National Testing Agency

Question Paper Name :	B Tech 25 Jul 2022 Shift 2
Subject Name :	B. Tech
Duration :	180
Total Marks :	300
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 :	300

Mathematics Section A

Section Number :	1
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	20
Number of Questions to be attempted :	20
Section Marks :	80
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 Option Orientation : Vertical

For $z \in \mathbb{C}$ if the minimum value of $(|z - 3\sqrt{2}| + |z - p\sqrt{2}\, i|)$ is $5\sqrt{2}$, then a value Question: of p is _____.

Options :

A. 3

B. $\frac{7}{2}$

C. 4

D. $\frac{9}{2}$

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

The number of real values of λ, such that the system of linear equations

$2x - 3y + 5z = 9$

$x + 3y - z = -18$

$3x - y + (\lambda^2 - |\lambda|)z = 16$

has no solutions, is

Options :

A. 0

B. 1

C. 2

D. 4

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

The number of bijective functions $f : \{1,3,5,7, \ldots, 99\} \to \{2,4,6,8, \ldots .100\}$, such that $f(3) \geq f(9) \geq f(15) \geq f(21) \geq \ldots ..f(99)$, is _____.

Options :

A. $^{50}P_{17}$

B. $^{50}P_{33}$

C. $33! \times 17$!

D. $\frac{50!}{2}$

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

The remainder when $(11)^{1011} + (1011)^{11}$ is divided by 9 is

Options :

A. 1

B. 4

C. 6

D. 8

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

$$\lim_{x \to \frac{\pi}{4}} \frac{8\sqrt{2} - (\cos x + \sin x)^7}{\sqrt{2} - \sqrt{2}\sin 2x}$$

is equal to

Options :

A. 14

B. 7

C. $14\sqrt{2}$

D. $7\sqrt{2}$

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

If A and B are two events such that

$$P(A) = \frac{1}{3}, P(B) = \frac{1}{5}$$

and

$$P(A \cup B) = \frac{1}{2}$$

, then $P\left(A \mid B'\right) + P\left(B \mid A'\right)$ is equal to :

Options :

A. $\frac{3}{4}$

B. $\frac{5}{8}$

C. $\frac{5}{4}$

D. $\frac{7}{8}$

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

Let $[t]$ denote the greatest integer less than or equal to t. Then the value of the integral $\int_{-3}^{101} \left([\sin(\pi x)] + e^{[\cos(2\pi x)]}\right) dx$ is equal to

Options :

A. $\frac{52(1-e)}{e}$

B. $\frac{52}{e}$

C. $\frac{52(2+e)}{e}$

D. $\frac{104}{e}$

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

Let the point $P(\alpha, \beta)$ be at a unit distance from each of the two lines

$$L_1 : 3x - 4y + 12 = 0$$

, and

$$L_2 : 8x + 6y + 11 = 0$$

. If P lies below L_1 and above L_2, then $100(\alpha + \beta)$ is equal to :

Options :

A. -14

B. 42

C. -22

D. 14

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

If the ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

meets the line

$$\frac{x}{7} + \frac{y}{2\sqrt{6}} = 1$$

on the x-axis and the line

$$\frac{x}{7} - \frac{y}{2\sqrt{6}} = 1$$

on the y-axis, then the eccentricity of the ellipse is :

Options :

A. $\frac{5}{7}$

B. $\frac{2\sqrt{6}}{7}$

C. $\frac{3}{7}$

D. $\frac{2\sqrt{5}}{7}$

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

Let the foci of the ellipse

$$\frac{x^2}{16}+\frac{y^2}{7}=1$$

and the hyperbola

$$\frac{x^2}{144}-\frac{y^2}{\alpha}=\frac{1}{25}$$

coincide. Then the length of the latus rectum of the hyperbola is :

Options :

A. $\frac{32}{9}$

B. $\frac{18}{5}$

C. $\frac{27}{4}$

D. $\frac{27}{10}$

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

The shortest distance between the lines

$$\frac{x+7}{-6}=\frac{y-6}{7}=z$$

and

$$\frac{7-x}{2}=y-2=z-6$$

is :

Options :

A. $2\sqrt{29}$

B. 1

C. $\sqrt{\frac{37}{29}}$

D. $\frac{\sqrt{29}}{2}$

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

Let

$$\vec{a} = \hat{i} - \hat{j} + 2\hat{k}$$

and let $\vec{b}$ be a vector such that

$$\vec{a} \times \vec{b} = 2\hat{i} - \hat{k}$$

and

$$\vec{a} \cdot \vec{b} = 3$$

. Then the projection of $\vec{b}$ on the vector $\vec{a} - \vec{b}$ is :

Options :

A. $\frac{2}{\sqrt{21}}$

B. $2\sqrt{\frac{3}{7}}$

C. $\frac{2}{3}\sqrt{\frac{7}{3}}$

D. $\frac{2}{3}$

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

If the mean deviation about median for the numbers 3, 5, 7, 2k, 12, 16, 21, 24, arranged in the ascending order, is 6 then the median is :

Options :

