National Testing Agency

Question Paper Name :	B Tech 26 Jul 2022 Shift 1
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

Let f : R → R be a continuous function such that

$$f(3x) - f(x) = x$$

. If

$$f(8) = 7$$

, then $f(14)$ is equal to :

Options :

A. 4

B. 10

C. 11

D. 16

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

Let O be the origin and A be the point $z_1 = 1 + 2i$. If B is the point z_2,

$$\mathrm{Re}(z_2) < 0$$

, such that OAB is a right angled isosceles triangle with OB as hypotenuse, then which of the following is NOT true?

Options :

A. $\arg z_2 = \pi - \tan^{-1}3$

B. $\arg(z_1 - 2z_2) = -\tan^{-1}\frac{4}{3}$

C. $|z_2| = \sqrt{10}$

D. $|2z_1 - z_2| = 5$

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

If the system of linear equations.

$$8x + y + 4z = -2$$
$$x + y + z = 0$$
$$\lambda x - 3y = \mu$$

has infinitely many solutions, then the distance of the point

$$\left(\lambda, \mu, -\frac{1}{2}\right)$$

from the plane $8x + y + 4z + 2 = 0$ is :

Options :

A. $3\sqrt{5}$

B. 4

C. $\frac{26}{9}$

D. $\frac{10}{3}$

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 odd natural number a, such that the area of the region bounded by y = 1, y = 3, x = 0, $x = y^a$ is $\frac{364}{3}$, is equal to :

Options :

A. 3

B. 5

C. 7

D. 9

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

Consider two G.Ps. 2, 2^2, 2^3, ... and 4, 4^2, 4^3, ... of 60 and n terms respectively. If the geometric mean of all the 60 + n terms is

$$(2)^{\frac{225}{8}}$$

, then

$$\sum_{k=1}^{n} k(n-k)$$

is equal to :

Options :

A. 560

B. 1540

C. 1330

D. 2600

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 the function

$$f(x) = \begin{cases} \frac{\log_e(1-x+x^2)+\log_e(1+x+x^2)}{\sec x - \cos x} & , \quad x \in \left(\frac{-\pi}{2}, \frac{\pi}{2}\right) - \{0\} \\ k & , \quad x = 0 \end{cases}$$

is continuous at x = 0, then k is equal to:

Options :

A. 1

B. -1

C. e

D. 0

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

If

$$f(x) = \begin{cases} x + a & , \quad x \leq 0 \\ |x - 4| & , \quad x > 0 \end{cases}$$

and

$$g(x) = \begin{cases} x + 1 & , \quad x < 0 \\ (x - 4)^2 + b & , \quad x \geq 0 \end{cases}$$

are continuous on R, then $(gof)(2) + (fog)(-2)$ is equal to :

Options :

A. -10

B. 10

C. 8

D. -8

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

$$f(x) = \begin{cases} x^3 - x^2 + 10x - 7, & x \leq 1 \\ -2x + \log_2(b^2 - 4), & x > 1 \end{cases}$$

.

Then the set of all values of b, for which f(x) has maximum value at x = 1, is :

Options :

A. $(-6, -2)$

B. $(2, 6)$

C. $[-6, -2) \cup (2,6]$

D. $\left[-\sqrt{6}, -2\right) \cup \left(2, \sqrt{6}\right]$

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

$$\frac{dy}{dx} + 2y\tan x = \sin x,\ 0 < x < \frac{\pi}{2}$$

and

$$y\left(\frac{\pi}{3}\right) = 0$$

, then the maximum value of $y(x)$ is :

Options :

A. $\frac{1}{8}$

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

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

D. $\frac{3}{8}$

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

A point P moves so that the sum of squares of its distances from the points $(1,2)$ and $(-2,1)$ is 14. Let

$$f(x, y) = 0$$

be the locus of P, which intersects the x-axis at the points A, B and the y-axis at the points C, D. Then the area of the quadrilateral ACBD is equal to :

Options :

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

B. $\frac{3\sqrt{17}}{2}$

C. $\frac{3\sqrt{17}}{4}$

D. 9

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 length of the perpendicular from the point $(1, -2,5)$ on the line passing through $(1,2,4)$ and parallel to the line

$$x + y - z = 0 = x - 2y + 3z - 5$$

is :

Options :

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

B. $\sqrt{\frac{9}{2}}$

C. $\sqrt{\frac{73}{2}}$

D. 1

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

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

and

$$\vec{b} = 2\hat{i} + \hat{j} - \alpha\hat{k}, \alpha > 0$$

. If the projection of $\vec{a} \times \vec{b}$ on the vector $-\hat{i} + 2\hat{j} - 2\hat{k}$ is 30, then α is equal to :

Options :

A. $\frac{15}{2}$

B. 8

C. $\frac{13}{2}$

D. 7

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

Let E_1, E_2, E_3 be three mutually exclusive events such that

$$P(E_1) = \frac{2+3p}{6}, P(E_2) = \frac{2-p}{8}$$

and

$$P(E_3) = \frac{1-p}{2}$$

. If the maximum and minimum values of p are p_1 and p_2, then $(p_1 + p_2)$ is equal to :

Options :

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

B. $\frac{5}{3}$

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

D. 1

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

$$\tan\left(2\tan^{-1}\frac{1}{5} + \sec^{-1}\frac{\sqrt{5}}{2} + 2\tan^{-1}\frac{1}{8}\right)$$

is equal to :

Options :

