

Central Board of Secondary Education

Question Paper Name :	B Tech 22 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

If α and β are roots of the equation $x^2 + px + \frac{3p}{4} = 0$, such that $|\alpha - \beta| = \sqrt{10}$, then p belongs to the set :

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

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

If a complex number z satisfies the equation $x + \sqrt{2}|z + 1| + i = 0$, then $|z|$ is equal to :

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

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

The number of ways in which an examiner can assign 30 marks to 8 questions, giving not less than 2 marks to any question, is :

- | | |
|------------------|------------------|
| (1) ${}^{30}C_7$ | (2) ${}^{21}C_8$ |
| (3) ${}^{21}C_7$ | (4) ${}^{30}C_8$ |

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

Given sum of the first n terms of an A.P. is $2n + 3n^2$. Another A.P. is formed with the same first term and double of the common difference, the sum of n terms of the new A.P. is :

- (1) $n + 4n^2$ (2) $6n^2 - n$
(3) $n^2 + 4n$ (4) $3n + 2n^2$

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

The sum $\frac{3}{1^2} + \frac{5}{1^2+2^2} + \frac{7}{1^2+2^2+3^2} + \dots$ upto 11-terms is:

- (1) $\frac{7}{2}$ (2) $\frac{11}{4}$
(3) $\frac{11}{2}$ (4) $\frac{60}{11}$

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

If the 7th term in the binomial expansion of $\left(\frac{3}{\sqrt[3]{84}} + \sqrt{3} \ln x\right)^9$, $x > 0$, is equal to 729, then x can be:

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

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

The number of solutions of the equation, $\sin^{-1} x = 2 \tan^{-1} x$ (in principal values) is :

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

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

Statement-1: The number of common solutions of the trigonometric equations $2 \sin^2 \theta - \cos 2\theta = 0$ and $2 \cos^2 \theta - 3 \sin \theta = 0$ in the interval $[0, 2\pi]$ is two. Statement-2: The number of solutions of the equation, $2 \cos^2 \theta - 3 \sin \theta = 0$ in the interval $[0, \pi]$ is two.

- (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 false; Statement-2 is true. (4) Statement-1 is true; Statement-2 is false.

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

If the x -intercept of some line L is double as that of the line, $3x + 4y = 12$ and the y -intercept of L is half as that of the same line, then the slope of L is :

- (1) -3 (2) $-3/8$
(3) $-3/2$ (4) $-3/16$

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

The acute angle between two lines such that the direction cosines l, m, n , of each of them satisfy the equations $l + m + n = 0$ and $l^2 + m^2 - n^2 = 0$ is :

- (1) 15° (2) 30°
(3) 60° (4) 45°

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

If a circle C passing through $(4, 0)$ touches the circle $x^2 + y^2 + 4x - 6y - 12 = 0$ externally at a point $(1, -1)$, then the radius of the circle C is :

- (1) 5 (2) $2\sqrt{5}$
(3) 4 (4) $\sqrt{57}$

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

Statement-1: The line $x - 2y = 2$ meets the parabola, $y^2 + 2x = 0$ only at the point $(-2, -2)$. Statement-2:

The line $y = mx - \frac{1}{2m} (m \neq 0)$ is tangent to the parabola, $y^2 = -2x$ at the point $(-\frac{1}{2m^2}, -\frac{1}{m})$

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

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

Let the equations of two ellipses be

$$E_1 : \frac{x^2}{3} + \frac{y^2}{2} = 1 \text{ and } E_2 : \frac{x^2}{16} + \frac{y^2}{b^2} = 1,$$

If the product of their eccentricities is $\frac{1}{2}$, then the length of the minor axis of ellipse E_2 is :

- (1) 8 (2) 9
(3) 4 (4) 2

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

The statement $p \rightarrow (q \rightarrow p)$ is equivalent to :

- (1) $p \rightarrow q$ (2) $p \rightarrow (p \vee q)$
(3) $p \rightarrow (p \rightarrow q)$ (4) $p \rightarrow (p \wedge q)$

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

Mean of 5 observations is 7. If four of these observations are 6, 7, 8, 10 and one is missing then the variance of all the five observations is :

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

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

If two vertices of an equilateral triangle are $A(-a, 0)$ and $B(a, 0)$, $a > 0$, and the third vertex C lies above x -axis then the equation of the circumcircle of $\triangle ABC$ is :

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

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

Let $R = \{(3, 3), (5, 5), (9, 9), (12, 12), (5, 12), (3, 9), (3, 12), (3, 5)\}$ be a relation on the set $A = \{3, 5, 9, 12\}$.

Then, R is :

- (1) reflexive, symmetric but not transitive. (2) symmetric, transitive but not reflexive.
(3) an equivalence relation. (4) reflexive, transitive but not symmetric.

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

If p, q, r are 3 real numbers satisfying the matrix equation, $[pqr] \begin{bmatrix} 3 & 4 & 1 \\ 3 & 2 & 3 \\ 2 & 0 & 2 \end{bmatrix} = [3 \quad 0 \quad 1]$ then $2p + q - r$

equals :

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

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

If the system of linear equations :

$$\begin{aligned} x_1 + 2x_2 + 3x_3 &= 6 \\ x_1 + 3x_2 + 5x_3 &= 9 \\ 2x_1 + 5x_2 + ax_3 &= b \end{aligned}$$

is consistent and has infinite number of solutions, then :

- (1) $a = 8, b$ can be any real number (2) $b = 15, a$ can be any real number
(3) $a \in R - \{8\}$ and $b \in R - \{15\}$ (4) $a = 8, b = 15$

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

Let $f(x) = -1 + |x - 2|$, and $g(x) = 1 - |x|$; then the set of all points where f_{og} is discontinuous is :

- (1) $\{0, 2\}$ (2) $\{0, 1, 2\}$
(3) $\{0\}$ (4) an empty set

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

For $a > 0, t \in (0, \frac{\pi}{2})$, let $x = \sqrt{a^{\sin^{-1}t}}$ and $y = \sqrt{a^{\cos^{-1}t}}$, Then, $1 + \left(\frac{dy}{dx}\right)^2$ equals :

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

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

Statement-1: The function $x^2(e^x + e^{-x})$ is increasing for all $x > 0$. Statement-2: The functions x^2e^x and x^2e^{-x} are increasing for all $x > 0$ and the sum of two increasing functions in any interval (a, b) is an increasing function in (a, b) .