A. 11.5

B. 10.5

C. 12

D. 11

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

$$2\sin\left(\frac{\pi}{22}\right)\sin\left(\frac{3\pi}{22}\right)\sin\left(\frac{5\pi}{22}\right)\sin\left(\frac{7\pi}{22}\right)\sin\left(\frac{9\pi}{22}\right)$$

is equal to :

Options :

A. $\frac{3}{16}$

B. $\frac{1}{16}$

C. $\frac{1}{32}$

D. $\frac{9}{32}$

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

The sum

$$\sum_{n=1}^{21}\frac{3}{(4n-1)(4n+3)}$$

is equal to

Options :

A. $\frac{7}{87}$

B. $\frac{7}{29}$

C. $\frac{14}{87}$

D. $\frac{21}{29}$

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

$$\lim_{n\to\infty}\frac{1}{2^n}\left(\frac{1}{\sqrt{1-\frac{1}{2^n}}}+\frac{1}{\sqrt{1-\frac{2}{2^n}}}+\frac{1}{\sqrt{1-\frac{3}{2^n}}}+\ \ldots\ +\frac{1}{\sqrt{1-\frac{2^n-1}{2^n}}}\right)$$

is equal to

Options :

A. $\frac{1}{2}$

B. 1

C. 2

D. -2

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

Let a smooth curve

$$y=f(x)$$

be such that the slope of the tangent at any point (x,y) on it is directly proportional to

$$\left(\frac{-y}{x}\right)$$

. If the curve passes through the points (1,2) and (8,1), then

$$\left|y\left(\frac{1}{8}\right)\right|$$

is equal to

Options :

A. $2\log_e 2$

B. 4

C. 1

D. $4\log_e 2$

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

The tangents at the points $A(1,3)$ and $B(1,-1)$ on the parabola $y^2-2x-2y=1$ meet at the point P. Then the area (in unit ^{2}) of the triangle PAB is :

Options :

A. 4

B. 6

C. 7

D. 8

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

A plane E is perpendicular to the two planes $2x - 2y + z = 0$ and $x - y + 2z = 4$, and passes through the point $P(1, -1, 1)$. If the distance of the plane E from the point $Q(a, a, 2)$ is $3\sqrt{2}$, then $(PQ)^2$ is equal to :

Options :

A. 9

B. 12

C. 21

D. 33

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

Consider the following statements:

P : Ramu is intelligent.

Q : Ramu is rich.

R : Ramu is not honest.

The negation of the statement "Ramu is intelligent and honest if and only if Ramu is not rich" can be expressed as:

Options :

A. $((P \wedge (\sim R)) \wedge Q) \wedge ((\sim Q) \wedge ((\sim P) \vee R))$

B. $((P \wedge R) \wedge Q) \vee ((\sim Q) \wedge ((\sim P) \vee (\sim R)))$

C. $((P \wedge R) \wedge Q) \wedge ((\sim Q) \wedge ((\sim P) \vee (\sim R)))$

D. $((P \wedge (\sim R)) \wedge Q) \vee ((\sim Q) \wedge ((\sim P) \vee R))$

Mathematics Section B

Section Number : 2

Section type : Online

Mandatory or Optional :	Mandatory
Number of Questions :	10
Number of Questions to be attempted :	5
Section Marks :	20
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 21 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Let

$$A = \{1,2,3,4,5,6,7\}$$

. Define

$$B = \{T \subseteq A$$

: either $1 \notin T$ or $2 \in T\}$ and

$$C = \{T \subseteq A : T$$

the sum of all the elements of T is a prime number $\}$. Then the number of elements in the set $B \cup C$ is _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 22 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Let $f(x)$ be a quadratic polynomial with leading coefficient 1 such that

$$f(0) = p, p \neq 0$$

, and

$$f(1) = \frac{1}{3}$$

. If the equations

$$f(x) = 0$$

and

$$f \circ f \circ f \circ f(x) = 0$$

have a common real root, then $f(-3)$ is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 23 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Let

$$A = \begin{bmatrix} 1 & a & a \\ 0 & 1 & b \\ 0 & 0 & 1 \end{bmatrix}, a, b \in \mathbb{R}$$

. If for some

$$n \in \mathbb{N}, A^n = \begin{bmatrix} 1 & 48 & 2160 \\ 0 & 1 & 96 \\ 0 & 0 & 1 \end{bmatrix}$$

then $n + a + b$ is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 24 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

The sum of the maximum and minimum values of the function

$$f(x) = |5x - 7| + \left[x^2 + 2x\right]$$

in the interval

$$\left[\frac{5}{4}, 2\right]$$

, where $[t]$ is the greatest integer $\leq t$, is _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 25 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Let

$$y = y(x)$$

be the solution of the differential equation

$$\frac{dy}{dx} = \frac{4y^3 + 2yx^2}{3xy^2 + x^3}, y(1) = 1$$

.