A. 1

B. 2

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

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

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

Let A be a 2×2 matrix with det (A) = -1 and det ((A + I) (Adj (A) + I)) = 4. Then the sum of the diagonal elements of A can be :

Options :

A. -1

B. 2

C. 1

D. $-\sqrt{2}$

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

If

$$a = \lim_{n \to \infty} \sum_{k=1}^{n} \frac{2n}{n^2 + k^2}$$

and

$$f(x) = \sqrt{\frac{1 - \cos x}{1 + \cos x}}$$

, $x \in (0,1)$, then :

Options :

A. $2\sqrt{2}\ f\left(\frac{a}{2}\right) = f'\left(\frac{a}{2}\right)$

B. $f\left(\frac{a}{2}\right) f'\left(\frac{a}{2}\right) = \sqrt{2}$

C. $\sqrt{2}\ f\left(\frac{a}{2}\right) = f'\left(\frac{a}{2}\right)$

D. $f\left(\frac{a}{2}\right) = \sqrt{2}\ f'\left(\frac{a}{2}\right)$

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 the tangent drawn to the parabola $y^2 = 24x$ at the point (α, β) is perpendicular to the line $2x + 2y = 5$. Then the normal to the hyperbola

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

at the point $(\alpha + 4, \beta + 4)$ does NOT pass through the point :

Options :

A. (25, 10)

B. (20, 12)

C. (30, 8)

D. $(15, 13)$

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 mean and variance of a binomial distribution are α and $\frac{\alpha}{3}$ respectively. If

$$P(X = 1) = \frac{4}{243}$$

, then

$$P(X = 4$$

or 5) is equal to :

Options :

A. $\frac{5}{9}$

B. $\frac{64}{81}$

C. $\frac{16}{27}$

D. $\frac{145}{243}$

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

Let

$$S = \left\{\theta \in [0,2\pi] : 8^{2\sin^2\theta} + 8^{2\cos^2\theta} = 16\right\}.$$

Then

$$n(s) + \sum_{\theta \in S}\left(\sec\left(\frac{\pi}{4} + 2\theta\right)\operatorname{cosec}\left(\frac{\pi}{4} + 2\theta\right)\right)$$

is equal to:

Options :

A. 0

B. -2

C. -4

D. 12

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

The statement $(\sim (p \Leftrightarrow \sim q)) \wedge q$ is :

Options :

A. a tautology

B. a contradiction

C. equivalent to $(p \Rightarrow q) \wedge q$

D. equivalent to $(p \Rightarrow q) \wedge p$

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

If for some $p, q, r \in \mathbf{R}$, not all have same sign, one of the roots of the equation

$$\left(p^2 + q^2\right)x^2 - 2q(p + r)x + q^2 + r^2 = 0$$

is also a root of the equation $x^2 + 2x - 8 = 0$, then

$$\frac{q^2 + r^2}{p^2}$$

is equal to _____,

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

The number of 5-digit natural numbers, such that the product of their digits is 36 , is _____.

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

The number of distinct real roots of the equation

$$x^5\left(x^3-x^2-x+1\right)+x\left(3x^3-4x^2-2x+4\right)-1=0$$

is _____.

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

If

$$\mathrm{n}(2\mathrm{n}+1)\int_0^1 (1-x^{\mathrm{n}})^{2\mathrm{n}}\mathrm{d}x = 1177\int_0^1 (1-x^{\mathrm{n}})^{2\mathrm{n}+1}\,\mathrm{d}x$$

, then $\mathrm{n} \in \mathbf{N}$ is equal to _____.

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

The equations of the sides AB, BC and CA of a triangle ABC are

$$2x+y=0, x+\mathrm{p}y=15\mathrm{a}$$

and $x-y=3$ respectively. If its orthocentre is

$$(2,a), -\frac{1}{2} < \mathrm{a} < 2$$

, then p 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 the function

$$f(x)=2x^2-\log_{\mathrm{e}} x, x>0$$

, be decreasing in $(0, \mathrm{a})$ and increasing in $(\mathrm{a}, 4)$. A tangent to the parabola $y^2=4ax$ at a point P on it passes through the point $(8\mathrm{a}, 8\mathrm{a}-1)$ but does not pass through the point

$$\left(-\frac{1}{a}, 0\right)$$

. If the equation of the normal at P is :

$$\frac{x}{\alpha}+\frac{y}{\beta}=1$$

, then $\alpha+\beta$ 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 Q and R be two points on the line

$$\frac{x+1}{2} = \frac{y+2}{3} = \frac{z-1}{2}$$

at a distance $\sqrt{26}$ from the point $P(4,2,7)$. Then the square of the area of the triangle PQR 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

The series of positive multiples of 3 is divided into sets :

$$\{3\}, \{6,9,12\}, \{15,18,21,24,27\}, \ \ldots$$

Then the sum of the elements in the 11^{th} set 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

If the coefficients of x and x^2 in the expansion of $(1+x)^p(1-x)^q, p, q \leq 15$, are -3 and -5 respectively, then the coefficient of x^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

Let a curve

$$y = y(x)$$

pass through the point $(3,3)$ and the area of the region under this curve, above the x-axis and between the abscissae 3 and

$$x(>3)$$

be

$$\left(\frac{y}{x}\right)^3$$

. If this curve also passes through the point $(\alpha, 6\sqrt{10}\ )$ in the first quadrant, then α 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 :