- (1) Statement-1 is false; Statement-2 is true. (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 true; Statement-2 is true;
Statement-2 is a correct explanation for statement-1.

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

The maximum area of a right angled triangle with hypotenuse h is :

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

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

If $\int \frac{x^2-x+1}{x^2+1} e^{\cot^{-1} x} dx = A(x)e^{\cot^{-1} x} + C$, then $A(x)$ is equal to :

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

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

The integral $\int_{7\pi/4}^{7\pi/3} \sqrt{\tan^2 x} dx$ is equal to :

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

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

The area of the region (in sq. units), in the first quadrant bounded by the parabola $y = 9x^2$ and the lines $x = 0, y = 1$ and $y = 4$, is :

- (1) $7/9$ (2) $14/3$
(3) $7/3$ (4) $14/9$

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

Consider the differential equation :

$$\frac{dy}{dx} = \frac{y^3}{2(xy^2 - x^2)}$$

Statement-1: The substitution $z = y^2$ transforms the above equation into a first order homogenous differential equation. Statement-2: The solution of this differential equation is $y^2 e^{-y^2}/x = C$.

- (1) Both statements are false. (2) Statement-1 is true and statement- 2 is false.
(3) Statement-1 is false and statement-2 is true. (4) Both statements are true.

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

If $\hat{a}, \hat{b}$ and $\hat{c}$ are unit vectors satisfying $\hat{a} - \sqrt{3}\hat{b} + \hat{c} = \vec{0}$, then the angle between the vectors $\hat{a}$ and $\hat{c}$ is :

- (1) $\frac{\pi}{4}$ (2) $\frac{\pi}{3}$
(3) $\frac{\pi}{6}$ (4) $\frac{\pi}{2}$

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

Let Q be the foot of perpendicular from the origin to the plane $4x - 3y + z + 13 = 0$ and R be a point $(-1, -6)$ on the plane. Then length QR is :

- (1) $\sqrt{14}$ (2) $\sqrt{\frac{19}{2}}$
(3) $3\sqrt{\frac{7}{2}}$ (4) $\frac{3}{\sqrt{2}}$

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

Given two independent events, if the probability that exactly one of them occurs is $\frac{26}{49}$ and the probability that none of them occurs is $\frac{15}{49}$, then the probability of more probable of the two events is :

- (1) $4/7$ (2) $6/7$
(3) $3/7$ (4) $5/7$

Physics Section A

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

The dimensions of angular momentum, latent heat and capacitance are, respectively.

- (1) $ML^2 T^1 A^2$, $L^2 T^{-2}$, $M^{-1} L^{-2} T^2$ (2) $ML^2 T^{-2}$, $L^2 T^2$, $M^{-1} L^{-2} T^4 A^2$
(3) $ML^2 T^{-1}$, $L^2 T^{-2}$, $ML^2 TA^2$ (4) $ML^2 T^{-1}$, $L^2 T^{-2}$, $M^{-1} L^{-2} T^4 A^2$

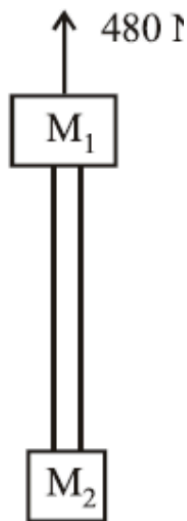
Question Number : 32 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

A ball projected from ground at an angle of 45° just clears a wall in front. If point of projection is 4 m from the foot of wall and ball strikes the ground at a distance of 6 m on the other side of the wall, the height of the wall is :

- (1) 4.4 m (2) 2.4 m
(3) 3.6 m (4) 1.6 m

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

Two blocks of mass $M_1 = 20$ kg and $M_2 = 12$ kg are connected by a metal rod of mass 8 kg. The system is pulled vertically up by applying a force of 480 N as shown. The tension at the mid-point of the rod is:



- (1) 144 N (2) 96 N
(3) 240 N (4) 192 N

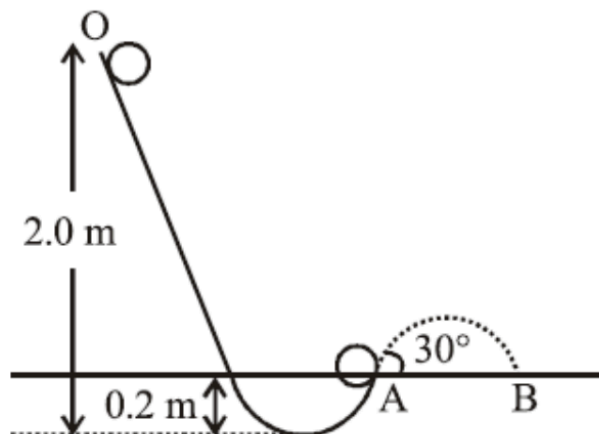
Question Number : 34 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

A body starts from rest on a long inclined plane of slope 45° . The coefficient of friction between the body and the plane varies as $\mu = 0.3x$, where x is distance travelled down the plane. The body will have maximum speed (for $g = 10$ m/s²) when $x =$

