

Paper:	B.E_B.Tech
Set Name:	Item29
Exam Date:	27 July 2022
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Language:	English

Topic:	Mathematics-Section A
Item No:	1
Question ID:	100401
Question Type:	MCQ
Question:	The domain of the function $f(x) = \sin^{-1}[2x^2 - 3] + \log_2\left(\log_{\frac{1}{2}}(x^2 - 5x + 5)\right)$, where $[t]$ is the greatest integer function, is :
A:	$\left(-\sqrt{\frac{5}{2}}, \frac{5 - \sqrt{5}}{2}\right)$
B:	$\left(\frac{5 - \sqrt{5}}{2}, \frac{5 + \sqrt{5}}{2}\right)$
C:	$\left(1, \frac{5 - \sqrt{5}}{2}\right)$
D:	$\left[1, \frac{5 + \sqrt{5}}{2}\right)$

Topic:	Mathematics-Section A
Item No:	2
Question ID:	100402
Question Type:	MCQ

Question:	Let S be the set of all (α, β), $\pi < \alpha, \beta < 2\pi$, for which the complex number $\frac{1 - i \sin \alpha}{1 + 2i \sin \alpha}$ is purely imaginary and $\frac{1 + i \cos \beta}{1 - 2i \cos \beta}$ is purely real. Let $Z_{\alpha\beta} = \sin 2\alpha + i \cos 2\beta$, $(\alpha, \beta) \in S$. Then $\sum_{(\alpha, \beta) \in S} \left(i Z_{\alpha\beta} + \frac{1}{i \bar{Z}_{\alpha\beta}} \right)$ is equal to :
A:	3
B:	$3i$
C:	1
D:	$2 - i$

Topic:	Mathematics-Section A
Item No:	3
Question ID:	100403
Question Type:	MCQ
Question:	If α, β are the roots of the equation $x^2 - \left(5 + 3\sqrt{\log_3 5} - 5\sqrt{\log_5 3} \right) + 3 \left(3^{(\log_3 5)^{\frac{1}{3}}} - 5^{(\log_5 3)^{\frac{2}{3}}} - 1 \right) = 0,$ then the equation, whose roots are $\alpha + \frac{1}{\beta}$ and $\beta + \frac{1}{\alpha}$, is :
A:	$3x^2 - 20x - 12 = 0$
B:	$3x^2 - 10x - 4 = 0$
C:	$3x^2 - 10x + 2 = 0$
D:	$3x^2 - 20x + 16 = 0$

Topic:	Mathematics-Section A
Item No:	4
Question ID:	100404
Question Type:	MCQ

Question:	Let $A = \begin{pmatrix} 4 & -2 \\ \alpha & \beta \end{pmatrix}$. If $A^2 + \gamma A + 18I = O$, then $\det(A)$ is equal to _____.
A:	- 18
B:	18
C:	- 50
D:	50

Topic:	Mathematics-Section A
Item No:	5
Question ID:	100405
Question Type:	MCQ
Question:	If for $p \neq q \neq 0$, the function $f(x) = \frac{\sqrt[7]{p(729+x)} - 3}{\sqrt[3]{729+qx} - 9}$ is continuous at $x=0$, then :
A:	$7pq f(0) - 1 = 0$
B:	$63q f(0) - p^2 = 0$
C:	$21q f(0) - p^2 = 0$
D:	$7pq f(0) - 9 = 0$

Topic:	Mathematics-Section A
Item No:	6
Question ID:	100406
Question Type:	MCQ

Question:	Let $f(x) = 2 + x - x - 1 + x + 1$, $x \in \mathbf{R}$. Consider (S1) : $f'\left(-\frac{3}{2}\right) + f'\left(-\frac{1}{2}\right) + f'\left(\frac{1}{2}\right) + f'\left(\frac{3}{2}\right) = 2$ (S2) : $\int_{-2}^2 f(x) \, dx = 12$ Then,
A:	both (S1) and (S2) are correct
B:	both (S1) and (S2) are wrong
C:	only (S1) is correct
D:	only (S2) is correct

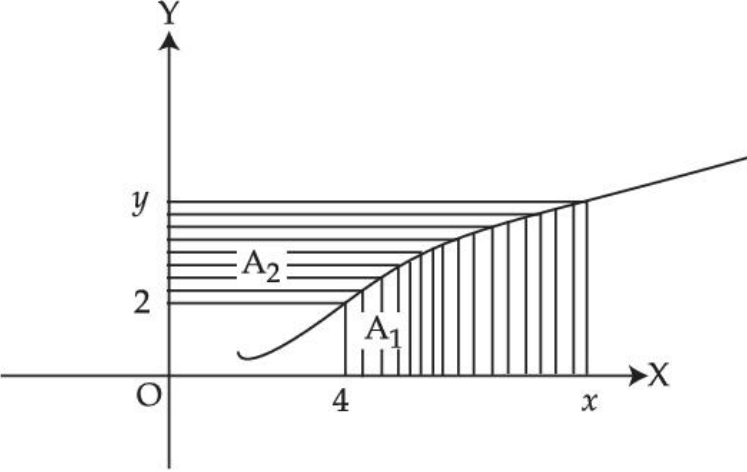
Topic:	Mathematics-Section A
Item No:	7
Question ID:	100407
Question Type:	MCQ
Question:	Let the sum of an infinite G.P., whose first term is a and the common ratio is r, be 5. Let the sum of its first five terms be $\frac{98}{25}$. Then the sum of the first 21 terms of an AP, whose first term is $10ar$, n^{th} term is a_n and the common difference is $10ar^2$, is equal to :
A:	21 a_{11}
B:	22 a_{11}
C:	15 a_{16}
D:	14 a_{16}

Topic:	Mathematics-Section A
Item No:	8
Question ID:	100408

Question Type:	MCQ
Question:	The area of the region enclosed by $y \leq 4x^2$, $x^2 \leq 9y$ and $y \leq 4$, is equal to :
A:	$\frac{40}{3}$
B:	$\frac{56}{3}$
C:	$\frac{112}{3}$
D:	$\frac{80}{3}$

Topic:	Mathematics-Section A
Item No:	9
Question ID:	100409
Question Type:	MCQ
Question:	$\int_0^2 \left(\left 2x^2 - 3x \right + \left[x - \frac{1}{2} \right] \right) dx$, where $[t]$ is the greatest integer function, is equal to :
A:	$\frac{7}{6}$
B:	$\frac{19}{12}$
C:	$\frac{31}{12}$
D:	$\frac{3}{2}$

Topic:	Mathematics-Section A
Item No:	10
Question ID:	100410

Question Type:	MCQ
Question:	Consider a curve $y = y(x)$ in the first quadrant as shown in the figure. Let the area A_1 is twice the area A_2. Then the normal to the curve perpendicular to the line $2x - 12y = 15$ does NOT pass through the point. 
A:	(6, 21)
B:	(8, 9)
C:	(10, -4)
D:	(12, -15)

Topic:	Mathematics-Section A
Item No:	11
Question ID:	100411
Question Type:	MCQ
Question:	The equations of the sides AB, BC and CA of a triangle ABC are $2x + y = 0$, $x + py = 39$ and $x - y = 3$ respectively and P(2, 3) is its circumcentre. Then which of the following is NOT true ?
A:	$(AC)^2 = 9p$
B:	$(AC)^2 + p^2 = 136$
C:	$32 < \text{area } (\Delta ABC) < 36$
D:	$34 < \text{area } (\Delta ABC) < 38$