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

Three masses

$$M = 100\ \text{kg},\ m_1 = 10\ \text{kg}$$

and

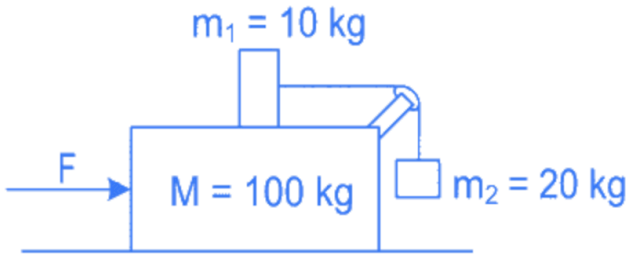
$$m_2 = 20\ \text{kg}$$

are arranged in a system as shown in figure. All the surfaces are frictionless and strings are inextensible and weightless. The pulleys are also weightless and frictionless. A force F is applied on the system so that the mass m_2 moves upward with an acceleration of 2 ms^{-2}. The value of F is :

(Take

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

)



Options :

A. 3360 N

B. 3380 N

C. 3120 N

D. 3240 N

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 parallel beam of light of wavelength 900 nm and intensity 100 Wm^{-2} is incident on a surface perpendicular to the beam. The number of photons crossing 1 cm^2 area perpendicular to the beam in one second is :

Options :

A. 3×10^{16}

B. 4.5×10^{16}

C. 4.5×10^{17}

D. 4.5×10^{20}

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

In Young's double slit experiment, the fringe width is 12 mm. If the entire arrangement is placed in water of refractive index $\frac{4}{3}$, then the fringe width becomes (in mm):

Options :

A. 16

B. 9

C. 48

D. 12

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

The magnetic field of a plane electromagnetic wave is given by :

$$\vec{B} = 2 \times 10^{-8} \sin\left(0.5 \times 10^{3} x + 1.5 \times 10^{11} t\right) \hat{j}\ \mathrm{T}$$

.

The amplitude of the electric field would be :

Options :

A. $6\ \mathrm{Vm}^{-1}$ along x-axis

B. $3\ \mathrm{Vm}^{-1}$ along z-axis

C. $6\ \mathrm{Vm}^{-1}$ along z-axis

D. $2 \times 10^{-8}\ \mathrm{Vm}^{-1}$ along z-axis

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

In a series LR circuit $X_L = R$ and power factor of the circuit is P_1. When capacitor with capacitance C such that $X_L = X_C$ is put in series, the power factor becomes P_2. The ratio $\frac{P_1}{P_2}$ is:

Options :

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

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

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

D. 2 : 1

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

A charge particle is moving in a uniform magnetic field $(2\hat{i} + 3\hat{j})$ T. If it has an acceleration of $(\alpha\hat{i} - 4\hat{j})$ m/s^2, then the value of α will be :

Options :

A. 3

B. 6

C. 12

D. 2

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

B_X and B_Y are the magnetic fields at the centre of two coils X and Y respectively each carrying equal current. If coil X has 200 turns and 20 cm radius and coil Y has 400 turns and 20 cm radius, the ratio of B_X and B_Y is :

Options :

A. 1 : 1

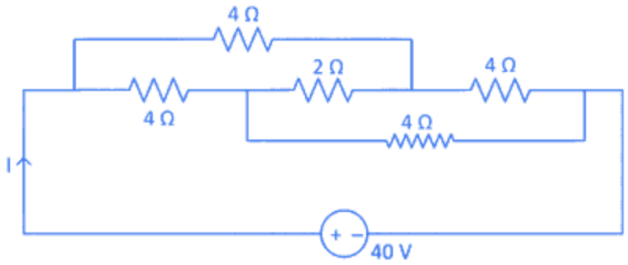
B. 1 : 2

C. 2 : 1

D. 4 : 1

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

The current I in the given circuit will be :



Options :

A. 10 A

B. 20 A

C. 4 A

D. 40 A

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

The total charge on the system of capacitors

$$C_1 = 1\mu\text{F}, C_2 = 2\mu\text{F}, \text{C}_3 = 4\mu\text{F}$$

and

$$\text{C}_4 = 3\mu\text{F}$$

connected in parallel is :

(Assume a battery of 20 V is connected to the combination)

Options :

A. $200\,\mu\text{C}$

B. 200 C

C. $10\,\mu\text{C}$

D. 10 C

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

When a particle executes Simple Hormonic Motion, the nature of graph of velocity as a function of displacement will be :

Options :

A. Circular

B. Elliptical

C. Sinusoidal

D. Straight line

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

7 mol of a certain monoatomic ideal gas undergoes a temperature increase of 40 K at constant pressure. The increase in the internal energy of the gas in this process is :

(Given

$$R = 8.3\,JK^{-1}\,mol^{-1}$$

)

Options :

A. 5810 J

B. 3486 J

C. 11620 J

D. 6972 J

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

A monoatomic gas at pressure P and volume V is suddenly compressed to one eighth of its original volume. The final pressure at constant entropy will be :

Options :

A. P

B. 8P

C. 32P

D. 64P

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

A water drop of radius 1 cm is broken into 729 equal droplets. If surface tension of water is 75 dyne/ cm, then the gain in surface energy upto first decimal place will be :

(Given $\pi = 3.14$)

Options :

A. 8.5×10^{-4} J

B. 8.2×10^{-4} J

C. 7.5×10^{-4} J

D. 5.3×10^{-4} J

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

The percentage decrease in the weight of a rocket, when taken to a height of 32 km above the surface of earth will, be :

(Radius of earth $= 6400$ km)

Options :

A. 1%

B. 3%

C. 4%

D. 0.5%

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

As per the given figure, two blocks each of mass 250 g are connected to a spring of spring constant 2 Nm^{-1}. If both are given velocity v in opposite directions, then maximum elongation of the spring is :



Options :

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

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

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

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

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

A monkey of mass 50 kg climbs on a rope which can withstand the tension (T) of 350 N. If monkey initially climbs down with an acceleration of 4 m/s^2 and then climbs up with an acceleration of 5 m/s^2. Choose the correct option

$$(g = 10\ m/s^2)$$

.