- (1) 9.8 m (2) 27 m
(3) 12 m (4) 3.33 m

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

A tennis ball (treated as hollow spherical shell) starting from O rolls down a hill. At point A the ball becomes air borne leaving at an angle of 30° with the horizontal. The ball strikes the ground at B. What is the value of the distance AB ? (Moment of inertia of a spherical shell of mass m and radius R about its diameter $= \frac{2}{3}mR^2$)



- | | |
|------------|------------|
| (1) 1.87 m | (2) 2.08 m |
| (3) 1.57 m | (4) 1.77 m |

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

The change in the value of acceleration of earth towards sun, when the moon comes from the position of solar eclipse to the position on the other side of earth in line with sun is: (mass of the moon $= 7.36 \times 10^{22}$ kg, radius of the moon's orbit $= 3.8 \times 10^8$ m).

- | | |
|---|---|
| (1) $6.73 \times 10^{-5} \text{ m/s}^2$ | (2) $6.73 \times 10^{-3} \text{ m/s}^2$ |
| (3) $6.73 \times 10^{-2} \text{ m/s}^2$ | (4) $6.73 \times 10^{-4} \text{ m/s}^2$ |

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

A uniform wire (Young's modulus $2 \times 10^{11} \text{ Nm}^{-2}$) is subjected to longitudinal tensile stress of $5 \times 10^7 \text{ Nm}^{-2}$. If the overall volume change in the wire is 0.02%, the fractional decrease in the radius of the wire is close to:

- | | |
|---------------------------|--------------------------|
| (1) 1.0×10^{-4} | (2) 1.5×10^{-4} |
| (3) 0.25×10^{-4} | (4) 5×10^{-4} |

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

Air of density 1.2 kg m^{-3} is blowing across the horizontal wings of an aeroplane in such a way that its speeds above and below the wings are 150 ms^{-1} and 100 ms^{-1} , respectively. The pressure difference between the upper and lower sides of the wings, is :

- | | |
|----------------------------|-----------------------------|
| (1) 60 Nm^{-2} | (2) 180 Nm^{-2} |
| (3) 7500 Nm^{-2} | (4) 12500 Nm^{-2} |

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

Given that 1 g of water in liquid phase has volume 1 cm^3 and in vapour phase 1671 cm^3 at atmospheric pressure and the latent heat of vaporization of water is 2256 J/g ; the change in the internal energy in joules for 1 g of water at 373 K when it changes from liquid phase to vapour phase at the same temperature is :

- | | |
|----------|---------|
| (1) 2256 | (2) 167 |
| (3) 2089 | (4) 1 |

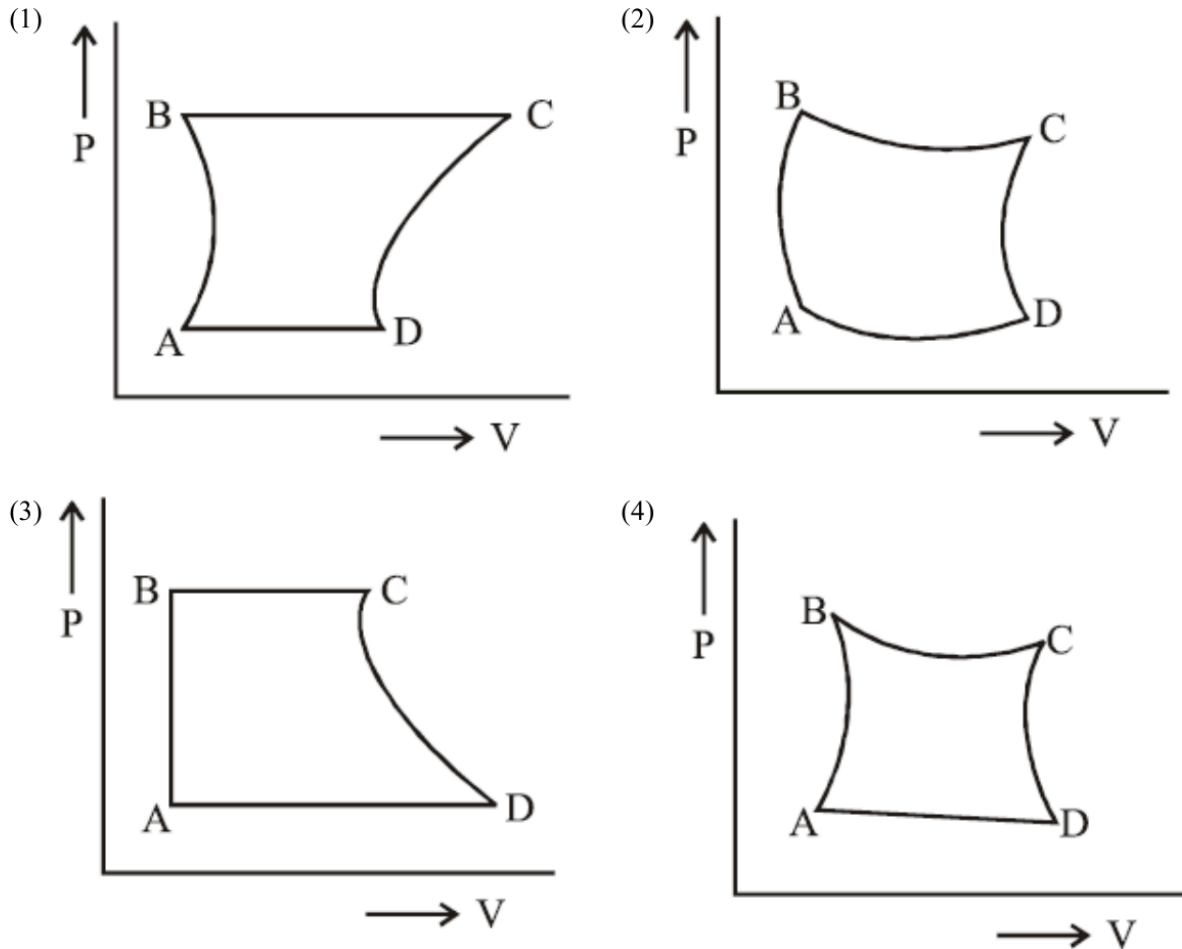
Question Number : 40 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