Topic:	Mathematics-Section A
Item No:	12
Question ID:	100412
Question Type:	MCQ
Question:	A circle C_1 passes through the origin O and has diameter 4 on the positive x -axis. The line $y = 2x$ gives a chord OA of circle C_1 . Let C_2 be the circle with OA as a diameter. If the tangent to C_2 at the point A meets the x -axis at P and y -axis at Q, then QA : AP is equal to :
A:	1 : 4
B:	1 : 5
C:	2 : 5
D:	1 : 3

Topic:	Mathematics-Section A
Item No:	13
Question ID:	100413
Question Type:	MCQ
Question:	If the length of the latus rectum of a parabola, whose focus is (a, a) and the tangent at its vertex is $x + y = a$, is 16, then $ a $ is equal to :
A:	$2\sqrt{2}$
B:	$2\sqrt{3}$
C:	$4\sqrt{2}$
D:	4

Topic:	Mathematics-Section A
Item No:	14
Question ID:	100414
Question Type:	MCQ

Question:	If the length of the perpendicular drawn from the point $P(a, 4, 2)$, $a > 0$ on the line $\frac{x+1}{2} = \frac{y-3}{3} = \frac{z-1}{-1}$ is $2\sqrt{6}$ units and $Q(\alpha_1, \alpha_2, \alpha_3)$ is the image of the point P in this line, then $a + \sum_{i=1}^3 \alpha_i$ is equal to :
A:	7
B:	8
C:	12
D:	14

Topic:	Mathematics-Section A
Item No:	15
Question ID:	100415
Question Type:	MCQ
Question:	If the line of intersection of the planes $ax + by = 3$ and $ax + by + cz = 0$, $a > 0$ makes an angle 30° with the plane $y - z + 2 = 0$, then the direction cosines of the line are :
A:	$\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0$
B:	$\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}, 0$
C:	$\frac{1}{\sqrt{5}}, -\frac{2}{\sqrt{5}}, 0$
D:	$\frac{1}{2}, -\frac{\sqrt{3}}{2}, 0$

Topic:	Mathematics-Section A
Item No:	16
Question ID:	100416
Question Type:	MCQ

Question:	Let X have a binomial distribution $B(n, p)$ such that the sum and the product of the mean and variance of X are 24 and 128 respectively. If $P(X > n - 3) = \frac{k}{2^n}$, then k is equal to :
A:	528
B:	529
C:	629
D:	630

Topic:	Mathematics-Section A
Item No:	17
Question ID:	100417
Question Type:	MCQ
Question:	A six faced die is biased such that $3 \times P(\text{a prime number}) = 6 \times P(\text{a composite number}) = 2 \times P(1)$. Let X be a random variable that counts the number of times one gets a perfect square on some throws of this die. If the die is thrown twice, then the mean of X is :
A:	$\frac{3}{11}$
B:	$\frac{5}{11}$
C:	$\frac{7}{11}$
D:	$\frac{8}{11}$

Topic:	Mathematics-Section A
Item No:	18
Question ID:	100418
Question Type:	MCQ

Question:	The angle of elevation of the top P of a vertical tower PQ of height 10 from a point A on the horizontal ground is 45° . Let R be a point on AQ and from a point B, vertically above R, the angle of elevation of P is 60° . If $\angle BAQ = 30^\circ$, $AB = d$ and the area of the trapezium PQRB is α , then the ordered pair (d, α) is :
A:	$(10(\sqrt{3} - 1), 25)$
B:	$\left(10(\sqrt{3} - 1), \frac{25}{2}\right)$
C:	$(10(\sqrt{3} + 1), 25)$
D:	$\left(10(\sqrt{3} + 1), \frac{25}{2}\right)$

Topic:	Mathematics-Section A
Item No:	19
Question ID:	100419
Question Type:	MCQ
Question:	Let $S = \left\{ \theta \in \left(0, \frac{\pi}{2}\right) : \sum_{m=1}^9 \sec\left(\theta + (m-1)\frac{\pi}{6}\right) \sec\left(\theta + \frac{m\pi}{6}\right) = -\frac{8}{\sqrt{3}} \right\}$. Then
A:	$S = \left\{ \frac{\pi}{12} \right\}$
B:	$S = \left\{ \frac{2\pi}{3} \right\}$
C:	$\sum_{\theta \in S} \theta = \frac{\pi}{2}$
D:	$\sum_{\theta \in S} \theta = \frac{3\pi}{4}$

Topic:	Mathematics-Section A
Item No:	20
Question ID:	100420

Question Type:	MCQ
Question:	If the truth value of the statement $(P \wedge (\sim R)) \rightarrow ((\sim R) \wedge Q)$ is F, then the truth value of which of the following is F ?
A:	$P \vee Q \rightarrow \sim R$
B:	$R \vee Q \rightarrow \sim P$
C:	$\sim(P \vee Q) \rightarrow \sim R$
D:	$\sim(R \vee Q) \rightarrow \sim P$

Topic:	Mathematics-Section B
Item No:	21
Question ID:	100421
Question Type:	Numeric Answer
Question:	Consider a matrix $A = \begin{bmatrix} \alpha & \beta & \gamma \\ \alpha^2 & \beta^2 & \gamma^2 \\ \beta + \gamma & \gamma + \alpha & \alpha + \beta \end{bmatrix}$, where α, β, γ are three distinct natural numbers. If $\frac{\det(\text{adj}(\text{adj}(\text{adj}(\text{adj } A))))}{(\alpha - \beta)^{16} (\beta - \gamma)^{16} (\gamma - \alpha)^{16}} = 2^{32} \times 3^{16}$, then the number of such 3 - tuples (α, β, γ) is _____.

Topic:	Mathematics-Section B
Item No:	22
Question ID:	100422
Question Type:	Numeric Answer
Question:	The number of functions f , from the set $A = \{x \in \mathbf{N} : x^2 - 10x + 9 \leq 0\}$ to the set $B = \{n^2 : n \in \mathbf{N}\}$ such that $f(x) \leq (x-3)^2 + 1$, for every $x \in A$, is _____.

Topic:	Mathematics-Section B
Item No:	23
Question ID:	100423

Question Type:	Numeric Answer
Question:	Let for the 9 th term in the binomial expansion of $(3 + 6x)^n$, in the increasing powers of $6x$, to be the greatest for $x = \frac{3}{2}$, the least value of n is n_0 . If k is the ratio of the coefficient of x^6 to the coefficient of x^3 , then $k + n_0$ is equal to :

Topic:	Mathematics-Section B
Item No:	24
Question ID:	100424
Question Type:	Numeric Answer
Question:	$\frac{2^3 - 1^3}{1 \times 7} + \frac{4^3 - 3^3 + 2^3 - 1^3}{2 \times 11} + \frac{6^3 - 5^3 + 4^3 - 3^3 + 2^3 - 1^3}{3 \times 15} + \dots +$ $\frac{30^3 - 29^3 + 28^3 - 27^3 + \dots + 2^3 - 1^3}{15 \times 63}$ is equal to _____.

Topic:	Mathematics-Section B
Item No:	25
Question ID:	100425
Question Type:	Numeric Answer
Question:	A water tank has the shape of a right circular cone with axis vertical and vertex downwards. Its semi-vertical angle is $\tan^{-1} \frac{3}{4}$. Water is poured in it at a constant rate of 6 cubic meter per hour. The rate (in square meter per hour), at which the wet curved surface area of the tank is increasing, when the depth of water in the tank is 4 meters, is _____.