Options :

A. $T = 700$ N while climbing upward

B. $T = 350$ N while going downward

C. Rope will break while climbing upward

D. Rope will break while going downward

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

Two projectiles thrown at 30° and 45° with the horizontal respectively, reach the maximum height in same time. The ratio of their initial velocities is :

Options :

A. $1:\sqrt{2}$

B. $2:1$

C. $\sqrt{2}:1$

D. $1:2$

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

A screw gauge of pitch 0.5 mm is used to measure the diameter of uniform wire of length 6.8 cm, the main scale reading is 1.5 mm and circular scale reading is 7 . The calculated curved surface area of wire to appropriate significant figures is :

[Screw gauge has 50 divisions on its circular scale]

Options :

A. $6.8\ cm^2$

B. $3.4\ cm^2$

C. $3.9\ cm^2$

D. $2.4\ cm^2$

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

A radio can tune to any station in 6 MHz to 10 MHz band. The value of corresponding wavelength bandwidth will be :

Options :

A. 4 m

B. 20 m

C. 30 m

D. 50 m

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

The disintegration rate of a certain radioactive sample at any instant is 4250 disintegrations per minute. 10 minutes later, the rate becomes 2250 disintegrations per minute. The approximate decay constant is :

(Take

$$\log_{10} 1.88 = 0.274)$$

Options :

A. $0.02\ min^{-1}$

B. $2.7\ min^{-1}$

C. $0.063\ min^{-1}$

D. $6.3\ min^{-1}$

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

If the initial velocity in horizontal direction of a projectile is unit vector $\hat{i}$ and the equation of trajectory is

$$y = 5x(1 - x)$$

. The y component vector of the initial velocity is _____ $\hat{j}$. (Take

$$g = 10\ \text{m/s}^2)$$

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

A disc of mass 1 kg and radius R is free to rotate about a horizontal axis passing through its centre and perpendicular to the plane of disc. A body of same mass as that of disc is fixed at the highest point of the disc. Now the system is released, when the body comes to the lowest position, its angular speed will be

$$4\sqrt{\frac{x}{3R}}\ \text{rad}\ s^{-1}$$

where $x =$ _____.

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

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

In an experiment to determine the Young's modulus of wire of a length exactly 1 m, the extension in the length of the wire is measured as 0.4 mm with an uncertainty of ± 0.02 mm when a load of 1 kg is applied. The diameter of the wire is measured as 0.4 mm with an uncertainty of ± 0.01 mm. The error in the measurement of Young's modulus (ΔY) is found to be $x \times 10^{10}\ \text{Nm}^{-2}$. The value of x is _____. (take

$$g = 10\ \text{ms}^{-2}$$

)

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

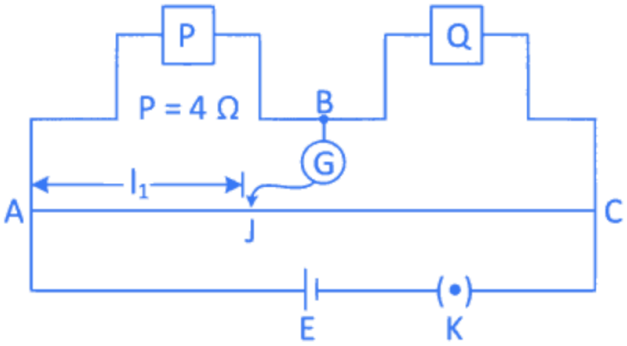
A composite parallel plate capacitor is made up of two different dielectric materials with different thickness $(t_1$ and $t_2)$ as shown in figure. The two different dielectric materials are separated by a conducting foil F. The voltage of the conducting foil is V.



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

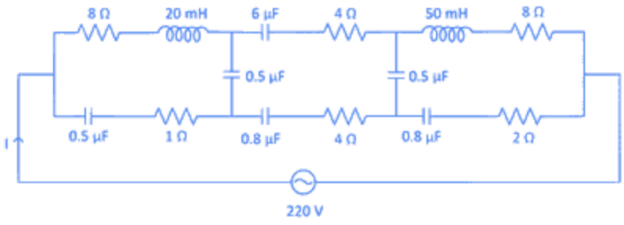
Resistances are connected in a meter bridge circuit as shown in the figure. The balancing length l_1 is 40 cm. Now an unknown resistance x is connected in series with P and new balancing length is found to be 80 cm measured from the same end. Then the value of x will be _____ Ω.



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

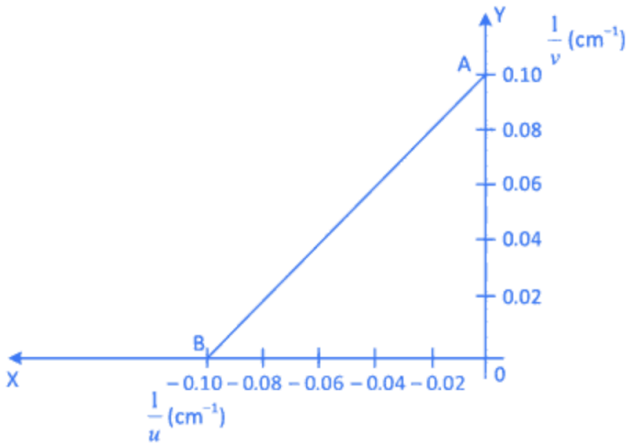
The effective current I in the given circuit at very high frequencies will be _____ A.