An ideal gas at atmospheric pressure is adiabatically compressed so that its density becomes 32 times of its initial value. If the final pressure of gas is 128 atmospheres, the value of ' γ ' of the gas is :

- (1) 1.5 (2) 1.4
(3) 1.3 (4) 1.6

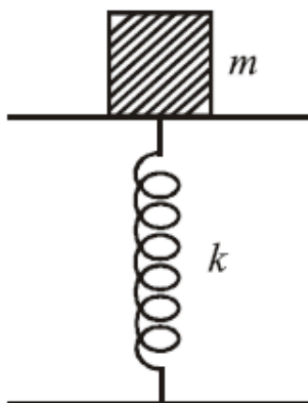
Question Number : 41 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

A certain amount of gas is taken through a cyclic process (A B C D A) that has two isobars, one isochore and one isothermal. The cycle can be represented on a P – V indicator diagram as :



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

A mass $m = 1.0 \text{ kg}$ is put on a flat pan attached to a vertical spring fixed on the ground. The mass of the spring and the pan is negligible. When pressed slightly and released, the mass executes simple harmonic motion. The spring constant is 500 N/m . What is the amplitude A of the motion, so that the mass m tends to get detached from the pan ? (Take $g = 10 \text{ m/s}^2$). The spring is stiff enough so that it does not get distorted

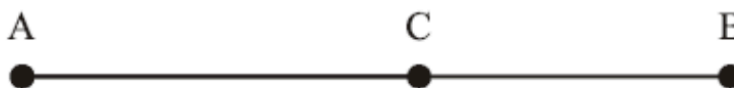


during the motion.

- | | |
|--------------------------|--------------------------|
| (1) $A > 2.0 \text{ cm}$ | (2) $A = 2.0 \text{ cm}$ |
| (3) $A < 2.0 \text{ cm}$ | (4) $A = 1.5 \text{ cm}$ |

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

A and B are two sources generating sound waves. A listener is situated at C. The frequency of the source at A is 500 Hz . A, now, moves towards C with a speed 4 m/s . The number of beats heard at C is 6. When A moves away from C with speed 4 m/s , the number of beats heard at C is 18. The speed of sound is 340 m/s . The



frequency of the source at B is :

- | | |
|----------------------|----------------------|
| (1) 500 Hz | (2) 506 Hz |
| (3) 512 Hz | (4) 494 Hz |

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

A point charge of magnitude $+1\mu\text{C}$ is fixed at $(0, 0, 0)$. An isolated uncharged spherical conductor, is fixed with its center at $(4, 0, 0)$. The potential and the induced electric field at the centre of the sphere is :

- | | |
|---|--|
| (1) $1.8 \times 10^5 \text{ V}$ and $-5.625 \times 10^6 \text{ V/m}$ | (2) 0 V and 0 V/m |
| (3) $2.25 \times 10^5 \text{ V}$ and $-5.625 \times 10^6 \text{ V/m}$ | (4) $2.25 \times 10^5 \text{ V}$ and 0 V/m |

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

Two small equal point charges of magnitude q are suspended from a common point on the ceiling by insulating mass less strings of equal lengths. They come to equilibrium with each string making angle θ from the vertical. If the mass of each charge is m , then the electrostatic potential at the centre of line joining them will be

$$\left(\frac{1}{4\pi \epsilon_0} = k \right).$$

- | | |
|---------------------------------|---------------------------------|
| (1) $2\sqrt{kmg \tan \theta}$ | (2) $\sqrt{kmg \tan \theta}$ |
| (3) $4\sqrt{kmg / \tan \theta}$ | (4) $4\sqrt{kmg / \tan \theta}$ |

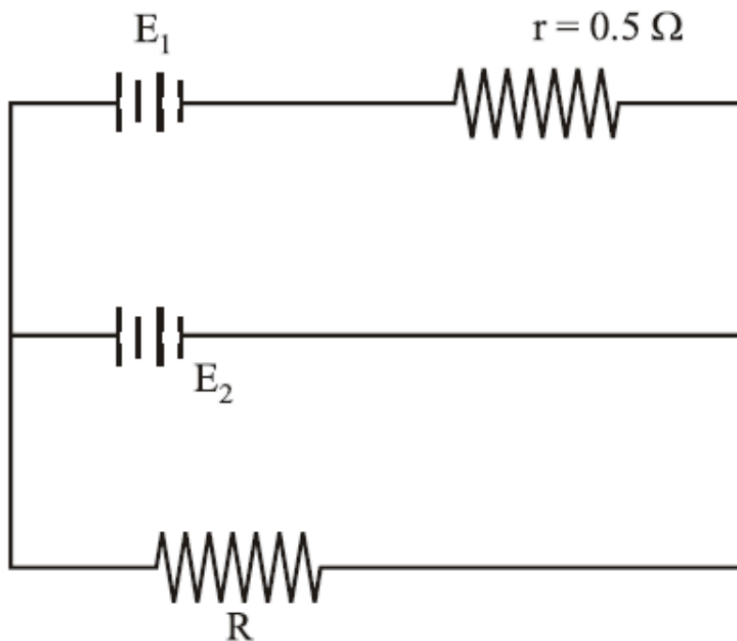
Question Number : 46 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