Topic:	Mathematics-Section B
Item No:	26
Question ID:	100426
Question Type:	Numeric Answer
Question:	For the curve $C : (x^2 + y^2 - 3) + (x^2 - y^2 - 1)^5 = 0$, the value of $3y' - y^3y''$, at the point (α, α) , $\alpha > 0$, on C , is equal to _____.

Topic:	Mathematics-Section B
Item No:	27
Question ID:	100427
Question Type:	Numeric Answer
Question:	Let $f(x) = \min\{[x - 1], [x - 2], \dots, [x - 10]\}$ where $[t]$ denotes the greatest integer $\leq t$. Then $\int_0^{10} f(x) dx + \int_0^{10} (f(x))^2 dx + \int_0^{10} f(x) dx$ is equal to _____.

Topic:	Mathematics-Section B
Item No:	28
Question ID:	100428
Question Type:	Numeric Answer
Question:	Let f be a differentiable function satisfying $f(x) = \frac{2}{\sqrt{3}} \int_0^{\sqrt{3}} f\left(\frac{\lambda^2 x}{3}\right) d\lambda, x > 0$ and $f(1) = \sqrt{3}$. If $y=f(x)$ passes through the point $(\alpha, 6)$, then α is equal to _____.

Topic:	Mathematics-Section B
Item No:	29
Question ID:	100429
Question Type:	Numeric Answer
Question:	A common tangent T to the curves $C_1 : \frac{x^2}{4} + \frac{y^2}{9} = 1$ and $C_2 : \frac{x^2}{42} - \frac{y^2}{143} = 1$ does not pass through the fourth quadrant. If T touches C_1 at (x_1, y_1) and C_2 at (x_2, y_2), then $2x_1 + x_2$ is equal to _____.

Topic:	Mathematics-Section B
Item No:	30
Question ID:	100430
Question Type:	Numeric Answer

Question:	Let $\vec{a}, \vec{b}, \vec{c}$ be three non-coplanar vectors such that $\vec{a} \times \vec{b} = 4\vec{c}$, $\vec{b} \times \vec{c} = 9\vec{a}$ and $\vec{c} \times \vec{a} = \alpha\vec{b}$, $\alpha > 0$. If $ \vec{a} + \vec{b} + \vec{c} = \frac{1}{36}$, then α is equal to _____.
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Topic:	Physics-Section A
Item No:	31
Question ID:	100431
Question Type:	MCQ
Question:	An expression of energy density is given by $u = \frac{\alpha}{\beta} \sin\left(\frac{\alpha x}{kt}\right)$, where α, β are constants, x is displacement, k is Boltzmann constant and t is the temperature. The dimensions of β will be :
A:	$[ML^2T^{-2}\theta^{-1}]$
B:	$[M^0L^2T^{-2}]$
C:	$[M^0L^0T^0]$
D:	$[M^0L^2T^0]$

Topic:	Physics-Section A
Item No:	32
Question ID:	100432
Question Type:	MCQ
Question:	A body of mass 10 kg is projected at an angle of 45° with the horizontal. The trajectory of the body is observed to pass through a point (20, 10). If T is the time of flight, then its momentum vector, at time $t = \frac{T}{\sqrt{2}}$, is _____. [Take $g = 10 \text{ m/s}^2$]
A:	$100\hat{i} + (100\sqrt{2} - 200)\hat{j}$
B:	$100\sqrt{2}\hat{i} + (100 - 200\sqrt{2})\hat{j}$
C:	$100\hat{i} + (100 - 200\sqrt{2})\hat{j}$

D:	$100\sqrt{2} \hat{i} + (100\sqrt{2} - 200) \hat{j}$
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Topic:	Physics-Section A
Item No:	33
Question ID:	100433
Question Type:	MCQ
Question:	A block of mass M slides down on a rough inclined plane with constant velocity. The angle made by the incline plane with horizontal is θ . The magnitude of the contact force will be :
A:	Mg
B:	$Mg \cos\theta$
C:	$\sqrt{Mg \sin\theta + Mg \cos\theta}$
D:	$Mg \sin\theta \sqrt{1 + \mu}$

Topic:	Physics-Section A
Item No:	34
Question ID:	100434
Question Type:	MCQ
Question:	A block 'A' takes 2 s to slide down a frictionless incline of 30° and length ' l ', kept inside a lift going up with uniform velocity ' v '. If the incline is changed to 45° , the time taken by the block, to slide down the incline, will be approximately :
A:	2.66 s
B:	0.83 s
C:	1.68 s
D:	0.70 s

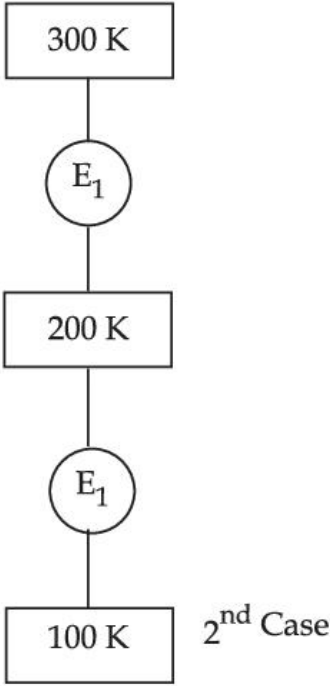
Topic:	Physics-Section A
Item No:	35
Question ID:	100435

Question Type:	MCQ
Question:	The velocity of the bullet becomes one third after it penetrates 4 cm in a wooden block. Assuming that bullet is facing a constant resistance during its motion in the block. The bullet stops completely after travelling at $(4 + x)$ cm inside the block. The value of x is :
A:	2.0
B:	1.0
C:	0.5
D:	1.5

Topic:	Physics-Section A
Item No:	36
Question ID:	100436
Question Type:	MCQ
Question:	A body of mass m is projected with velocity λv_e in vertically upward direction from the surface of the earth into space. It is given that v_e is escape velocity and $\lambda < 1$. If air resistance is considered to be negligible, then the maximum height from the centre of earth, to which the body can go, will be : (R : radius of earth)
A:	$\frac{R}{1 + \lambda^2}$
B:	$\frac{R}{1 - \lambda^2}$
C:	$\frac{R}{1 - \lambda}$
D:	$\frac{\lambda^2 R}{1 - \lambda^2}$

Topic:	Physics-Section A
Item No:	37
Question ID:	100437

Question Type:	MCQ
Question:	A steel wire of length 3.2 m ($Y_s = 2.0 \times 10^{11} \text{ Nm}^{-2}$) and a copper wire of length 4.4 m ($Y_c = 1.1 \times 10^{11} \text{ Nm}^{-2}$), both of radius 1.4 mm are connected end to end. When stretched by a load, the net elongation is found to be 1.4 mm. The load applied, in Newton, will be : (Given $\pi = \frac{22}{7}$)
A:	360
B:	180
C:	1080
D:	154

Topic:	Physics-Section A
Item No:	38
Question ID:	100438
Question Type:	MCQ
Question:	In 1st case, Carnot engine operates between temperatures 300 K and 100 K. In 2nd case, as shown in the figure, a combination of two engines is used. The efficiency of this combination (in 2nd case) will be : 
A:	same as the 1 st case.

B:	always greater than the 1 st case.
C:	always less than the 1 st case.
D:	may increase or decrease with respect to the 1 st case.