If for some $n \in \mathbb{N}, y(2) \in [n - 1, n)$, then n is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 26 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Let f be a twice differentiable function on $\mathbb{R}$. If

$$f'(0) = 4$$

and

$$f(x) + \int_0^x (x-t)f'(t)dt = \left(e^{2x} + e^{-2x}\right)\cos 2x + \frac{2}{a}x$$

, then $(2a+1)^5\, a^2$ is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 27 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Let

$$a_n = \int_{-1}^{n} \left(1 + \frac{x}{2} + \frac{x^2}{3} + \ldots.. + \frac{x^{n-1}}{n}\right)dx$$

for every n ∈ N. Then the sum of all the elements of the set $\{n \in N : a_n \in (2, 30)\}$ is _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 28 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Let the area enclosed by the x-axis, and the tangent and normal drawn to the curve

$$4x^3 - 3xy^2 + 6x^2 - 5xy - 8y^2 + 9x + 14 = 0$$

at the point $(-2, 3)$ be A. Then 8A is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 29 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Let

$$x = \sin(2\tan^{-1}\alpha)$$

and

$$y = \sin\left(\frac{1}{2}\tan^{-1}\frac{4}{3}\right)$$

. If

$$S = \{a \in R : y^2 = 1 - x\}$$

, then

$$\sum_{\alpha \in S} 16\alpha^3$$

is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 30 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

If the circles

$$x^2 + y^2 + 6x + 8y + 16 = 0$$

and

$$x^2 + y^2 + 2\left(3 - \sqrt{3}\ \right)x + 2\left(4 - \sqrt{6}\ \right)y = k + 6\sqrt{3}\ + 8\sqrt{6}$$

, $k > 0$, touch internally at the point $P(\alpha, \beta)$, then $\left(\alpha + \sqrt{3}\ \right)^2 + \left(\beta + \sqrt{6}\ \right)^2$ is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Physics Section A

Section Number :	3
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	20
Number of Questions to be attempted :	20
Section Marks :	80
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 Option Orientation : Vertical

The electric current in a circular coil of 2 turns produces a magnetic induction B_1 at its centre. The coil is unwound and in rewound into a circular coil of 5 tuns and the same current produces a magnetic induction B_2 at its centre. The ratio of $\frac{B_2}{B_1}$ is

Options :

A. $\frac{5}{2}$

B. $\frac{25}{4}$

C. $\frac{5}{4}$

D. $\frac{25}{2}$

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

A drop of liquid of density ρ is floating half immersed in a liquid of density σ and surface tension 7.5×10^{-4} Ncm^{-1}. The radius of drop in cm will be :

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

Options :

A. $\frac{15}{\sqrt{(2\rho - \sigma)}}$

B. $\frac{15}{\sqrt{(\rho - \sigma)}}$

C. $\frac{3}{2\sqrt{(\rho - \sigma)}}$

D. $\frac{3}{20\sqrt{(2\rho - \sigma)}}$

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

Two billiard balls of mass 0.05 kg each moving in opposite directions with 10 ms^{-1} collide and rebound with the same speed. If the time duration of contact is t = 0.005 s, then what is the force exerted on the ball due to each other?

Options :

A. 100 N

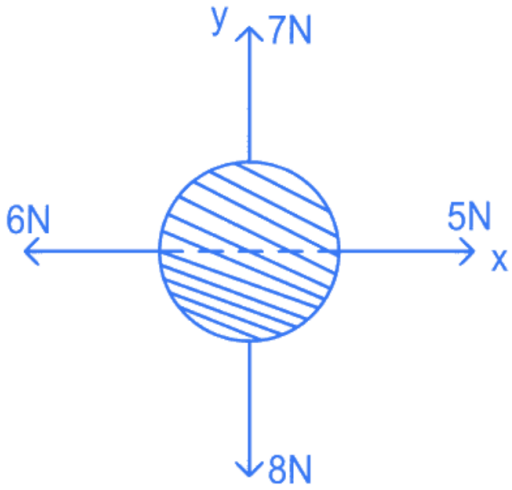
B. 200 N

C. 300 N

D. 400 N

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

For a free body diagram shown in the figure, the four forces are applied in the 'x' and 'y' directions. What additional force must be applied and at what angle with positive x-axis so that the net acceleration of body is zero?



Options :

A. $\sqrt{2}\ N, 45^\circ$

B. $\sqrt{2}\ N, 135^\circ$

C. $\frac{2}{\sqrt{3}} N, 30^\circ$

D. $2N, 45^\circ$

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

Capacitance of an isolated conducting sphere of radius R_1 becomes n times when it is enclosed by a concentric conducting sphere of radius R_2 connected to earth. The ratio of their radii

$$\left(\frac{R_2}{R_1}\right)$$

is :

Options :

A. $\frac{n}{n-1}$

B. $\frac{2n}{2n+1}$

C. $\frac{n+1}{n}$

D. $\frac{2n+1}{n}$

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

The ratio of wavelengths of proton and deuteron accelerated by potential V_p and V_d is 1 : $\sqrt{2}$. Then the ratio of V_p to V_d will be :

Options :

A. 1 : 1

B. $\sqrt{2}$: 1

C. 2 : 1

D. 4 : 1

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

For an object placed at a distance 2.4 m from a lens, a sharp focused image is observed on a screen placed at a distance 12 cm from the lens. A glass plate of refractive index 1.5 and thickness 1 cm is introduced between lens and screen such that the glass plate plane faces parallel to the screen. By what distance should the object be shifted so that a sharp focused image is observed again on the screen?