To establish an instantaneous current of 2 A through a $1\mu\text{F}$ capacitor ; the potential difference across the capacitor plates should be changed at the rate of:

- (1) $2 \times 10^4 \text{ V/s}$ (2) $4 \times 10^6 \text{ V/s}$
(3) $2 \times 10^6 \text{ V/s}$ (4) $4 \times 10^4 \text{ V/s}$

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

A dc source of emf $E_1 = 100 \text{ V}$ and internal resistance $r = 0.5\Omega$, a storage battery of emf $E_2 = 90 \text{ V}$ and an external resistance R are connected as shown in figure. For what value of R no current will pass through the

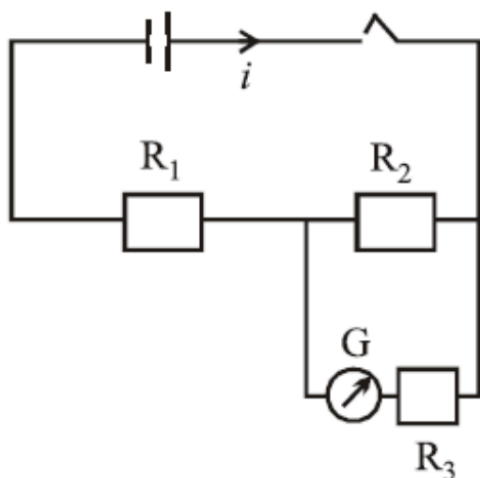


battery?

- (1) 5.5Ω (2) 3.5Ω
(3) 4.5Ω (4) 2.5Ω

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

To find the resistance of a galvanometer by the half deflection method the following circuit is used with resistances $R_1 = 9970 \Omega$, $R_2 = 30 \Omega$ and $R_3 = 0$. The deflection in the galvanometer is d . With $R_3 = 107 \Omega$ the deflection changed to $\frac{d}{2}$. The galvanometer resistance is approximately:



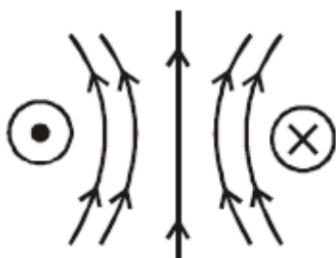
- (1) 107Ω (2) 137Ω
(3) $107/2\Omega$ (4) 77Ω

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

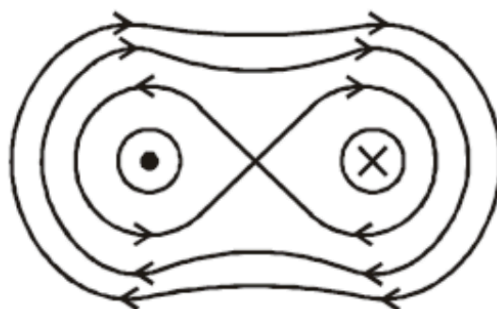
Choose the correct sketch of the magnetic field lines of a circular current loop shown by the dot

and the cross $\otimes$.

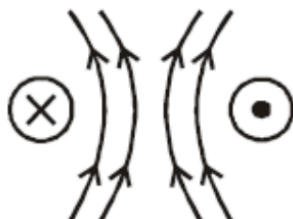
(1)



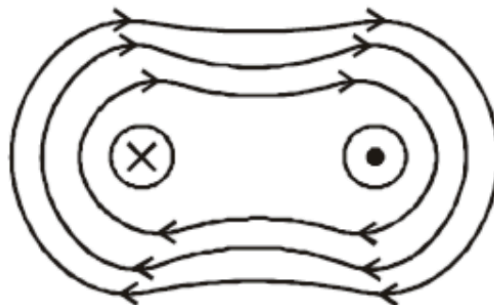
(2)



(3)



(4)



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

A current i is flowing in a straight conductor of length L . The magnetic induction at a point on its axis at a distance $\frac{L}{4}$ from its centre will be :

(1) Zero

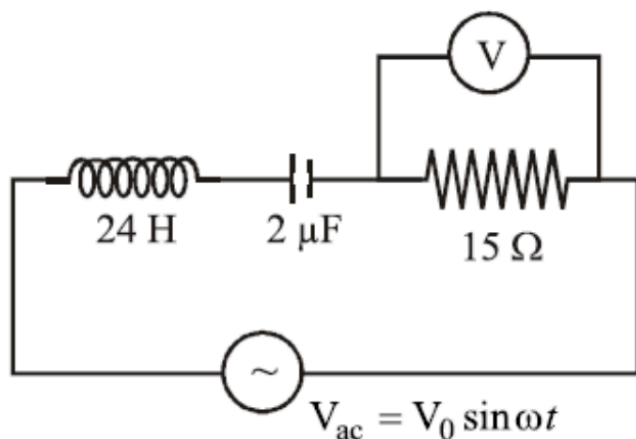
(2) $\frac{\mu_0 i}{2\pi L}$

(3) $\frac{\mu_0 i}{\sqrt{2}L}$

(4) $\frac{4\mu_0 i}{\sqrt{5}\pi L}$

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

An LCR circuit as shown in the figure is connected to a voltage source V_{ac} whose frequency can be varied.