Topic:	Physics-Section A
Item No:	39
Question ID:	100439
Question Type:	MCQ
Question:	Which statements are correct about degrees of freedom ? (A) A molecule with n degrees of freedom has n^2 different ways of storing energy. (B) Each degree of freedom is associated with $\frac{1}{2} RT$ average energy per mole. (C) A monatomic gas molecule has 1 rotational degree of freedom where as diatomic molecule has 2 rotational degrees of freedom. (D) CH_4 has a total of 6 degrees of freedom. Choose the correct answer from the options given below :
A:	(B) and (C) only
B:	(B) and (D) only
C:	(A) and (B) only
D:	(C) and (D) only

Topic:	Physics-Section A
Item No:	40
Question ID:	100440
Question Type:	MCQ
Question:	A charge of $4 \mu C$ is to be divided into two. The distance between the two divided charges is constant. The magnitude of the divided charges so that the force between them is maximum, will be :
A:	$1 \mu C$ and $3 \mu C$
B:	$2 \mu C$ and $2 \mu C$

C:	0 and 4 μC
D:	1.5 μC and 2.5 μC

Topic:	Physics-Section A
Item No:	41
Question ID:	100441
Question Type:	MCQ
Question:	(A) The drift velocity of electrons decreases with the increase in the temperature of conductor. (B) The drift velocity is inversely proportional to the area of cross-section of given conductor. (C) The drift velocity does not depend on the applied potential difference to the conductor. (D) The drift velocity of electron is inversely proportional to the length of the conductor. (E) The drift velocity increases with the increase in the temperature of conductor. Choose the correct answer from the options given below :
A:	(A) and (B) only
B:	(A) and (D) only
C:	(B) and (E) only
D:	(B) and (C) only

Topic:	Physics-Section A
Item No:	42
Question ID:	100442
Question Type:	MCQ
Question:	A compass needle of oscillation magnetometer oscillates 20 times per minute at a place P of dip 30°. The number of oscillations per minute become 10 at another place Q of 60° dip. The ratio of the total magnetic field at the two places ($B_Q : B_P$) is :
A:	$\sqrt{3} : 4$
B:	$4 : \sqrt{3}$
C:	$\sqrt{3} : 2$

D:	$2 : \sqrt{3}$
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Topic:	Physics-Section A
Item No:	43
Question ID:	100443
Question Type:	MCQ
Question:	A cyclotron is used to accelerate protons. If the operating magnetic field is 1.0 T and the radius of the cyclotron 'dees' is 60 cm, the kinetic energy of the accelerated protons in MeV will be : [use $m_p = 1.6 \times 10^{-27}$ kg, $e = 1.6 \times 10^{-19}$ C]
A:	12
B:	18
C:	16
D:	32

Topic:	Physics-Section A
Item No:	44
Question ID:	100444
Question Type:	MCQ
Question:	A series LCR circuit has $L = 0.01$ H, $R = 10 \Omega$ and $C = 1 \mu\text{F}$ and it is connected to ac voltage of amplitude (V_m) 50 V. At frequency 60% lower than resonant frequency, the amplitude of current will be approximately :
A:	466 mA
B:	312 mA
C:	238 mA
D:	196 mA

Topic:	Physics-Section A
Item No:	45
Question ID:	100445
Question Type:	MCQ

Question:	Identify the correct statements from the following descriptions of various properties of electromagnetic waves. (A) In a plane electromagnetic wave electric field and magnetic field must be perpendicular to each other and direction of propagation of wave should be along electric field or magnetic field. (B) The energy in electromagnetic wave is divided equally between electric and magnetic fields. (C) Both electric field and magnetic field are parallel to each other and perpendicular to the direction of propagation of wave. (D) The electric field, magnetic field and direction of propagation of wave must be perpendicular to each other. (E) The ratio of amplitude of magnetic field to the amplitude of electric field is equal to speed of light. Choose the most appropriate answer from the options given below :
A:	(D) only
B:	(B) and (D) only
C:	(B), (C) and (E) only
D:	(A), (B) and (E) only

Topic:	Physics-Section A
Item No:	46
Question ID:	100446
Question Type:	MCQ
Question:	Two coherent sources of light interfere. The intensity ratio of two sources is 1 : 4. For this interference pattern if the value of $\frac{I_{\max} + I_{\min}}{I_{\max} - I_{\min}}$ is equal to $\frac{2\alpha + 1}{\beta + 3}$, then $\frac{\alpha}{\beta}$ will be :
A:	1.5
B:	2
C:	0.5
D:	1

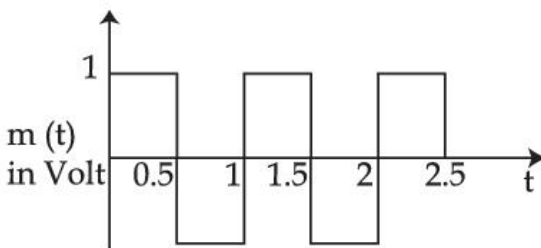
Topic:	Physics-Section A
Item No:	47

Question ID:	100447
Question Type:	MCQ
Question:	With reference to the observations in photo-electric effect, identify the correct statements from below : (A) The square of maximum velocity of photoelectrons varies linearly with frequency of incident light. (B) The value of saturation current increases on moving the source of light away from the metal surface. (C) The maximum kinetic energy of photo-electrons decreases on decreasing the power of LED (light emitting diode) source of light. (D) The immediate emission of photo-electrons out of metal surface can not be explained by particle nature of light/electromagnetic waves. (E) Existence of threshold wavelength can not be explained by wave nature of light/electromagnetic waves. Choose the correct answer from the options given below :
A:	(A) and (B) only
B:	(A) and (E) only
C:	(C) and (E) only
D:	(D) and (E) only

Topic:	Physics-Section A
Item No:	48
Question ID:	100448
Question Type:	MCQ
Question:	The activity of a radioactive material is 6.4×10^{-4} curie. Its half life is 5 days. The activity will become 5×10^{-6} curie after :
A:	7 days
B:	15 days
C:	25 days
D:	35 days

Topic:	Physics-Section A
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Item No:	49
Question ID:	100449
Question Type:	MCQ
Question:	For a constant collector-emitter voltage of 8 V, the collector current of a transistor reached to the value of 6 mA from 4 mA, whereas base current changed from 20 μ A to 25 μ A value. If transistor is in active state, small signal current gain (current amplification factor) will be :
A:	240
B:	400
C:	0.0025
D:	200

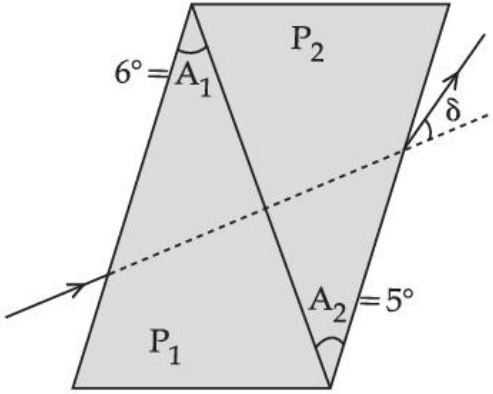
Topic:	Physics-Section A
Item No:	50
Question ID:	100450
Question Type:	MCQ
Question:	A square wave of the modulating signal is shown in the figure. The carrier wave is given by $C(t) = 5 \sin(8 \pi t)$ Volt. The modulation index is : 
A:	0.2
B:	0.1
C:	0.3
D:	0.4