Options :

A. 0.8 m

B. 3.2 m

C. 1.2 m

D. 5.6 m

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

Light wave travelling in air along x-direction is given by

$$E_y = 540 \sin \pi \times 10^4 (x - ct)\, Vm^{-1}$$

. Then, the peak value of magnetic field of wave will be (Given c = 3×10^8 ms^{-1})

Options :

A. 18×10^{-7} T

B. 54×10^{-7} T

C. 54×10^{-8} T

D. 18×10^{-8} T

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

When you walk through a metal detector carrying a metal object in your pocket, it raises an alarm. This phenomenon works on :

Options :

A. Electromagnetic induction

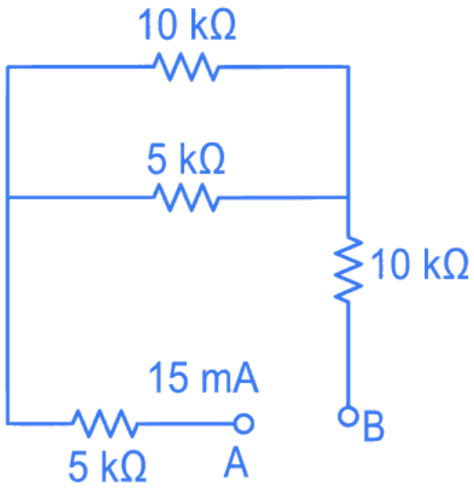
B. Resonance in ac circuits

C. Mutual induction in ac circuits

D. Interference of electromagnetic waves

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

A current of 15 mA flows in the circuit as shown in figure. The value of potential difference between the points A and B will be:



Options :

A. 50 V

B. 75 V

C. 150 V

D. 275 V

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

The length of a seconds pendulum at a height h = 2R from earth surface will be:

(Given R = Radius of earth and acceleration due to gravity at the surface of earth, $g = \pi^2\ ms^{-2}$)

Options :

A. $\frac{2}{9}$ m

B. $\frac{4}{9}$ m

C. $\frac{8}{9}$ m

D. $\frac{1}{9}$ m

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

Sound travels in a mixture of two moles of helium and n moles of hydrogen. If rms speed of gas molecules in the mixture is $\sqrt{2}$ times the speed of sound, then the value of n will be :

Options :

A. 1

B. 2

C. 3

D. 4

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

An object is taken to a height above the surface of earth at a distance $\frac{5}{4}$ R from the centre of the earth. Where radius of earth, R = 6400 km. The percentage decrease in the weight of the object will be :

Options :

A. 36%

B. 50%

C. 64%

D. 25%

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

A bag of sand of mass 9.8 kg is suspended by a rope. A bullet of 200 g travelling with speed 10 ms^{-1} gets embedded in it, then loss of kinetic energy will be :

Options :

A. 4.9 J

B. 9.8 J

C. 14.7 J

D. 19.6 J

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

A ball is projected from the ground with a speed 15 ms^{-1} at an angle θ with horizontal so that its range and maximum height are equal,
then '$\tan\theta$' will be equal to :

Options :

A. $\frac{1}{4}$

B. $\frac{1}{2}$

C. 2

D. 4

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

The maximum error in the measurement of resistance, current and time for which current flows in an electrical circuit are 1%, 2% and 3% respectively. The maximum percentage error in the detection of the dissipated heat will be :

Options :

A. 2

B. 4

C. 6

D. 8

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

Hydrogen atom from excited state comes to the ground state by emitting a photon of wavelength λ. The value of principal quantum number 'n' of the excited state will be : (R : Rydberg constant)

Options :

A. $\sqrt{\frac{\lambda R}{\lambda - 1}}$

B. $\sqrt{\frac{\lambda R}{\lambda R - 1}}$

C. $\sqrt{\frac{\lambda}{\lambda R - 1}}$

D. $\sqrt{\frac{\lambda R^2}{\lambda R - 1}}$

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

In AM modulation, a signal is modulated on a carrier wave such that maximum and minimum amplitudes are found to be 6 V and 2 V respectively. The modulation index is :

Options :

A. 100%

B. 80%

C. 60%

D. 50%

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

An electron with energy 0.1 keV moves at right angle to the earth's magnetic field of 1×10^{-4} Wbm^{-2}. The frequency of revolution of the electron will be :

(Take mass of electron = 9.0×10^{-31} kg)

Options :

A. 1.6×10^5 Hz

B. 5.6×10^5 Hz

C. 2.8×10^6 Hz

D. 1.8×10^6 Hz

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

Let η_1 is the efficiency of an engine at

$$T_1 = 447°C$$

and

$$T_2 = 147°C$$

while η_2 is the efficiency at

$$T_1 = 947°C$$

and

$$T_2 = 47°C$$

The ratio

$$\frac{\eta_1}{\eta_2}$$

will be :

Options :

A. 0.41

B. 0.56

C. 0.73

D. 0.70

Physics Section B

Section Number :	4
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	10
Number of Questions to be attempted :	5
Section Marks :	20
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 51 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A particle is moving in a straight line such that its velocity is increasing at 5 ms^{-1} per meter. The acceleration of the particle is _____ ms^{-2} at a point where its velocity is 20 ms^{-1}.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 52 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Three identical spheres each of mass M are placed at the corners of a right angled triangle with mutually perpendicular sides equal to 3 m each. Taking point of intersection of mutually perpendicular sides as origin, the magnitude of position vector of centre of mass of the system will be $\sqrt{x}$ m. The value of x is _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 53 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A block of ice of mass 120 g at temperature 0°C is put in 300 g of water at 25°C. The x g of ice melts as the temperature of the water reaches 0°C. The value of x is _____.