The frequency, at which the voltage across the resistor is maximum, is :

(1) 902 Hz

(2) 143 Hz

(3) 23 Hz

(4) 345 Hz

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

In a series $L - C - R$ circuit, $C = 10^{-11}$ Farad, $L = 10^{-5}$ Henry and $R = 100\Omega$, when a constant D.C. voltage E is applied to the circuit, the capacitor acquires a charge 10^{-9} C. The D.C. source is replaced by a sinusoidal voltage source in which the peak voltage E_0 is equal to the constant D.C. voltage E . At resonance the peak value of the charge acquired by the capacitor will be :

- | | |
|------------------|-----------------|
| (1) 10^{-15} C | (2) 10^{-6} C |
| (3) 10^{-10} C | (4) 10^{-8} C |

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

A plane electromagnetic wave in a non-magnetic dielectric medium is given by $\vec{E} = \vec{E}_0 (4 \times 10^{-7}x - 50t)$ with distance being in meter and time in seconds. The dielectric constant of the medium is :

- | | |
|---------|---------|
| (1) 2.4 | (2) 5.8 |
| (3) 8.2 | (4) 4.8 |

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

The focal length of the objective and the eyepiece of a telescope are 50 cm and 5 cm respectively. If the telescope is focussed for distinct vision on a scale distant 2 m from its objective, then its magnifying power will be :

- | | |
|--------|--------|
| (1) -4 | (2) -8 |
| (3) +8 | (4) -2 |

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

The image of an illuminated square is obtained on a screen with the help of a converging lens. The distance of the square from the lens is 40 cm. The area of the image is 9 times that of the square. The focal length of the lens is :

- | | |
|-----------|-----------|
| (1) 36 cm | (2) 27 cm |
| (3) 60 cm | (4) 30 cm |

Question Number : 56 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 Statements. Statement-1: Short wave transmission is achieved due to the total internal reflection of the e-m wave from an appropriate height in the ionosphere. Statement-2: Refractive index of a plasma is independent of the frequency of e-m waves.

- | | |
|---|--|
| (1) Statement-1 is true, Statement- 2 is false. | (2) Statement-1 is false, Statement- 2 is true. |
| (3) Statement-1 is true, Statement- 2 is true but Statement -2 is not the correct explanation of statement-1. | (4) Statement-1 is true, Statement-2 is true and Statement -2 is the correct explanation of Statement-1. |

Question Number : 57 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 Statements. Statement-1: In Young's double slit experiment, the number of fringes observed in the field of view is small with longer wavelength of light and is large with shorter wavelength of light. Statement-2: In the double slit experiment the fringe width depends directly on the wavelength of light.

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

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

Orbits of a particle moving in a circle are such that the perimeter of the orbit equals an integer number of de-Broglie wavelengths of the particle. For a charged particle moving in a plane perpendicular to a magnetic field, the radius of the n^{th} orbital will therefore be proportional to :

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

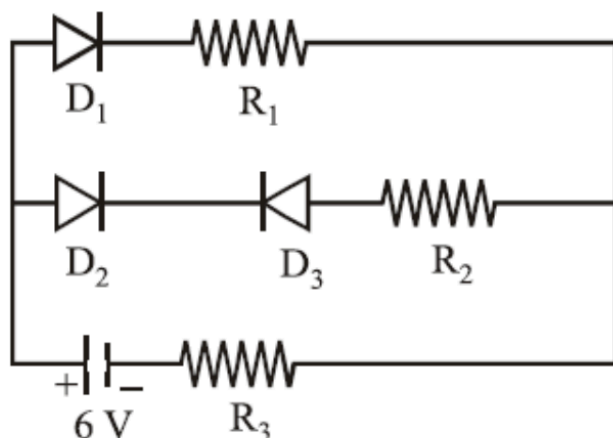
Question Number : 59 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The half-life of a radioactive element A is the same as the mean-life of another radioactive element B. Initially both substances have the same number of atoms, then :

- (1) A and B decay at the same rate always. (2) A and B decay at the same rate initially.
(3) A will decay at a faster rate than B. (4) B will decay at a faster rate than A.

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

Figure shows a circuit in which three identical diodes are used. Each diode has forward resistance of 20Ω and infinite backward resistance. Resistors $R_1 = R_2 = R_3 = 50\Omega$. Battery voltage is 6 V. The current through R_3



is :

- (1) 50 mA (2) 100 mA
(3) 60 mA (4) 25 mA

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

The density of 3M solution of sodium chloride is 1.252 g mL^{-1} . The molality of the solution will be : (molar mass, NaCl = 585 g mol^{-1})

- (1) 260 m (2) 2.18 m
(3) 2.79 m (4) 3.00 m

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

The wave number of the first emission line in the Balmer series of H-Spectrum is : (R = Rydberg constant) :

- (1) $\frac{5}{36}R$ (2) $\frac{9}{400}R$
(3) $\frac{7}{6}R$ (4) $\frac{3}{4}R$

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

The order of increasing sizes of atomic radii among the elements O, S, Se and As is :

- (1) As < S < O < Se (2) Se < S < As < O
(3) O < S < As < Se (4) O < S < Se < As

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

The solubility order for alkali metal fluoride in water is :

- (1) LiF < RbF < KF < NaF (2) RbF < KF < NaF < LiF
(3) LiF > NaF > KF > RbF (4) LiF < NaF < KF < RbF

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

Bond order normally gives idea of stability of a molecular species. All the molecules viz. H_2 , Li_2 and B_2 have the same bond order yet they are not equally stable. Their stability order is :

- (1) $\text{H}_2 > \text{B}_2 > \text{Li}_2$ (2) $\text{Li}_2 > \text{H}_2 > \text{B}_2$
(3) $\text{Li}_2 > \text{B}_2 > \text{H}_2$ (4) None of these

