (2) Coordination isomerism
(3) Ionisation isomerism (4) Solvate isomerism

Question Number : 85 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No



X is:

- (1) $\text{CH}_2 - \text{CH} - \text{CH}_3$
 (2) $\text{CH}_2 - \text{CH}_2 - \text{CH}_2\text{Cl}$

(3) Cl
 $\text{CH} - \text{CH}_2 - \text{CH}_3$
 (4) $\text{CH}_2 - \text{CH} = \text{CH}_2$


Question Number : 86 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Aryl fluoride may be prepared from arene diazonium chloride using :

- (1) HBF_4/Δ (2) $\text{HBF}_4/\text{NaNO}_2, \text{Cu}, \Delta$
(3) CuF/HF (4) Cu/HF

Question Number : 87 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

An ether (A), $\text{C}_5\text{H}_{12}\text{O}$, when heated with excess of hot concentrated HI produced two alkyl halides which when treated with NaOH yielded compounds (B) and (C). Oxidation of (B) and (C) gave a propanone and an ethanoic acid respectively. The IUPAC name of the ether (A) is :

- (1) 2-ethoxypropane (2) ethoxypropane
(3) methoxybutane (4) 2-methoxybutane

Question Number : 88 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Formaldehyde can be distinguished from acetaldehyde by the use of :

- | | |
|----------------------|------------------------|
| (1) Schiff's reagent | (2) Tollen's reagent |
| (3) I_2 /Alkali | (4) Fehling's solution |

Question Number : 89 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If a polythene sample contains two monodisperse fractions in the ratio 2 : 3 with degree of polymerization 100 and 200, respectively, then its weight average molecular weight will be :

- | | |
|----------|----------|
| (1) 4900 | (2) 4600 |
| (3) 4300 | (4) 5200 |

Question Number : 90 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which of the following enzyme converts starch into maltose?

- | | |
|--------------|---------------|
| (1) Diastase | (2) Maltase |
| (3) Zymase | (4) Invertase |