[Use specific heat capacity of water = 4200 $Jkg^{-1}K^{-1}$, Latent heat of ice = 3.5×10^5 Jkg^{-1}]

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 54 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

$$\frac{x}{x+4}$$

is the ratio of energies of photons produced due to transition of an electron of hydrogen atom from its

(i) third permitted energy level to the second level and

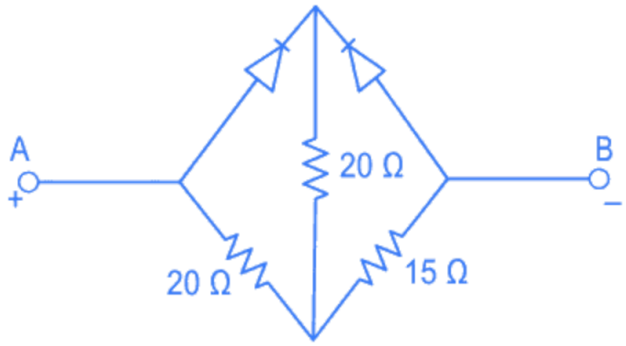
(ii) the highest permitted energy level to the second permitted level.

The value of x will be _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 55 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Two ideal diodes are connected in the network as shown in figure. The equivalent resistance between A and B is _____ Ω.



Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 56 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Two parallel plate capacitors of capacity C and 3C are connected in parallel combination and charged to a potential difference 18 V. The battery is then disconnected and the space between the plates of the capacitor of capacity C is completely filled with a material of dielectric constant 9. The final potential difference across the combination of capacitors will be _____ V.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 57 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A convex lens of focal length 20 cm is placed in front of a convex mirror with principal axis coinciding each other. The distance between the lens and mirror is 10 cm. A point object is placed on principal axis at a distance of 60 cm from the convex lens. The image formed by combination coincides the object itself. The focal length of the convex mirror is _____ cm.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 58 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Magnetic flux (in weber) in a closed circuit of resistance 20 Ω varies with time t(s) at $\phi = 8t^2 - 9t + 5$. The magnitude of the induced current at t = 0.25 s will be _____ mA.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 59 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

In a potentiometer arrangement, a cell of emf 1.20 V gives a balance point at 36 cm length of wire. This cell is now replaced by another cell of emf 1.80 V. The difference in balancing length of potentiometer wire in above conditions will be _____ cm.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 60 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Two waves executing simple harmonic motions travelling in the same direction with same amplitude and frequency are superimposed. The resultant amplitude is equal to the $\sqrt{3}$ times of amplitude of individual motions. The phase difference between the two motions is _____ (degree).

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Chemistry Section A

Section Number :	5
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	20
Number of Questions to be attempted :	20
Section Marks :	80
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 Option Orientation : Vertical

Match List I with List II:

	List I (molecule)		**List II (hybridization ; shape)**
(A)	XeO_3	(I)	sp^3d ; linear
(B)	XeF_2	(II)	sp^3 ; pyramidal
(C)	$XeOF_4$	(III)	sp^3d^3 ; distorted octahedral
(D)	XeF_6	(IV)	sp^3d^2 ; square pyramidal

Choose the correct answer from the options given below:

Options :

A. A-II, B-I, C-IV, D-III

B. A-II, B-IV, C-III, D-I

C. A-IV, B-II, C-III, D-I

D. A-IV, B-II, C-I, D-III

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

Two solutions A and B are prepared by dissolving 1 g of non-volatile solutes X and Y, respectively in 1 kg of water. The ratio of depression in freezing points for A and B is found to be 1 : 4. The ratio of molar masses of X and Y is

Options :

A. 1 : 4

B. 1 : 0.25

C. 1 : 0.20

D. 1 : 5

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

K_{a_1}, K_{a_2} and K_{a_3} are the respective ionization constants for the following reactions (a), (b) and (c).