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

Given Reaction Energy Change		(in kJ)	Based on data provided, the
	$\text{Li(s)} \rightarrow \text{Li(g)}$	161	
	$\text{Li(g)} \rightarrow \text{Li}^+(\text{g})$	520	
	$\frac{1}{2} \text{F}_2(\text{g}) \rightarrow \text{F(g)}$	77	
	$\text{F(g)} + \text{e}^- \rightarrow \text{F}^-(\text{g})$	(Electron gain enthalpy)	
	$\text{Li}^+(\text{g}) + \text{F}^-(\text{g}) \rightarrow \text{LiF(s)}$	-1047	
	$\text{Li(s)} + \frac{1}{2} \text{F}_2(\text{g}) \rightarrow \text{LiF(s)}$	-617	

value of electron gain enthalpy of fluorine would be :

- (1) -300 kJ mol^{-1} (2) -350 kJ mol^{-1}
(3) -328 kJ mol^{-1} (4) -228 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

The reaction $X \rightarrow Y$ is an exothermic reaction. Activation energy of the reaction for X into Y is 150 kJ mol^{-1} . Enthalpy of reaction is 135 kJ mol^{-1} . The activation energy for the reverse reaction, $Y \rightarrow X$ will be :

- (1) 280 kJ mol^{-1} (2) 285 kJ mol^{-1}
(3) 270 kJ mol^{-1} (4) 15 kJ mol^{-1}

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

Which one of the following arrangements represents the correct order of solubilities of sparingly soluble salts Hg_2Cl_2 , $\text{Cr}_2(\text{SO}_4)_3$, BaSO_4 and CrCl_3 respectively?

- (1) $\text{BaSO}_4 > \text{Hg}_2\text{Cl}_2 > \text{Cr}_2(\text{SO}_4)_3 > \text{CrCl}_3$ (2) $\text{BaSO}_4 > \text{Hg}_2\text{Cl}_2 > \text{CrCl}_3 > \text{Cr}_2(\text{SO}_4)_3$
(3) $\text{BaSO}_4 > \text{CrCl}_3 > \text{Hg}_2\text{Cl}_2 > \text{Cr}_2(\text{SO}_4)_3$ (4) $\text{Hg}_2\text{Cl}_2 > \text{BaSO}_4 > \text{CrCl}_3 > \text{Cr}_2(\text{SO}_4)_3$

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

NaOH is a strong base. What will be pH of $5.0 \times 10^{-2} \text{ M NaOH}$ solution ? ($\log 2 = 0.3$)

- (1) 14.00 (2) 13.70
(3) 13.00 (4) 12.70

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

	Acid	K_a	
Values of dissociation constant, K_a are given as follows :	HCN	6.2×10^{-10}	Correct order of increasing
	HF	7.2×10^{-4}	
	HNO_2	4.0×10^{-4}	

base strength of the base CN^- , F^- and NO_2^- will be :

- (1) $\text{F}^- < \text{CN}^- < \text{NO}_2^-$ (2) $\text{NO}_2^- < \text{CN}^- < \text{F}^-$
(3) $\text{F}^- < \text{NO}_2^- < \text{CN}^-$ (4) $\text{NO}_2^- < \text{F}^- < \text{CN}^-$

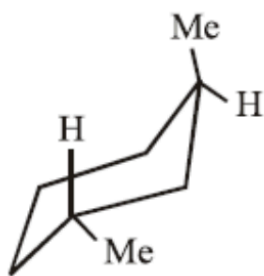
Question Number : 71 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

For which of the following compounds Kjeldahl method can be used to determine the percentage of Nitrogen?

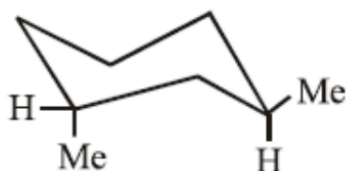
- (1) Nitrobenzene (2) Pyridine
(3) Alanine (4) Diazomethane

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

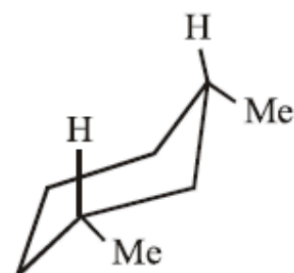
Arrange in the correct order of stability (decreasing order) for the following molecules: (I)



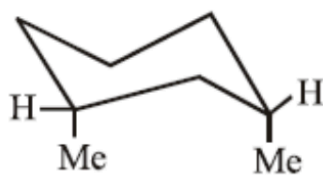
(II)



(III)



(IV)



(1) (I) > (II) > (III) > (IV)

(2) (IV) > (III) > (II) ≈ (I)

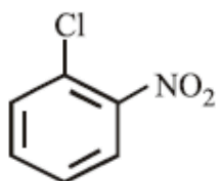
(3) (I) > (II) ≈ (III) > (IV)

(4) (III) > (I) ≈ (II) > (IV)

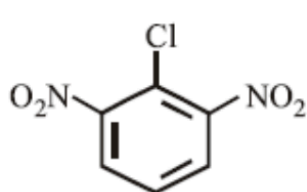
Question Number : 73 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

A major component of Borsch reagent is obtained by reacting hydrazine hydrate with which of the following ?

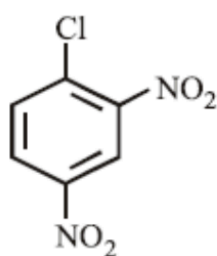
(1)



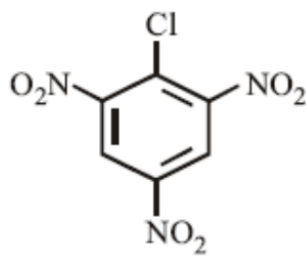
(2)



(3)



(4)



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

Clemmensen reduction of a ketone is carried out in the presence of :

- (1) LiAlH_4
- (2) $\text{Zn} - \text{Hg}$ with HCl
- (3) Glycol with KOH
- (4) H_2 with Pt as catalyst

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

Which of the following would not give 2-phenylbutane as the major product in a Friedel-Crafts alkylation reaction ?