Topic:	Physics-Section B
Item No:	51
Question ID:	100451

Question Type:	Numeric Answer												
Question:	In an experiment to determine the Young's modulus, steel wires of five different lengths (1, 2, 3, 4, and 5 m) but of same cross section (2 mm^2) were taken and curves between extension and load were obtained. The slope (extension/load) of the curves were plotted with the wire length and the following graph is obtained. If the Young's modulus of given steel wires is $x \times 10^{11} \text{ Nm}^{-2}$, then the value of x is _____. <table border="1"> <caption>Data points from the graph</caption> <thead> <tr> <th>Wire length (m)</th> <th>Extension / Load ($\times 10^{-5} \text{ Nm}^{-2}$)</th> </tr> </thead> <tbody> <tr><td>1</td><td>0.25</td></tr> <tr><td>2</td><td>0.5</td></tr> <tr><td>3</td><td>0.75</td></tr> <tr><td>4</td><td>1.0</td></tr> <tr><td>5</td><td>1.25</td></tr> </tbody> </table>	Wire length (m)	Extension / Load ($\times 10^{-5} \text{ Nm}^{-2}$)	1	0.25	2	0.5	3	0.75	4	1.0	5	1.25
Wire length (m)	Extension / Load ($\times 10^{-5} \text{ Nm}^{-2}$)												
1	0.25												
2	0.5												
3	0.75												
4	1.0												
5	1.25												

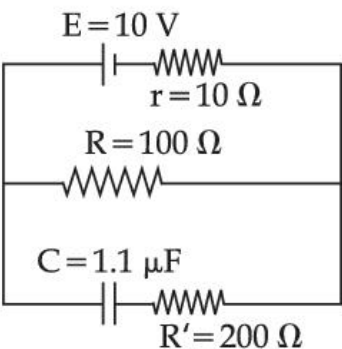
Topic:	Physics-Section B
Item No:	52
Question ID:	100452
Question Type:	Numeric Answer
Question:	In the given figure of meter bridge experiment, the balancing length AC corresponding to null deflection of the galvanometer is 40 cm. The balancing length, if the radius of the wire AB is doubled, will be _____ cm.

Topic:	Physics-Section B
Item No:	53
Question ID:	100453
Question Type:	Numeric Answer

Question:	A thin prism of angle 6° and refractive index for yellow light (n_Y)1.5 is combined with another prism of angle 5° and $n_Y=1.55$. The combination produces no dispersion. The net average deviation (δ) produced by the combination is $\left(\frac{1}{x}\right)^\circ$. The value of x is _____ . 
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Topic:	Physics-Section B
Item No:	54
Question ID:	100454
Question Type:	Numeric Answer
Question:	A conducting circular loop is placed in X - Y plane in presence of magnetic field $\vec{B} = (3t^3 \hat{j} + 3t^2 \hat{k})$ in SI unit. If the radius of the loop is 1 m, the induced emf in the loop, at time, $t=2$ s is $n\pi$ V. The value of n is _____.

Topic:	Physics-Section B
Item No:	55
Question ID:	100455
Question Type:	Numeric Answer

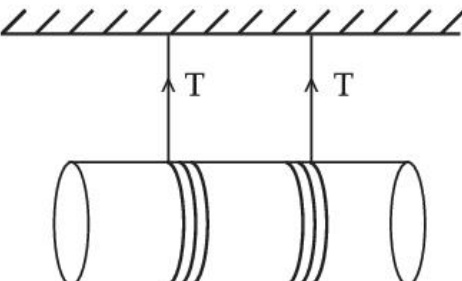
Question:	As show in the figure, in steady state, the charge stored in the capacitor is _____ $\times 10^{-6}$ C. 
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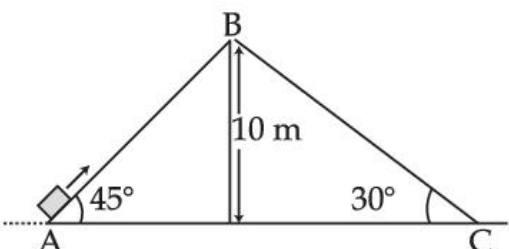
Topic:	Physics-Section B
Item No:	56
Question ID:	100456
Question Type:	Numeric Answer
Question:	A parallel plate capacitor with width 4 cm, length 8 cm and separation between the plates of 4 mm is connected to a battery of 20 V. A dielectric slab of dielectric constant 5 having length 1 cm, width 4 cm and thickness 4 mm is inserted between the plates of parallel plate capacitor. The electrostatic energy of this system will be _____ ϵ_0 J. (Where ϵ_0 is the permittivity of free space)

Topic:	Physics-Section B
Item No:	57
Question ID:	100457
Question Type:	Numeric Answer
Question:	A wire of length 30 cm, stretched between rigid supports, has it's n^{th} and $(n+1)^{\text{th}}$ harmonics at 400 Hz and 450 Hz, respectively. If tension in the string is 2700 N, it's linear mass density is _____ kg/m.

Topic:	Physics-Section B
Item No:	58
Question ID:	100458
Question Type:	Numeric Answer

Question:	A spherical soap bubble of radius 3 cm is formed inside another spherical soap bubble of radius 6 cm. If the internal pressure of the smaller bubble of radius 3 cm in the above system is equal to the internal pressure of the another single soap bubble of radius r cm. The value of r is _____.
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Topic:	Physics-Section B
Item No:	59
Question ID:	100459
Question Type:	Numeric Answer
Question:	A solid cylinder length is suspended symmetrically through two massless strings, as shown in the figure. The distance from the initial rest position, the cylinder should by unbinding the strings to achieve a speed of 4 ms^{-1}, is _____ cm. (take $g = 10 \text{ ms}^{-2}$) 

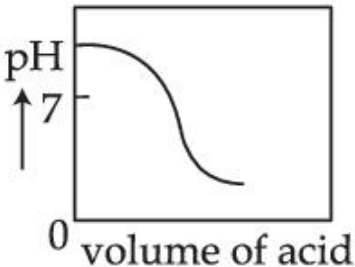
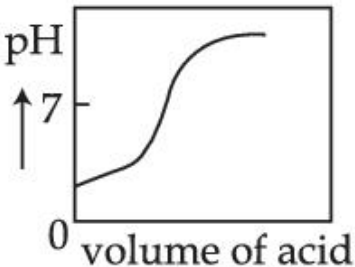
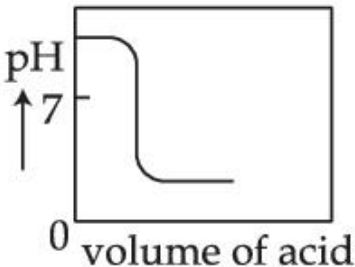
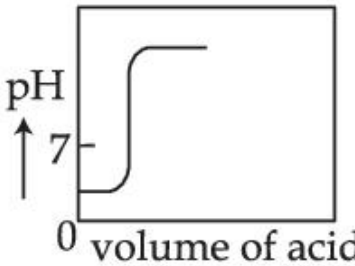
Topic:	Physics-Section B
Item No:	60
Question ID:	100460
Question Type:	Numeric Answer
Question:	Two inclined planes are placed as shown in figure. A block is projected from the Point A of inclined plane AB along its surface with a velocity just sufficient to carry it to the top Point B at a height 10 m. After reaching the Point B the block slides down on inclined plane BC. Time it takes to reach to the point C from point A is $t(\sqrt{2} + 1)\text{s}$. The value of t is _____. (use $g = 10 \text{ m/s}^2$) 

Topic:	Chemistry-Section A
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Item No:	61
Question ID:	100461
Question Type:	MCQ
Question:	The correct decreasing order of energy for the orbitals having, following set of quantum numbers : (A) $n=3, l=0, m=0$ (B) $n=4, l=0, m=0$ (C) $n=3, l=1, m=0$ (D) $n=3, l=2, m=1$ is :
A:	(D) > (B) > (C) > (A)
B:	(B) > (D) > (C) > (A)
C:	(C) > (B) > (D) > (A)
D:	(B) > (C) > (D) > (A)