(a) $H_2C_2O_4 \rightleftarrows H^+ + HC_2O_4^-$

(b) $HC_2O_4^- \rightleftarrows H^+ + C_2O_4^{2-}$

(c) $H_2C_2O_4 \rightleftarrows 2H^+ + C_2O_4^{2-}$

The relationship between K_{a_1}, K_{a_2} and K_{a_3} is given as :

Options :

A. $K_{a_3} = K_{a_1} + K_{a_2}$

B. $K_{a_3} = K_{a_1} - K_{a_2}$

C. $K_{a_3} = K_{a_1} / K_{a_2}$

D. $K_{a_3} = K_{a_1} \times K_{a_2}$

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

The molar conductivity of a conductivity cell filled with 10 moles of 20 mL NaCl solution is Λ_{m1} and that of 20 moles another identical cell heaving 80 mL NaCl solution is Λ_{m2}. The conductivities exhibited by these two cells are same. The relationship between Λ_{m2} and Λ_{m1} is

Options :

A. $\Lambda_{m2} = 2\Lambda_{m1}$

B. $\Lambda_{m2} = \Lambda_{m1} / 2$

C. $\frac{\Lambda_{m2}}{\Lambda_{m1}} =$

D. $\Lambda_{m2} = 4\Lambda_{m1}$

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

The first ionization enthalpies of Be, B, N and O follow the order

Options :

A. O < N < B < Be

B. Be < B < N < O

C. B < Be < N < O

D. B < Be < O < N

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

The correct order of energy of absorption for the following metal complexes is :

A : $[Ni(en)_3]^{2+}$, B : $[Ni(NH_3)_6]^{2+}$, C : $[Ni(H_2O)_6]^{2+}$

Options :

A. C < B < A

B. B < C < A

C. $C < A < B$

D. $A < C < B$

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

Match List I with List II:

	List I		**List II**
(A)	Sulphate	(I)	Pesticide
(B)	Fluoride	(II)	Bending of bones
(C)	Nicotine	(III)	Laxative effect
(D)	Sodium arsinite	(IV)	Herbicide

Choose the correct answer from the options given below :

Options :

A. A-II, B-III, C-IV, D-I

B. A-IV, B-III, C-II, D-I

C. A-III, B-II, C-I, D-IV

D. A-III, B-II, C-IV, D-I

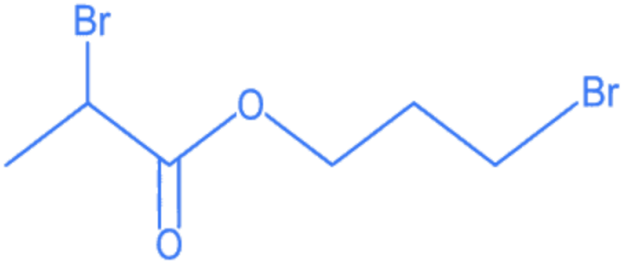
Question Number : 68 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Major product of the following reaction is

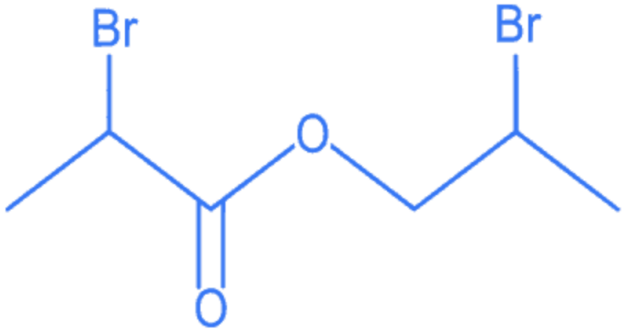


Options :

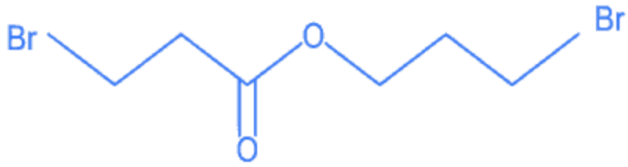
A.



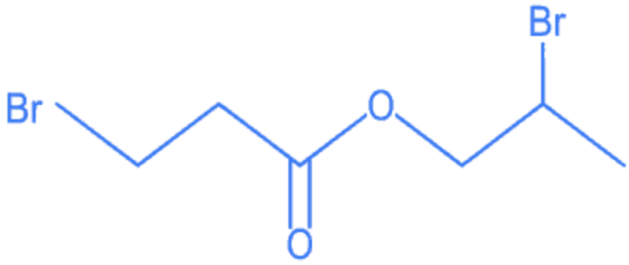
B.



C.

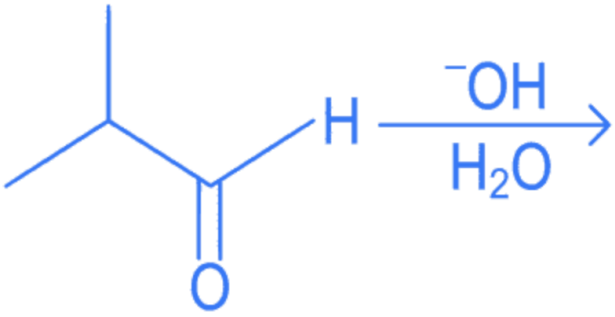


D.



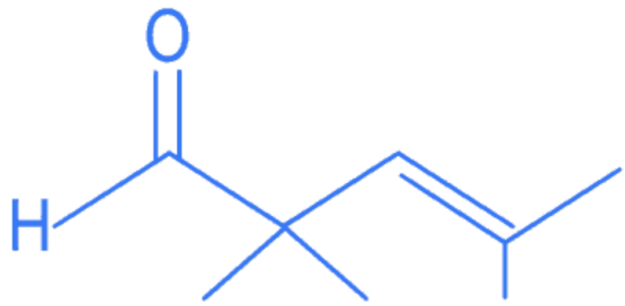
Question Number : 69 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

What is the major product of the following reaction?