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

The graph between $\frac{1}{u}$ and $\frac{1}{v}$ for a thin convex lens in order to determine its focal length is plotted as shown in the figure. The refractive index of lens is 1.5 and its both the surfaces have same radius of curvature R. The value of R will be _____ cm. (where $u =$ object distance, $v =$ image distance)



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

In the hydrogen spectrum, λ be the wavelength of first transition line of Lyman series. The wavelength difference will be "aλ" between the wavelength of 3rd transition line of Paschen series and that of 2nd transition line of Balmer series where

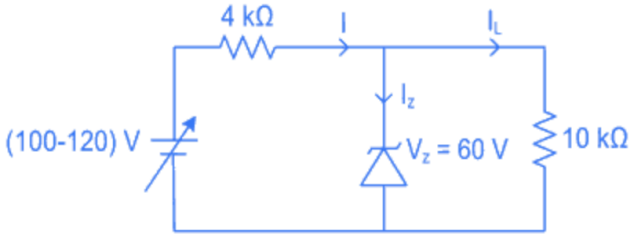
a =

_____.

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 the circuit shown below, maximum zener diode current will be _____ mA.



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

When a car is approaching the observer, the frequency of horn is 100 Hz. After passing the observer, it is 50 Hz. If the observer moves with the car, the frequency will be

$$\frac{x}{3}\ \text{Hz}$$

where $x =$ _____.

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 (Compound)		**List II (Shape)**
(A)	BrF_5	(I)	bent
(B)	$[CrF_6]^{3-}$	(II)	square pyramidal
(C)	O_3	(III)	trigonal bipyramidal
(D)	PCl_5	(IV)	octahedral

Choose the correct answer from the options given below :

Options :

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

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

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

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

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

Match List - I with List - II.

	List I (Processes / Reactions)		**List II (Catalyst)**
(A)	$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$	(I)	Fe(s)
(B)	$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$	(II)	Pt(s) – Rh(s)
(C)	$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$	(III)	V_2O_5
(D)	Vegetable oil(l) + H_2 → Vegetable ghee(s)	(IV)	Ni(s)

Choose the correct answer from the options given below :

Options :

A. (A) – (III), (B) – (I), (C) – (II), (D) – (IV)

B. (A) – (III), (B) – (II), (C) – (I), (D) – (IV)

C. (A) – (IV), (B) – (III), (C) – (I), (D) – (II)

D. (A) – (IV), (B) – (II), (C) – (III), (D) – (I)

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

Given two statements below :

Statement I : In Cl_2 molecule the covalent radius is double of the atomic radius of chlorine.

Statement II : Radius of anionic species is always greater than their parent atomic radius.

Choose the most appropriate answer from options given below :

Options :

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.

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

Which of the given reactions is not an example of disproportionation reaction?

Options :

A. $2H_2O_2 \rightarrow 2H_2O + O_2$

B. $2NO_2 + H_2O \rightarrow HNO_3 + HNO_2$

C. $MnO_4^- + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$

D. $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

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 dark purple colour of $KMnO_4$ disappears in the titration with oxalic acid in acidic medium. The overall change in the oxidation number of manganese in the reaction is :

Options :

A. 5

B. 1

C. 7

D. 2

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

$$\dot{Cl} + CH_4 \rightarrow A + B$$

A and B in the above atmospheric reaction step are :

Options :

A. C_2H_6 and Cl_2

B. $\dot{C}HCl_2$ and H_2

C. $\dot{C}H_3$ and HCl

D. C_2H_6 and HCl

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

Which technique among the following, is most appropriate in separation of a mixture of 100 mg of *p*-nitrophenol and picric acid ?

Options :

A. Steam distillation

B. 2-5 ft long column of silica gel

C. Sublimation

D. Preparative TLC (Thin Layer Chromatography)

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

The difference in the reaction of phenol with bromine in chloroform and bromine in water medium is due to :

Options :

A. Hyperconjugation in substrate

B. Polarity of solvent

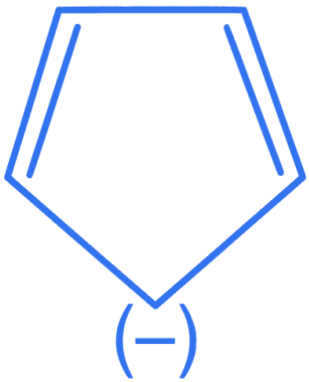
C. Free radical formation

D. Electromeric effect the substrate

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

Which of the following compounds is not aromatic?

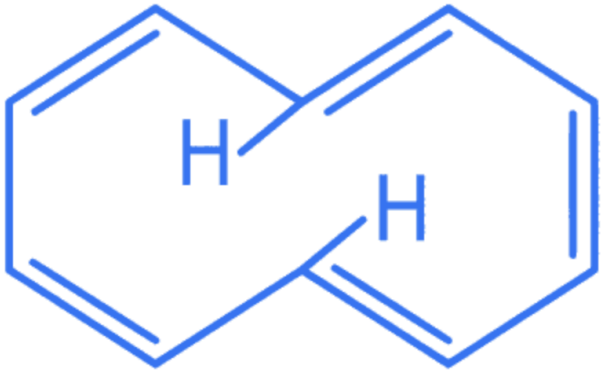
Options :

A. 