Topic:	Chemistry-Section A										
Item No:	62										
Question ID:	100462										
Question Type:	MCQ										
Question:	Match List - I with List - II. <table border="0"> <tr> <td style="text-align: center;">List - I</td> <td style="text-align: center;">List - II</td> </tr> <tr> <td>(A) $\psi_{MO} = \psi_A - \psi_B$</td> <td>(I) Dipole moment</td> </tr> <tr> <td>(B) $\mu = Q \times r$</td> <td>(II) Bonding molecular orbital</td> </tr> <tr> <td>(C) $\frac{N_b - N_a}{2}$</td> <td>(III) Anti-bonding molecular orbital</td> </tr> <tr> <td>(D) $\psi_{MO} = \psi_A + \psi_B$</td> <td>(IV) Bond order</td> </tr> </table> Choose the correct answer from the options given below :	List - I	List - II	(A) $\psi_{MO} = \psi_A - \psi_B$	(I) Dipole moment	(B) $\mu = Q \times r$	(II) Bonding molecular orbital	(C) $\frac{N_b - N_a}{2}$	(III) Anti-bonding molecular orbital	(D) $\psi_{MO} = \psi_A + \psi_B$	(IV) Bond order
List - I	List - II										
(A) $\psi_{MO} = \psi_A - \psi_B$	(I) Dipole moment										
(B) $\mu = Q \times r$	(II) Bonding molecular orbital										
(C) $\frac{N_b - N_a}{2}$	(III) Anti-bonding molecular orbital										
(D) $\psi_{MO} = \psi_A + \psi_B$	(IV) Bond order										
A:	(A) - (II), (B) - (I), (C) - (IV), (D) - (III)										
B:	(A) - (III), (B) - (IV), (C) - (I), (D) - (II)										
C:	(A) - (III), (B) - (I), (C) - (IV), (D) - (II)										

D:	(A) - (III), (B) - (IV), (C) - (II), (D) - (I)
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Topic:	Chemistry-Section A
Item No:	63
Question ID:	100463
Question Type:	MCQ
Question:	The plot of pH-metric titration of weak base NH_4OH vs strong acid HCl looks like :
A:	
B:	
C:	
D:	

Topic:	Chemistry-Section A
Item No:	64
Question ID:	100464

Question Type:	MCQ
Question:	Given below are two statements : Statement I : For KI, molar conductivity increases steeply with dilution Statement II : For carbonic acid, molar conductivity increases slowly with dilution In the light of the above statements, choose the correct answer from the options given below :
A:	Both Statement I and Statement II are true
B:	Both Statement I and Statement II are false
C:	Statement I is true but Statement II is false
D:	Statement I is false but Statement II is true

Topic:	Chemistry-Section A
Item No:	65
Question ID:	100465
Question Type:	MCQ
Question:	Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R). Assertion (A) : Dissolved substances can be removed from a colloidal solution by diffusion through a parchment paper. Reason (R) : Particles in a true solution cannot pass through parchment paper but the colloidal particles can pass through the parchment paper. In the light of the above statements, choose the correct answer from the options given below :
A:	Both (A) and (R) are correct and (R) is the correct explanation of (A)
B:	Both (A) and (R) are correct but (R) is not the correct explanation of (A)
C:	(A) is correct but (R) is not correct
D:	(A) is not correct but (R) is correct

Topic:	Chemistry-Section A
Item No:	66
Question ID:	100466
Question Type:	MCQ

Question:	Outermost electronic configurations of four elements A, B, C, D are given below : (A) $3s^2$ (B) $3s^23p^1$ (C) $3s^23p^3$ (D) $3s^23p^4$ The correct order of first ionization enthalpy for them is :
A:	(A) < (B) < (C) < (D)
B:	(B) < (A) < (D) < (C)
C:	(B) < (D) < (A) < (C)
D:	(B) < (A) < (C) < (D)

Topic:	Chemistry-Section A
Item No:	67
Question ID:	100467
Question Type:	MCQ
Question:	An element A of group 1 shows similarity to an element B belonging to group 2. If A has maximum hydration enthalpy in group 1 then B is :
A:	Mg
B:	Be
C:	Ca
D:	Sr

Topic:	Chemistry-Section A
Item No:	68
Question ID:	100468
Question Type:	MCQ

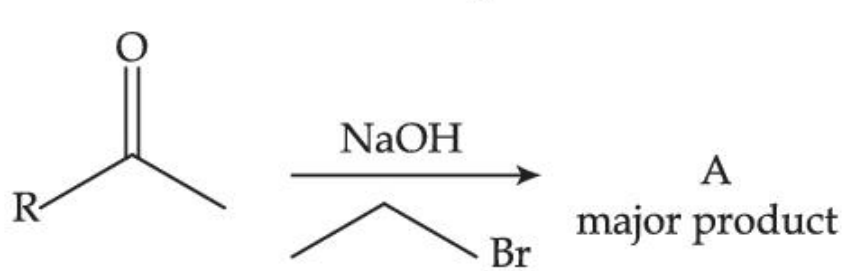
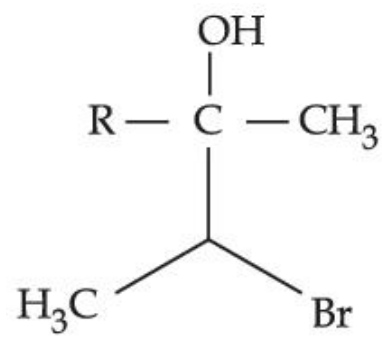
Question:	Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R). Assertion (A) : Boron is unable to form BF_6^{3-}. Reason (R) : Size of B is very small. In the light of the above statements, choose the correct answer from the options given below :
A:	Both (A) and (R) are true and (R) is the correct explanation of (A)
B:	Both (A) and (R) are true but (R) is not the correct explanation of (A)
C:	(A) is true but (R) is false
D:	(A) is false but (R) is true

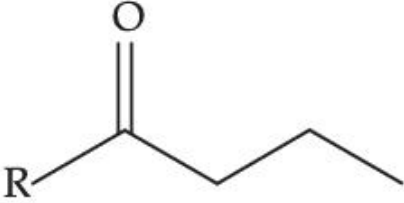
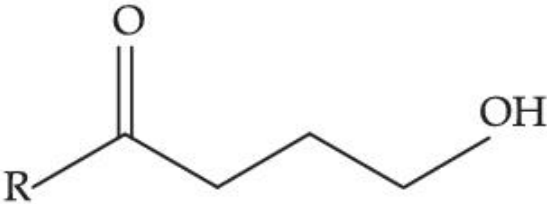
Topic:	Chemistry-Section A
Item No:	69
Question ID:	100469
Question Type:	MCQ
Question:	In neutral or alkaline solution, MnO_4^- oxidises thiosulphate to :
A:	$\text{S}_2\text{O}_7^{2-}$
B:	$\text{S}_2\text{O}_8^{2-}$
C:	SO_3^{2-}
D:	SO_4^{2-}

Topic:	Chemistry-Section A
Item No:	70
Question ID:	100470
Question Type:	MCQ
Question:	Low oxidation state of metals in their complexes are common when ligands :
A:	have good π -accepting character
B:	have good σ -donor character
C:	are having good π -donating ability