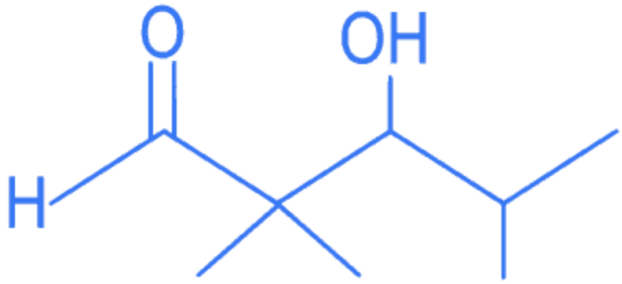


Options :

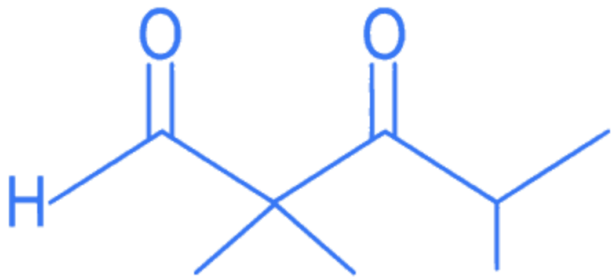
A.



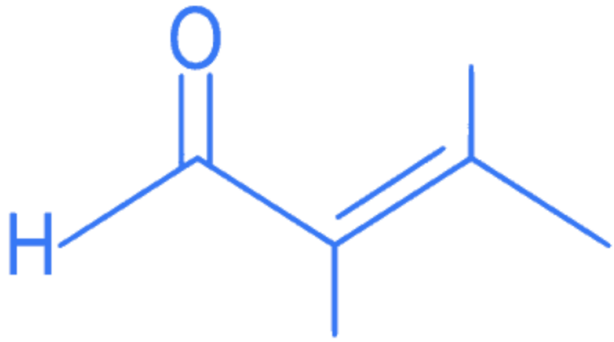
B.



C.

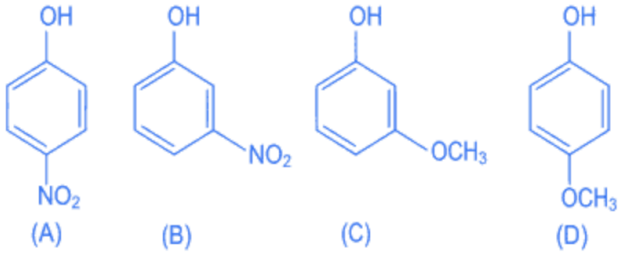


D.



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

Arrange the following in decreasing acidic strength.



Options :

A. A > B > C > D

B. B > A > C > D

C. D > C > A > B

D. D > C > B > A

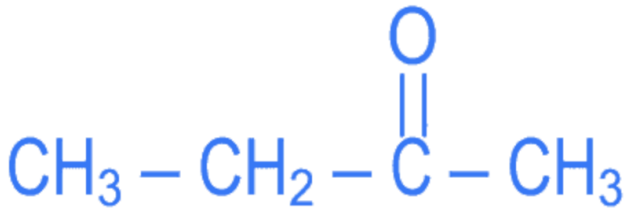
Question Number : 71 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

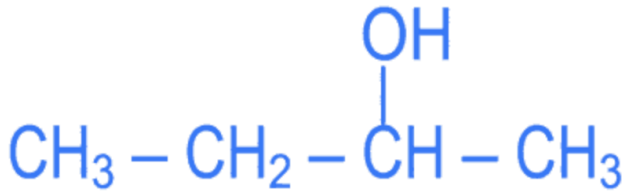
$$CH_3 - CH_2 - CN \xrightarrow[Ether]{CH_3MgBr} A \xrightarrow{H_3O^+} B \xrightarrow[HCl]{Zn - Hg} C$$

The correct structure of C is

Options :

A. $CH_3 - CH_2 - CH_2 - CH_3$

B. 

C. 

D. $CH_3 - CH_2 - CH = CH_2$

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

Glycosidic linkage between C_1 of α-glucose and C_2 of β-fructose is found in

Options :

A. maltose

B. sucrose

C. lactose

D. amylose

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

In base vs. acid titration, at the end point methyl orange is present as

Options :

A. quinonoid form

B. heterocyclic form

C. phenolic form

D. benzenoid form

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

For micelle formation, which of the following statements are correct?

A. Micelle formation is an exothermic process.

B. Micelle formation is an endothermic process.

C. The entropy change is positive.

D. The entropy change is negative.

Options :

A. A and D only

B. A and C only

C. B and C only

D. B and D only

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

Given below are two statements.

Statement I : Pig iron is obtained by heating cast iron with scrap iron.

Statement II : Pig iron has a relatively lower carbon content than that of cast iron.