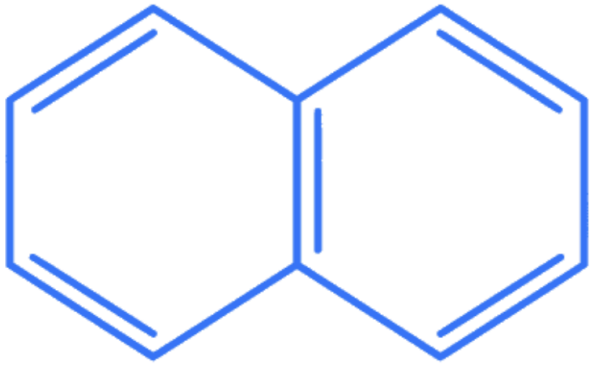
B.



C.

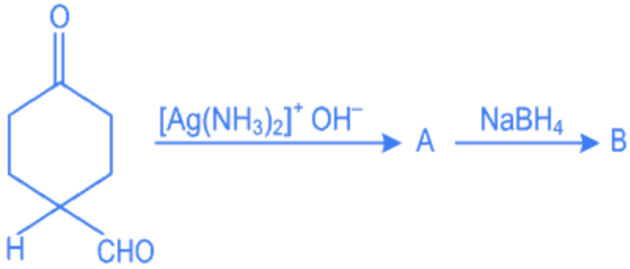


D.



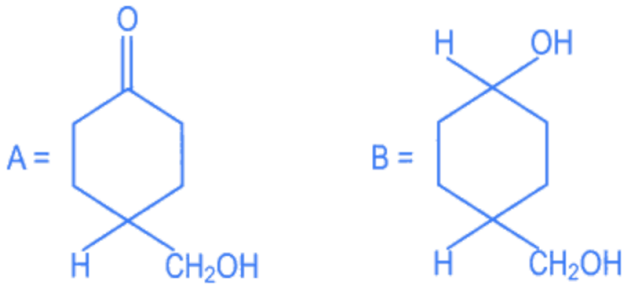
Question Number : 70 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The products formed in the following reaction, A and B are

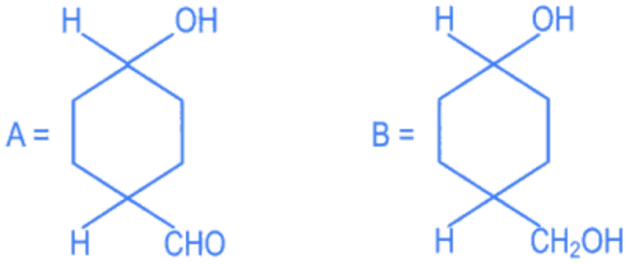


Options :

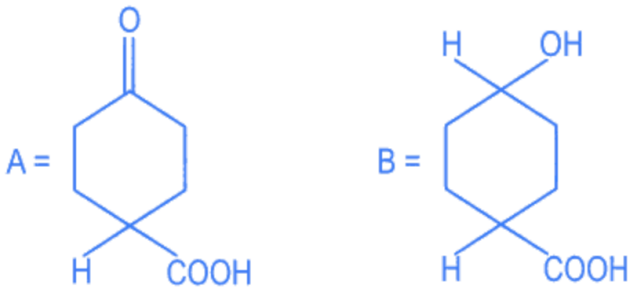
A.



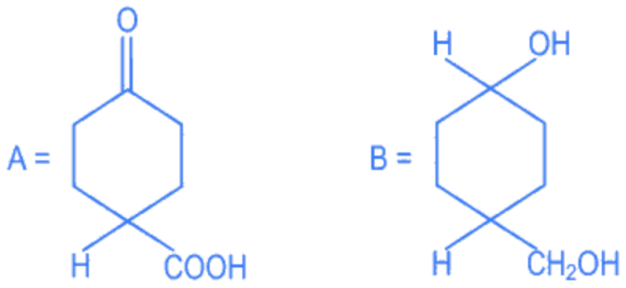
B.



C.

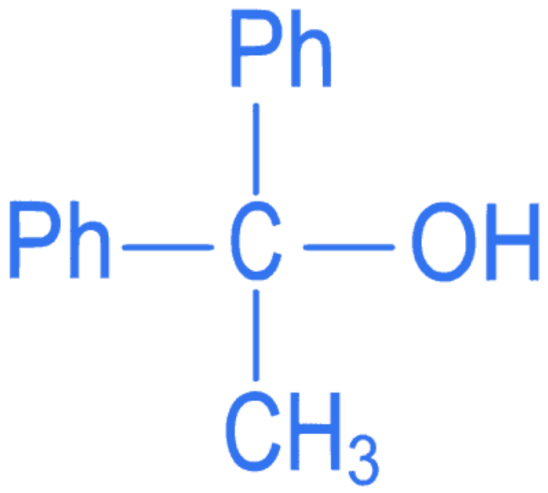


D.



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

Which reactant will give the following alcohol on reaction with one mole of phenyl magnesium bromide (PhMgBr) followed by acidic hydrolysis?