D:	are having poor σ -donating ability
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Topic:	Chemistry-Section A
Item No:	71
Question ID:	100471
Question Type:	MCQ
Question:	Given below are two statements : Statement I : The non bio-degradable fly ash and slag from steel industry can be used by cement industry. Statement II : The fuel obtained from plastic waste is lead free. In the light of the above statements, choose the most appropriate answer from the options given below :
A:	Both Statement I and Statement II are correct
B:	Both Statement I and Statement II are incorrect
C:	Statement I is correct but Statement II is incorrect
D:	Statement I is incorrect but Statement II is correct

Topic:	Chemistry-Section A
Item No:	72
Question ID:	100472
Question Type:	MCQ
Question:	The structure of A in the given reaction is :  The diagram shows a chemical reaction. On the left is a ketone molecule with a central carbon atom double-bonded to an oxygen atom (O) and single-bonded to an R group and a methyl group (CH₃). This reacts with NaOH and isobutyl bromide (represented by a skeletal structure of a three-carbon chain with a methyl branch and a bromine atom at the end). An arrow points to the right, labeled with NaOH above and the isobutyl bromide structure below. To the right of the arrow is the product A, labeled 'A major product'.
A:	 The diagram shows the chemical structure of the product A. It is a four-carbon chain. The second carbon from the left is bonded to a hydroxyl group (OH) and a methyl group (CH₃). The third carbon from the left is bonded to a methyl group (H₃C) and a bromine atom (Br). The first carbon is bonded to an R group.

B:	$ \begin{array}{c} \text{OH} \\ \\ \text{R} - \text{C} - \text{CH}_3 \\ \\ \text{CH}_2\text{CH}_3 \end{array} $
C:	
D:	

Topic:	Chemistry-Section A
Item No:	73
Question ID:	100473
Question Type:	MCQ
Question:	Major product 'B' of the following reaction sequence is : $ \text{CH}_3 - \underset{\text{CH}_3}{\text{C}} = \text{CH} - \text{CH}_3 \xrightarrow[\text{CH}_3\text{OH}]{\text{Br}_2} \text{A} \xrightarrow{\text{HI}} \text{B} \text{ (major product)} $
A:	$ \begin{array}{c} \text{HO} \quad \text{Br} \\ \quad \\ \text{CH}_3 - \text{C} - \text{CH} - \text{CH}_3 \\ \\ \text{CH}_3 \end{array} $
B:	$ \begin{array}{c} \text{I} \quad \text{Br} \\ \quad \\ \text{CH}_3 - \text{C} - \text{CH} - \text{CH}_3 \\ \\ \text{CH}_3 \end{array} $

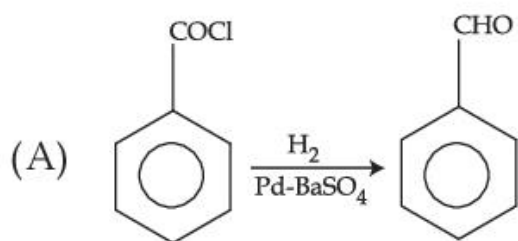
C:	$ \begin{array}{c} \text{Br} \quad \text{OH} \\ \quad \\ \text{CH}_3 - \text{C} - \text{CH} - \text{CH}_3 \\ \\ \text{CH}_3 \end{array} $
D:	$ \begin{array}{c} \text{Br} \quad \text{I} \\ \quad \\ \text{CH}_3 - \text{C} - \text{CH} - \text{CH}_3 \\ \\ \text{CH}_3 \end{array} $

Topic:	Chemistry-Section A
Item No:	74
Question ID:	100474
Question Type:	MCQ
Question:	

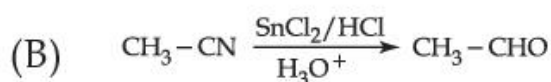
Match List - I with List - II.

List - I

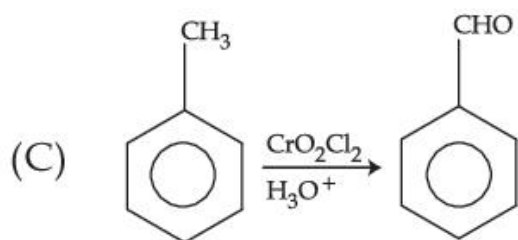
List - II



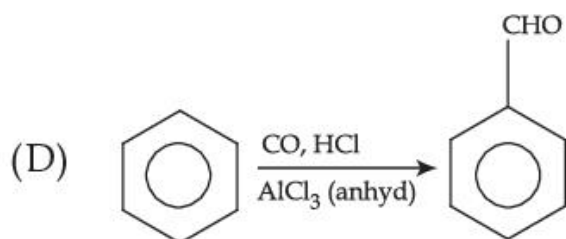
(I) Gatterman Koch reaction



(II) Etard reaction



(III) Stephen reaction



(IV) Rosenmund reaction

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

A: (A) - (IV), (B) - (III), (C) - (II), (D) - (I)

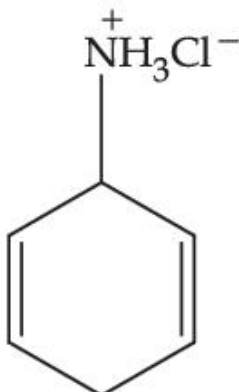
B: (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

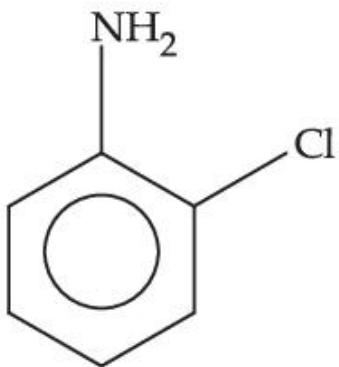
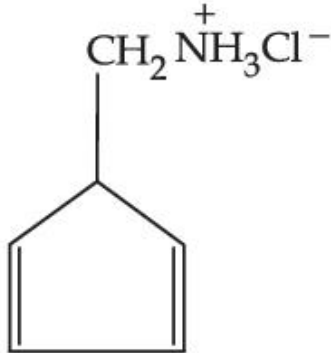
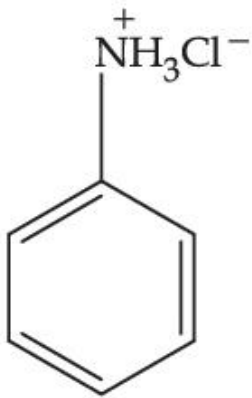
C: (A) - (II), (B) - (III), (C) - (IV), (D) - (I)

D: (A) - (III), (B) - (II), (C) - (I), (D) - (IV)

Topic:	Chemistry-Section A
Item No:	75
Question ID:	100475
Question Type:	MCQ

Question:	Match List - I with List - II.	
	List - I (Polymer)	List - II (Monomer)
	(A) Neoprene	(I) Acrylonitrile
	(B) Teflon	(II) Chloroprene
	(C) Acrilan	(III) Tetrafluoroethene
	(D) Natural rubber	(IV) Isoprene
	Choose the correct answer from the options given below :	
A:	(A) - (II), (B) - (III), (C) - (I), (D) - (IV)	
B:	(A) - (II), (B) - (I), (C) - (III), (D) - (IV)	
C:	(A) - (II), (B) - (I), (C) - (IV), (D) - (III)	
D:	(A) - (I), (B) - (II), (C) - (III), (D) - (IV)	

Topic:	Chemistry-Section A
Item No:	76
Question ID:	100476
Question Type:	MCQ
Question:	An organic compound 'A' contains nitrogen and chlorine. It dissolves readily in water to give a solution that turns litmus red. Titration of compound 'A' with standard base indicates that the molecular weight of 'A' is 131 ± 2 . When a sample of 'A' is treated with aq. NaOH, a liquid separates which contains N but not Cl. Treatment of the obtained liquid with nitrous acid followed by phenol gives orange precipitate. The compound 'A' is :
A:	