- (1) 1-butene + HF
- (2) 2-butanol + H_2SO_4
- (3) Butanoyl chloride + AlCl_3 then Zn, HCl
- (4) Butyl chloride + AlCl_3

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

Which one of the following statements about packing in solids is incorrect ?

- (1) Coordination number in bcc mode of packing is 8
- (2) Coordination number in hcp mode of packing is 12
- (3) Void space in hcp mode of packing is 32%
- (4) Void space in ccp mode of packing is 26%

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

A molecule M associates in a given solvent according to the equation $M \rightleftharpoons (M)_n$. For a certain concentration of M , the van't Hoff factor was found to be 0.9 and the fraction of associated molecules was 0.2. The value of n is:

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

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

Flocculation value of BaCl_2 is much less than that of KCl for sol A and flocculation value of Na_2SO_4 is much less than that of NaBr for sol B. The correct statement among the following is :

- (1) Both the sols A and B are negatively charged.
- (2) Sol A is positively charged and Sol B is negatively charged.
- (3) Both the sols A and B are positively charged.
- (4) Sol A is negatively charged and sol B is positively charged.

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

In Goldschmidt aluminothermic process which of the following reducing agents is used :

- (1) calcium
- (2) coke
- (3) Al-powder
- (4) sodium

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

Oxidation state of sulphur in anions SO_3^{2-} , $\text{S}_2\text{O}_4^{2-}$ and $\text{S}_2\text{O}_6^{2-}$ increases in the orders :

- (1) $\text{S}_2\text{O}_6^{2-} < \text{S}_2\text{O}_4^{2-} < \text{SO}_3^{2-}$
- (2) $\text{SO}_3^{2-} < \text{S}_2\text{O}_4^{2-} < \text{S}_2\text{O}_6^{2-}$
- (3) $\text{S}_2\text{O}_4^{2-} < \text{SO}_3^{2-} < \text{S}_2\text{O}_6^{2-}$
- (4) $\text{S}_2\text{O}_4^{2-} < \text{S}_2\text{O}_6^{2-} < \text{SO}_3^{2-}$

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

XeO_4 molecule is tetrahedral having:

- (1) Two $p\pi - d\pi$ bonds
- (2) One $p\pi - d\pi$ bonds
- (3) Four $p\pi - d\pi$ bonds
- (4) Three $p\pi - d\pi$ bonds

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

Which of the following is diamagnetic ?

- (1) $[\text{Fe}(\text{CN})_6]^{3-}$ (2) $[\text{Co}(\text{ox})_3]^{3-}$
(3) $[\text{FeF}_6]^{3-}$ (4) $[\text{CoF}_6]^{3-}$

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

Which of the following statements is incorrect?

- (1) Fe^{2+} ion also gives blood red colour with SCN^- ion. (2) Fe^{3+} ion also gives blood red colour with SCN^- ion.
(3) On passing H_2S into Na_2ZnO_2 solution a white ppt of ZnS is formed. (4) Cupric ion reacts with excess of ammonia solution to give deep blue colour of $[\text{Cu}(\text{NH}_3)_4]^{2+}$ ion.

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

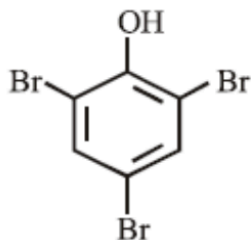
The Wurtz-Fittig reaction involves condensation of:

- (1) two molecules of aryl halides (2) one molecule of each of aryl-halide and alkyl-halide.
(3) one molecule of each of aryl-halide and phenol. (4) two molecules of aralkyl-halides.

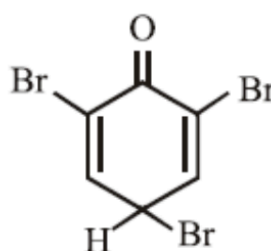
Question Number : 85 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

What is the structure of the major product when phenol is treated with bromine water?

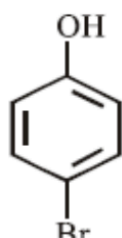
(1)



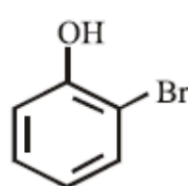
(2)



(3)



(4)



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

Amongst the following alcohols which would react fastest with conc. HCl and ZnCl_2 ?

- (1) pentanol (2) 2-methyl butanol
(3) 2-pentanol (4) 2-methyl butan-2-ol

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

In Williamson synthesis of mixed ether having a primary and a tertiary alkyl group if tertiary halide is used, then :

- (1) Rate of reaction will be slow due to slow cleavage of carbon-halogen bond. (2) Alkene will be the main product.
(3) Simple ether will form instead of mixed ether. (4) Expected mixed ether will be formed.

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

The polymer used for optical lenses is :

- | | |
|-------------------|-----------------------------|
| (1) polypropylene | (2) polyvinyl chloride |
| (3) polythene | (4) polymethyl methacrylate |

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

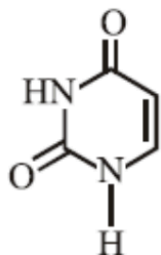
Which of the following statements about aspirin is not true?

- | | |
|--|---|
| (1) It is effective in relieving pain. | (2) It is a neurologically active drug. |
| (3) It has antiblood clotting action. | (4) It belongs to narcotic analgesics. |

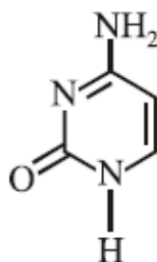
Question Number : 90 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No
Single Line Question Option : No

Which of the following structures represents thymine ?

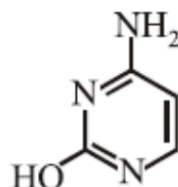
(1)



(2)



(3)



(4)