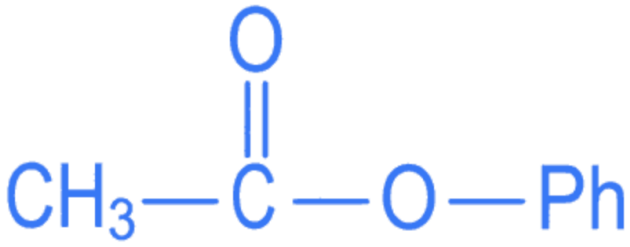


Options :

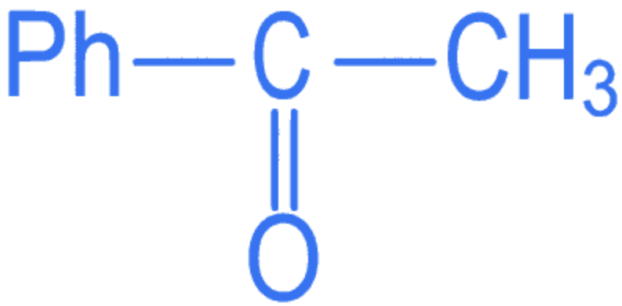
A. $CH_3 - C \equiv N$

B. $Ph - C \equiv N$

C.

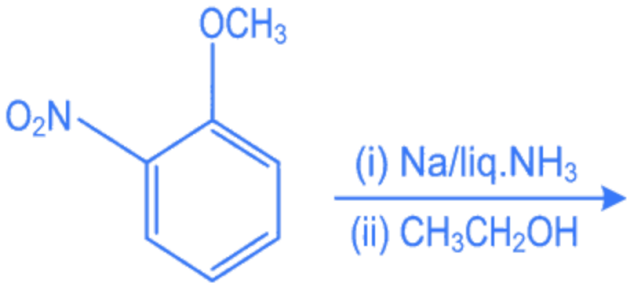


D.



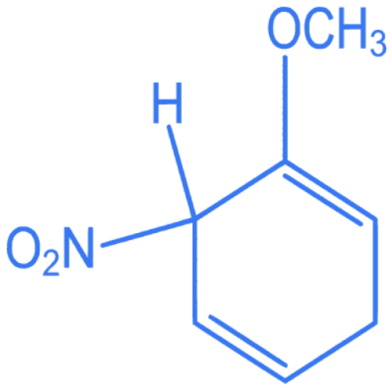
Question Number : 72 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The major product of the following reaction is

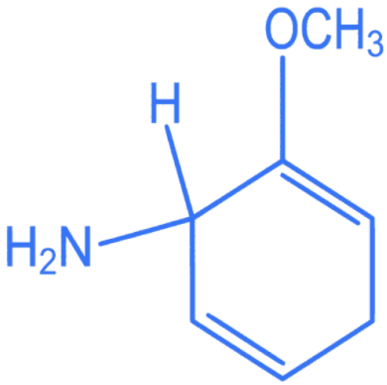


Options :

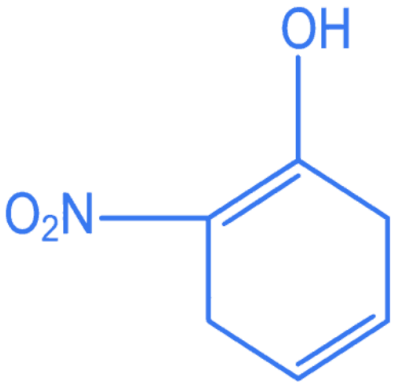
A.



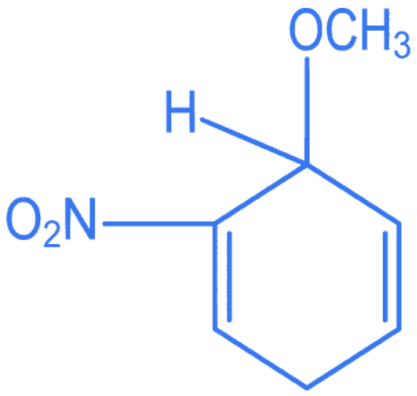
B.



C.

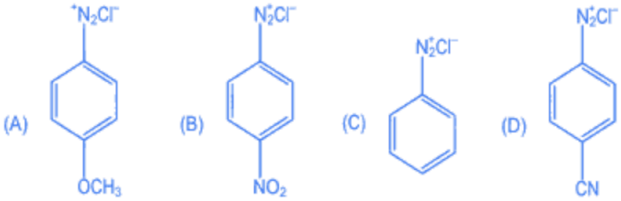


D.



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

The correct stability order of the following diazonium salt is



Options :

A. (A) > (B) > (C) > (D)

B. (A) > (C) > (D) > (B)

C. (C) > (A) > (D) > (B)

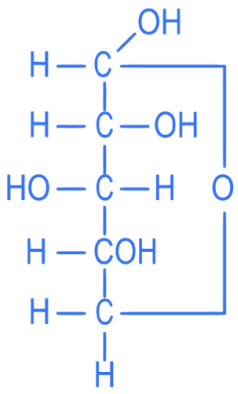
D. (C) > (D) > (B) > (A)

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

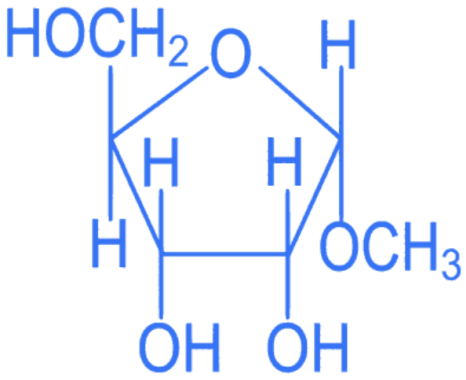
Which one of the following is a reducing sugar?

Options :

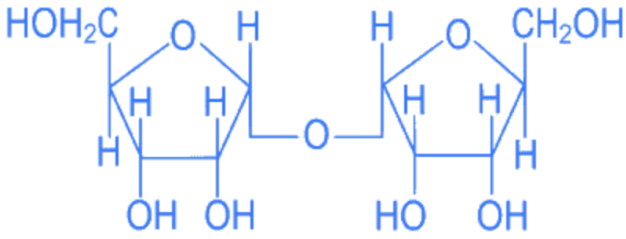
A.



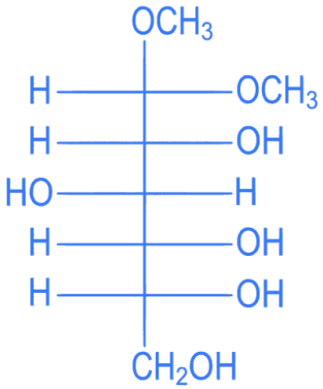
B.



C.



D.



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 : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Experimental reaction of CH_3Cl with aniline and anhydrous $AlCl_3$ does not give *o* and *p*-methylaniline.

Reason (R): The $-NH_2$ group of aniline becomes deactivating because of salt formation with anhydrous $AlCl_3$ and hence yields *m*-methyl aniline as the product.

In the light of the above statements, choose the most appropriate answer from the options given below :

Options :

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.

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

Refining using liquation method is the most suitable for metals with :

Options :

A. Low melting point

B. High boiling point

C. High electrical conductivity

D. Less tendency to be soluble in melts than impurities

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

Which of the following can be used to prevent the decomposition of H_2O_2 ?

Options :

A. Urea

B. Formaldehyde

C. Formic acid

D. Ethanol

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

Reaction of $BeCl_2$ with $LiAlH_4$ gives :

(A) $AlCl_3$

(B) BeH_2

(C) LiH

(D) LiCl

(E) $BeAlH_4$

Choose the correct answer from options given below :

Options :

A. (A), (D) and (E)

B. (A), (B) and (D)

C. (D) and (E)

D. (B), (C) and (D)

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

Borazine, also known as inorganic benzene, can be prepared by the reaction of 3-equivalents of "*X*" with 6-equivalents of "*Y*". "*X*" and "*Y*", respectively are :

Options :

A. $B(OH)_3$ and NH_3

B. B_2H_6 and NH_3

C. B_2H_6 and HN_3

D. NH_3 and B_2O_3

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

Stearic acid and polyethylene glycol react to form which one of the following soap/s detergents ?

Options :

A. Cationic detergent

B. Soap

C. Anionic detergent

D. Non-ionic detergent

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

Chlorophyll extracted from the crushed green leaves was dissolved in water to make 2 L solution of Mg of concentration 48 ppm. The number of atoms of Mg in this solution is $x \times 10^{20}$ atoms. The value of x is _____. (Nearest Integer)

(Given : Atomic mass of Mg is

$$24 \text{ g mol}^{-1}; N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$$

)

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

The wavelength of an electron and a neutron will become equal when the velocity of the electron is x times the velocity of neutron. The value of x is _____. (Nearest Integer)

(Mass of electron is 9.1×10^{-31} kg and mass of neutron is 1.6×10^{-27} kg)

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

2.4 g coal is burnt in a bomb calorimeter in excess of oxygen at 298 K and 1 atm pressure. The temperature of the calorimeter rises from 298 K to 300 K. The enthalpy change during the combustion of coal is $-x$ kJ mol^{-1}. The value of x is _____. (Nearest Integer)

(Given : Heat capacity of bomb calorimeter 20.0 kJ K^{-1}. Assume coal to be pure carbon)

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

When 800 mL of 0.5 M nitric acid is heated in a beaker, its volume is reduced to half and 11.5 g of nitric acid is evaporated. The molarity of the remaining nitric acid solution is x $\times 10^{-2}$ M. (Nearest integer)

(Molar mass of nitric acid is 63 g mol^{-1})

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

At 298 K, the equilibrium constant is 2×10^{15} for the reaction :

$$Cu(s) + 2Ag^{+}(aq) \rightleftharpoons Cu^{2+}(aq) + 2Ag(s)$$

The equilibrium constant for the reaction

$$\frac{1}{2}Cu^{2+}(aq) + Ag(s) \rightleftharpoons \frac{1}{2}Cu(s) + Ag^{+}(aq)$$

is $x \times 10^{-8}$. The value of x is _____. (Nearest Integer)

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 amount of charge in F (Faraday) required to obtain one mole of iron from Fe_3O_4 is _____. (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

For a reaction $A \rightarrow 2\,B + C$ the half lives are 100 s and 50 s when the concentration of reactant A is 0.5 and 1.0 mol L^{-1} respectively. The order of the reaction is _____ . (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 difference between spin only magnetic moment values of $\left[Co\left(H_2O\right)_6\right]Cl_2$ and $\left[Cr\left(H_2O\right)_6\right]Cl_3$ 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

In the presence of sunlight, benzene reacts with Cl_2 to give product, X. The number of hydrogens in X is _____.

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 mixture of hydrogen and oxygen contains 40% hydrogen by mass when the pressure is 2.2 bar. The partial pressure of hydrogen is bar. (Nearest Integer)

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