B:	
C:	
D:	

Topic:	Chemistry-Section A		
Item No:	77		
Question ID:	100477		
Question Type:	MCQ		
Question:	Match List - I with List - II.		
	List - I		List - II
	(A) Glucose + HI	(I) Gluconic acid	
	(B) Glucose + Br ₂ water	(II) Glucose pentacetate	
	(C) Glucose + acetic anhydride	(III) Saccharic acid	
	(D) Glucose + HNO ₃	(IV) Hexane	
Choose the correct answer from the options given below :			

A:	(A) - (IV), (B) - (I), (C) - (II), (D) - (III)
B:	(A) - (IV), (B) - (III), (C) - (II), (D) - (I)
C:	(A) - (III), (B) - (I), (C) - (IV), (D) - (II)
D:	(A) - (I), (B) - (III), (C) - (IV), (D) - (II)

Topic:	Chemistry-Section A
Item No:	78
Question ID:	100478
Question Type:	MCQ
Question:	Which of the following enhances the lathering property of soap ?
A:	Sodium stearate
B:	Sodium carbonate
C:	Sodium rosinate
D:	Trisodium phosphate

Topic:	Chemistry-Section A										
Item No:	79										
Question ID:	100479										
Question Type:	MCQ										
Question:	Match List - I with List - II. <table border="0"> <tr> <td style="text-align: center;">List - I (Mixture)</td> <td style="text-align: center;">List - II (Purification Process)</td> </tr> <tr> <td>(A) Chloroform & Aniline</td> <td>(I) Steam distillation</td> </tr> <tr> <td>(B) Benzoic acid & Napthalene</td> <td>(II) Sublimation</td> </tr> <tr> <td>(C) Water & Aniline</td> <td>(III) Distillation</td> </tr> <tr> <td>(D) Napthalene & Sodium chloride</td> <td>(IV) Crystallisation</td> </tr> </table> Choose the correct answer from the options given below :	List - I (Mixture)	List - II (Purification Process)	(A) Chloroform & Aniline	(I) Steam distillation	(B) Benzoic acid & Napthalene	(II) Sublimation	(C) Water & Aniline	(III) Distillation	(D) Napthalene & Sodium chloride	(IV) Crystallisation
List - I (Mixture)	List - II (Purification Process)										
(A) Chloroform & Aniline	(I) Steam distillation										
(B) Benzoic acid & Napthalene	(II) Sublimation										
(C) Water & Aniline	(III) Distillation										
(D) Napthalene & Sodium chloride	(IV) Crystallisation										
A:	(A) - (IV), (B) - (III), (C) - (I), (D) - (II)										
B:	(A) - (III), (B) - (I), (C) - (IV), (D) - (II)										

C:	(A) - (III), (B) - (IV), (C) - (II), (D) - (I)
D:	(A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Topic:	Chemistry-Section A
Item No:	80
Question ID:	100480
Question Type:	MCQ
Question:	Fe^{3+} cation gives a prussian blue precipitate on addition of potassium ferrocyanide solution due to the formation of :
A:	$[\text{Fe}(\text{H}_2\text{O})_6]_2 [\text{Fe}(\text{CN})_6]$
B:	$\text{Fe}_2[\text{Fe}(\text{CN})_6]_2$
C:	$\text{Fe}_3[\text{Fe}(\text{OH})_2 (\text{CN})_4]_2$
D:	$\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$

Topic:	Chemistry-Section B
Item No:	81
Question ID:	100481
Question Type:	Numeric Answer
Question:	The normality of H_2SO_4 in the solution obtained on mixing 100 mL of 0.1 M H_2SO_4 with 50 mL of 0.1 M NaOH is _____ $\times 10^{-1}$ N. (Nearest Integer)

Topic:	Chemistry-Section B
Item No:	82
Question ID:	100482
Question Type:	Numeric Answer
Question:	For a real gas at 25°C temperature and high pressure (99 bar) the value of compressibility factor is 2, so the value of Vander Waal's constant 'b' should be _____ $\times 10^{-2}$ L mol ⁻¹ (Nearest integer) (Given R = 0.083 L bar K ⁻¹ mol ⁻¹)

Topic:	Chemistry-Section B
Item No:	83
Question ID:	100483
Question Type:	Numeric Answer
Question:	A gas (Molar mass= 280 g mol^{-1}) was burnt in excess O_2 in a constant volume calorimeter and during combustion the temperature of calorimeter increased from 298.0 K to 298.45 K . If the heat capacity of calorimeter is 2.5 kJ K^{-1} and enthalpy of combustion of gas is 9 kJ mol^{-1} then amount of gas burnt is _____ g. (Nearest Integer)

Topic:	Chemistry-Section B
Item No:	84
Question ID:	100484
Question Type:	Numeric Answer
Question:	When a certain amount of solid A is dissolved in 100 g of water at 25°C to make a dilute solution, the vapour pressure of the solution is reduced to one-half of that of pure water. The vapour pressure of pure water is 23.76 mmHg . The number of moles of solute A added is _____. (Nearest Integer)

Topic:	Chemistry-Section B
Item No:	85
Question ID:	100485
Question Type:	Numeric Answer
Question:	$[A] \rightarrow [B]$ Reactant Product If formation of compound [B] follows the first order of kinetics and after 70 minutes the concentration of [A] was found to be half of its initial concentration. Then the rate constant of the reaction is $x \times 10^{-6} \text{ s}^{-1}$. The value of x is _____. (Nearest Integer)

Topic:	Chemistry-Section B
Item No:	86
Question ID:	100486
Question Type:	Numeric Answer

Question:	Among the following ores Bauxite, Siderite, Cuprite, Calamine, Haematite, Kaolinite, Malachite, Magnetite, Sphalerite, Limonite, Cryolite, the number of principal ores of iron is _____.
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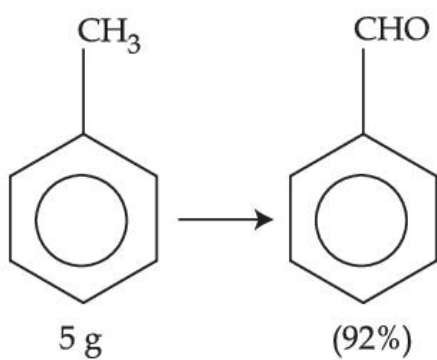
Topic:	Chemistry-Section B
Item No:	87
Question ID:	100487
Question Type:	Numeric Answer
Question:	The oxidation state of manganese in the product obtained in a reaction of potassium permanganate and hydrogen peroxide in basic medium is _____.

Topic:	Chemistry-Section B
Item No:	88
Question ID:	100488
Question Type:	Numeric Answer
Question:	The number of molecule(s) or ion(s) from the following having non-planar structure is _____. NO_3^- , H_2O_2 , BF_3 , PCl_3 , XeF_4 , SF_4 , XeO_3 , PH_4^+ , SO_3 , $[\text{Al}(\text{OH})_4]^-$

Topic:	Chemistry-Section B
Item No:	89
Question ID:	100489
Question Type:	Numeric Answer
Question:	The spin only magnetic moment of the complex present in Fehling's reagent is _____ B.M. (Nearest integer).

Topic:	Chemistry-Section B
Item No:	90
Question ID:	100490
Question Type:	Numeric Answer

Question:



In the above reaction, 5 g of toluene is converted into benzaldehyde with 92% yield. The amount of benzaldehyde produced is _____ $\times 10^{-2}$ g. (Nearest integer)