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

Options :

A. Both Statement I and Statement II are correct.

B. Both Statement I and Statement II are not correct.

C. Statement I is correct but Statement II is not correct.

D. Statement I is not correct but Statement II is correct.

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

High purity (> 99.95%) dihydrogen is obtained by :

Options :

A. reaction of zinc with aqueous alkali.

B. electrolysis of acidified water using platinum electrodes.

C. electrolysis of warm aqueous barium hydroxide solution between nickel electrodes.

D. reaction of zinc with dilute acid.

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

The correct order of density is :

Options :

A. Be > Mg > Ca > Sr

B. Sr > Ca > Mg > Be

C. Sr > Be > Mg > Ca

D. Be > Sr > Mg > Ca

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

The total number of acidic oxides from the following list is

$NO, N_2O, B_2O_3, N_2O_5, CO, SO_3, P_4O_{10}$

Options :

A. 3

B. 4

C. 5

D. 6

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

Match List I with List II :

	List I		**List II**
(A)	Nylon 6, 6	(I)	Buckets
(B)	Low density polythene	(II)	Non-stick utensils
(C)	High density polythene	(III)	Bristles of brushes
(D)	Teflon	(IV)	Toys

Choose the correct answer from the options given below :

Options :

A. A-III, B-I, C-IV, D-II

B. A-III, B-IV, C-I, D-II

C. A-II, B-I, C-IV, D-III

D. A-II, B-IV, C-I, D-III

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

Some drugs bind to a site other than the active site of an enzyme. This site is known as

Options :

A. non-active site

B. allosteric site

C. competitive site

D. therapeutic site

Chemistry Section B

Section Number :	6
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	10
Number of Questions to be attempted :	5
Section Marks :	20
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 81 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

56.0 L of nitrogen gas is mixed with excess hydrogen gas and it is found that 20 L of ammonia gas is produced. The volume of unused nitrogen gas is found to be _____ L.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 82 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

When the excited electron of a H atom from n = 5 drops to the ground state, the maximum number of emission lines observed are _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 83 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

While performing a thermodynamics experiment, a student made the following observations.

$HCl + NaOH \rightarrow NaCl + H_2O\ \Delta H = -57.3\ kJ\ mol^{-1}$

$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O\ \Delta H = -55.3\ kJ\ mol^{-1}$

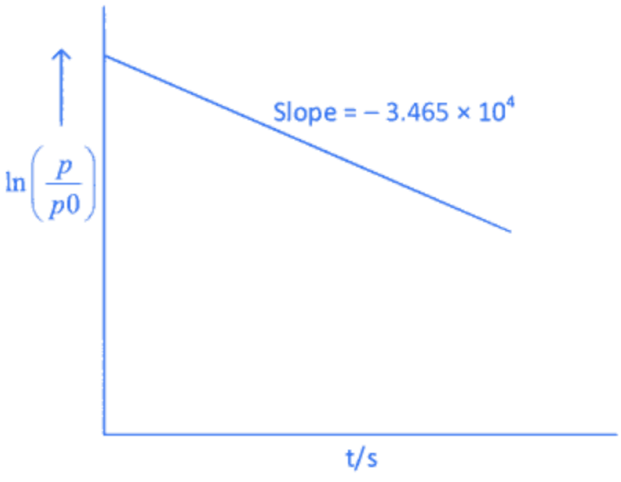
The enthalpy of ionization of CH_3COOH as calculated by the student is _____ $kJ\ mol^{-1}$. (nearest integer)

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 84 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

For the decomposition of azomethane.

$CH_3N_2CH_3(g) \rightarrow CH_3CH_3(g) + N_2(g)$, a first order reaction, the variation in partial pressure with time at 600 K is given as



The half life of the reaction is _____ $\times 10^{-5}$ s. [Nearest integer]

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 85 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

The sum of number of lone pairs of electrons present on the central atoms of XeO_3, $XeOF_4$ and XeF_6, is

_____

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 86 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

The spin-only magnetic moment value of M^{3+} ion (in gaseous state) from the pairs Cr^{3+} / Cr^{2+}, Mn^{3+} / Mn^{2+}, Fe^{3+} / Fe^{2+} and Co^{3+} / Co^{2+} that has negative standard electrode potential, is _____ B.M. [Nearest integer]

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 87 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A sample of 4.5 mg of an unknown monohydric alcohol, R-OH was added to methylmagnesium iodide. A gas is evolved and is collected and its volume measured to be 3.1 mL. The molecular weight of the unknown alcohol is _____ g/mol. [Nearest integer]

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 88 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

The separation of two coloured substances was done by paper chromatography. The distances travelled by solvent front, substance A and substance B from the base line are 3.25 cm, 2.08 cm and 1.05 cm, respectively. The ratio of R_f values of A to B is _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 89 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

The total number of monobromo derivatives formed by the alkanes with molecular formula C_5H_{12} is (excluding stereo isomers) _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal

Text Areas : PlainText

Question Number : 90 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A sealed flask with a capacity of 2 dm^3 contains 11 g of propane gas. The flask is so weak that it will burst if the pressure becomes 2 MPa. The minimum temperature at which the flask will burst is _____ °C. [Nearest integer]

(Given : R = 8.3 J K^{-1} mol^{-1} , Atomic masses of C and H are 12u and 1u, respectively.) (Assume that propane behaves as an ideal gas.)

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText