National Testing Agency

Question Paper Name :	B Tech 28 Jun 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 a function f : N → N be defined by

$$f(n) = \begin{cases} 2n, & n = 2,4,6,8, \ldots\ldots \\ n-1, & n = 3,7,11,15, \ldots\ldots \\ \frac{n+1}{2}, & n = 1,5,9,13, \ldots\ldots \end{cases}$$

then, f is

Options :

A. one-one but not onto

B. onto but not one-one

C. neither one-one nor onto

D. one-one and onto

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

If the system of linear equations

$$2x + 3y - z = -2$$
$$x + y + z = 4$$
$$x - y + |\lambda|z = 4\lambda - 4$$

where, $\lambda \in R$, has no solution, then

Options :

A. $\lambda = 7$

B. $\lambda = -7$

C. $\lambda = 8$

D. $\lambda^2 = 1$

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 total number of 5-digit numbers, formed by using the digits 1, 2, 3, 5, 6, 7 without repetition, which are multiple of 6, is :

Options :

A. 36

B. 48

C. 60

D. 72

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

Let $A_1, A_2, A_3, \ldots\ldots$ be an increasing geometric progression of positive real numbers. If $A_1A_3A_5A_7 = \frac{1}{1296}$ and $A_2 + A_4 = \frac{7}{36}$, then the value of $A_6 + A_8 + A_{10}$ is equal to

Options :

A. 33

B. 37

C. 43

D. 47

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

Let [t] denote the greatest integer less than or equal to t. Then, the value of the integral

$$\int_0^1 [-8x^2 + 6x - 1]dx$$

is equal to :

Options :

A. -1

B. $\frac{-5}{4}$

C. $\frac{\sqrt{17} - 13}{8}$

D. $\frac{\sqrt{17} - 16}{8}$

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

Let $f : R \to R$ be defined as

$$f(x) = \begin{cases} [e^x], & x < 0 \\ ae^x + [x-1], & 0 \le x < 1 \\ b + [\sin(\pi x)], & 1 \le x < 2 \\ [e^{-x}] - c, & x \ge 2 \end{cases}$$

where a, b, c $\in$ R and [t] denotes greatest integer less than or equal to t. Then, which of the following statements is true?

Options :

A. There exists a, b, c $\in$ R such that f is continuous on R.

B. If f is discontinuous at exactly one point, then a + b + c = 1

C. If f is discontinuous at exactly one point, then a + b + c $\neq$ 1

D. f is discontinuous at at least two points, for any values of a, b and c

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

The area of the region S = {(x, y) : $y^2 \le 8x$, $y \ge \sqrt{2}\ x$, $x \ge 1$} is

Options :

A. $\frac{13\sqrt{2}}{6}$

B. $\frac{11\sqrt{2}}{6}$

C. $\frac{5\sqrt{2}}{6}$

D. $\frac{19\sqrt{2}}{6}$

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 solution curve

$$y = y(x)$$

of the differential equation

$$\left[\frac{x}{\sqrt{x^2 - y^2}} + e^{\frac{y}{x}}\right]x\frac{dy}{dx} = x + \left[\frac{x}{\sqrt{x^2 - y^2}} + e^{\frac{y}{x}}\right]y$$

pass through the points (1, 0) and $(2\alpha, \alpha)$, $\alpha > 0$. Then α is equal to

Options :

A. $\frac{1}{2}\exp\left(\frac{\pi}{6} + \sqrt{e} - 1\right)$

B. $\frac{1}{2}\exp\left(\frac{\pi}{6} + e - 1\right)$

C. $\exp\left(\frac{\pi}{6} + \sqrt{e} + 1\right)$

D. $2\exp\left(\frac{\pi}{3} + \sqrt{e} - 1\right)$

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

Let y = y(x) be the solution of the differential equation

$$x(1 - x^2)\frac{dy}{dx} + (3x^2y - y - 4x^3) = 0$$

, $x > 1$, with

$$y(2) = -2$$

. Then y(3) is equal to :

Options :

A. -18

B. -12

C. -6

D. -3

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

The number of real solutions of

$$x^7 + 5x^3 + 3x + 1 = 0$$

is equal to _____.

Options :

A. 0

B. 1

C. 3

D. 5

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 probability, that in a randomly selected 3-digit number at least two digits are odd, is :

Options :

A. $\frac{19}{36}$

B. $\frac{15}{36}$

C. $\frac{13}{36}$

D. $\frac{23}{36}$

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

If

$$\sum_{k=1}^{31} \left({}^{31}C_k\right)\left({}^{31}C_{k-1}\right) - \sum_{k=1}^{30} \left({}^{30}C_k\right)\left({}^{30}C_{k-1}\right) = \frac{\alpha(60!)}{(30!)(31!)}$$

,

where $\alpha \in R$, then the value of 16α is equal to

Options :

A. 1411

B. 1320

C. 1615

D. 1855

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 A be a matrix of order 3×3 and det (A) = 2. Then det (det (A) adj (5 adj (A^3))) is equal to _____.

Options :

A. 512×10^6

B. 256×10^6

C. 1024×10^6

D. 256×10^{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

Let the eccentricity of the hyperbola

$$H: \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

be

$$\sqrt{\frac{5}{2}}$$

and length of its latus rectum be $6\sqrt{2}$. If $y = 2x + c$ is a tangent to the hyperbola H, then the value of c^2 is equal to :

Options :

A. 18

B. 20

C. 24

D. 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

If the tangents drawn at the points $O(0,0)$ and $P\left(1+\sqrt{5}\ ,2\right)$ on the circle

$$x^2+y^2-2x-4y=0$$

intersect at the point Q, then the area of the triangle OPQ is equal to :

Options :

A. $\frac{3+\sqrt{5}}{2}$

B. $\frac{4+2\sqrt{5}}{2}$

C. $\frac{5+3\sqrt{5}}{2}$

D. $\frac{7+3\sqrt{5}}{2}$

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 two distinct point Q, R lie on the line of intersection of the planes $-x+2y-z=0$ and $3x-5y+2z=0$ and

$$PQ=PR=\sqrt{18}$$

where the point P is $(1,-2,3)$, then the area of the triangle PQR is equal to :

Options :

A. $\frac{2}{3}\sqrt{38}$

B. $\frac{4}{3}\sqrt{38}$

C. $\frac{8}{3}\sqrt{38}$

D. $\sqrt{\frac{152}{3}}$

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

The acute angle between the planes P_1 and P_2, when P_1 and P_2 are the planes passing through the intersection of the planes

$$5x + 8y + 13z - 29 = 0$$

and $8x - 7y + z - 20 = 0$ and the points (2, 1, 3) and (0, 1, 2), respectively, is :

Options :

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

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

C. $\frac{\pi}{6}$

D. $\frac{\pi}{12}$

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

Let the plane

$$P: \vec{r} \cdot \vec{a} = d$$

contain the line of intersection of two planes

$$\vec{r} \cdot \left(\hat{i} + 3\hat{j} - \hat{k}\right) = 6$$

and

$$\vec{r} \cdot \left(-6\hat{i} + 5\hat{j} - \hat{k}\right) = 7$$

. If the plane P passes through the point

$$\left(2,3,\frac{1}{2}\right)$$

, then the value of

$$\frac{|13\vec{a}|^2}{d^2}$$

is equal to :

Options :

A. 90

B. 93

C. 95

D. 97

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 AB and PQ be two vertical poles, 160 m apart from each other. Let C be the middle point of B and Q, which are feet of these two poles. Let $\frac{\pi}{8}$ and θ be the angles of elevation from C to P and A, respectively. If the height of pole PQ is twice the height of pole AB, then $\tan^2\theta$ is equal to

Options :

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

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

C. $\frac{3-2\sqrt{2}}{4}$

D. $\frac{3-\sqrt{2}}{4}$

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

Let p, q, r be three logical statements. Consider the compound statements

$S_1 : ((\sim p) \vee q) \vee ((\sim p) \vee r)$ and

$$S_2 : p \rightarrow (q \vee r)$$

Then, which of the following is NOT true?

Options :

A. If S_2 is True, then S_1 is True

B. If S_2 is False, then S_1 is False

C. If S_2 is False, then S_1 is True

D. If S_1 is False, then S_2 is False

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 R_1 and R_2 be relations on the set $\{1, 2, ..., 50\}$ such that

$R_1 = \{(p, p^n) : p$ is a prime and $n \geq 0$ is an integer$\}$ and

$R_2 = \{(p, p^n) : p$ is a prime and $n = 0$ or $1\}$.

Then, the number of elements in $R_1 - R_2$ 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

The number of real solutions of the equation

$$e^{4x} + 4e^{3x} - 58e^{2x} + 4e^{x} + 1 = 0$$

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 mean and standard deviation of 15 observations are found to be 8 and 3 respectively. On rechecking it was found that, in the observations, 20 was misread as 5. Then, the correct variance 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

If

$$\vec{a} = 2\hat{i} + \hat{j} + 3\hat{k}$$

,

$$\vec{b} = 3\hat{i} + 3\hat{j} + \hat{k}$$

and

$$\vec{c} = c_1\hat{i} + c_2\hat{j} + c_3\hat{k}$$

are coplanar vectors and

$$\vec{a} \cdot \vec{c} = 5$$

, $\vec{b} \perp \vec{c}$, then $122(c_1 + c_2 + c_3)$ 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

A ray of light passing through the point P(2, 3) reflects on the x-axis at point A and the reflected ray passes through the point Q(5, 4). Let R be the point that divides the line segment AQ internally into the ratio 2 : 1. Let the co-ordinates of the foot of the perpendicular M from R on the bisector of the angle PAQ be (α, β). Then, the value of $7\alpha + 3\beta$ 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 $A = \{1, a_1, a_2 \ldots\ldots a_{18}, 77\}$ be a set of integers with $1 < a_1 < a_2 < \ldots\ldots < a_{18} < 77$.

Let the set $A + A = \{x + y : x, y \in A\}$ contain exactly 39 elements. Then, the value of $a_1 + a_2 + \ldots\ldots + a_{18}$ 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

The number of positive integers k such that the constant term in the binomial expansion of

$$\left(2x^3 + \frac{3}{x^k}\right)^{12}$$

, $x \neq 0$ is $2^8 \cdot l$, where l is an odd integer, 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 number of elements in the set $\{z = a + ib \in C : a, b \in Z \text{ and } 1 < |z - 3 + 2i| < 4\}$ is _____.

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 l be a line which is normal to the curve $y = 2x^2 + x + 2$ at a point P on the curve. If the point Q(6, 4) lies on the line l and O is origin, then the area of the triangle OPQ 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 the lines

$$y + 2x = \sqrt{11} + 7\sqrt{7}$$

and

$$2y + x = 2\sqrt{11} + 6\sqrt{7}$$

be normal to a circle

$$C : (x - h)^2 + (y - k)^2 = r^2$$

. If the line

$$\sqrt{11}\ y - 3x = \frac{5\sqrt{77}}{3} + 11$$

is tangent to the circle C, then the value of $(5h - 8k)^2 + 5r^2$ 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

Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : Product of Pressure (P) and time (t) has the same dimension as that of coefficient of viscosity.

Reason R : Coefficient of viscosity = $\frac{Force}{Velocity\ gradient}$

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

A particle of mass m is moving in a circular path of constant radius r such that its centripetal acceleration (a) is varying with time t as $a = k^2rt^2$, where k is a constant. The power delivered to the particle by the force acting on it is given as

Options :

A. zero

B. $mk^2r^2t^2$

C. mk^2r^2t

D. mk^2rt

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

Motion of a particle in x-y plane is described by a set of following equations

$$x = 4\sin\left(\frac{\pi}{2} - \omega t\right) m$$

and

$$y = 4\sin(\omega t)\, m$$

. The path of the particle will be :

Options :

A. circular

B. helical

C. parabolic

D. elliptical

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

Match List-I with List-II

	List-I		**List-II**
(A)	Moment of inertia of solid sphere of radius R about any tangent.	(I)	$\frac{5}{3}MR^2$
(B)	Moment of inertia of hollow sphere of radius (R) about any tangent.	(II)	$\frac{7}{5}MR^2$
(C)	Moment of inertia of circular ring of radius (R) about its diameter.	(III)	$\frac{1}{4}MR^2$
(D)	Moment of inertia of circular disc of radius (R) about any diameter.	(IV)	$\frac{1}{2}MR^2$

Choose the correct answer from the options given below :

Options :

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

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

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

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

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

Two planets A and B of equal mass are having their period of revolutions T_A and T_B such that $T_A = 2T_B$. These planets are revolving in the circular orbits of radii r_A and r_B respectively. Which out of the following would be the correct relationship of their orbits?

Options :

A. $2r_A^2 = r_B^3$

B. $r_A^3 = 2r_B^3$

C. $r_A^3 = 4r_B^3$

D. $$T_A^2 - T_B^2 = \frac{\pi^2}{GM}\left(r_B^3 - 4r_A^3\right)$$

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 water drop of diameter 2 cm is broken into 64 equal droplets. The surface tension of water is 0.075 N/m. In this process the gain in surface energy will be :

Options :

A. 2.8×10^{-4} J

B. 1.5×10^{-3} J

C. 1.9×10^{-4} J

D. 9.4×10^{-5} J

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

Given below are two statements :

Statement I : When μ amount of an ideal gas undergoes adiabatic change from state (P_1, V_1, T_1) to state (P_2, V_2, T_2), then work done is

$$W = \frac{\mu R(T_2 - T_1)}{1 - \gamma}$$

, where

$$\gamma = \frac{C_p}{C_v}$$

and R = universal gas constant.

Statement II : In the above case, when work is done on the gas, the temperature of the gas would rise.

Choose the correct answer from the options given below :

Options :

A. Both Statement I and Statement II are true.

B. Both Statement I and Statement II are false.

C. Statement I is true but Statement II is false.

D. Statement I is false but Statement II is true.

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

Given below are two statements :

Statement I : A point charge is brought in an electric field. The value of electric field at a point near to the charge may increase if the charge is positive.

Statement II : An electric dipole is placed in a non-uniform electric field. The net electric force on the dipole will not be zero.

Choose the correct answer from the options given below :

Options :

A. Both Statement I and Statement II are true.

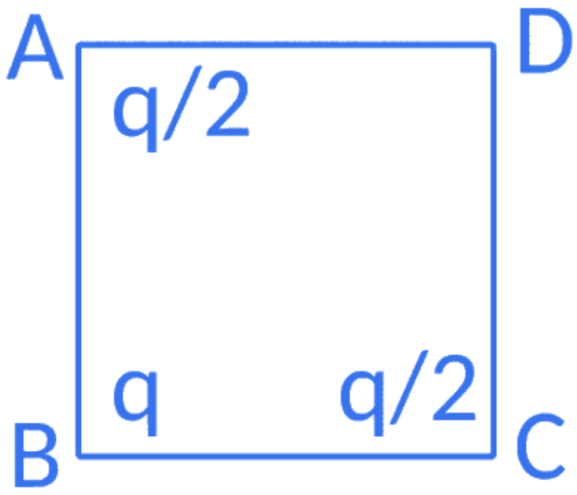
B. Both Statement I and Statement II are false.

C. Statement I is true but Statement II is false.

D. Statement I is false but Statement II is true.

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 three charges q/2, q and q/2 are placed at the corners A, B and C of a square of side 'a' as shown in figure. The magnitude of electric field (E) at the corner D of the square, is :



Options :

A. $\frac{q}{4\pi \in_0 a^2}\left(\frac{1}{\sqrt{2}}+\frac{1}{2}\right)$

B. $\frac{q}{4\pi \in_0 a^2}\left(1+\frac{1}{\sqrt{2}}\right)$

C. $\frac{q}{4\pi \in_0 a^2}\left(1-\frac{1}{\sqrt{2}}\right)$

D. $\frac{q}{4\pi \in_0 a^2}\left(\frac{1}{\sqrt{2}}-\frac{1}{2}\right)$

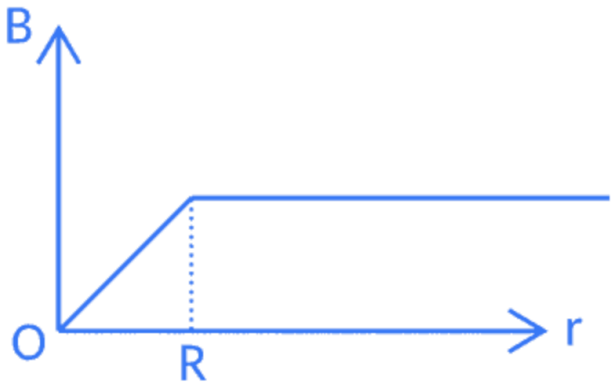
Question Number : 40 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

An infinitely long hollow conducting cylinder with radius R carries a uniform current along its surface.

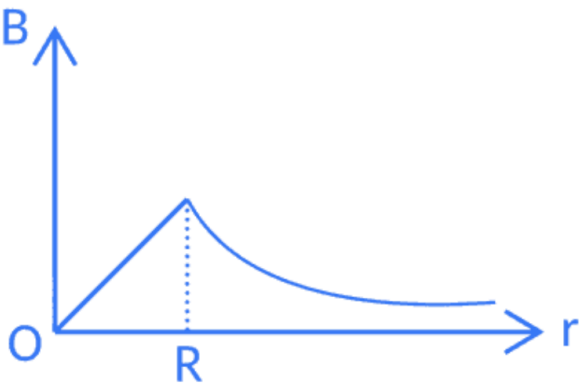
Choose the correct representation of magnetic field (B) as a function of radial distance (r) from the axis of cylinder.

Options :

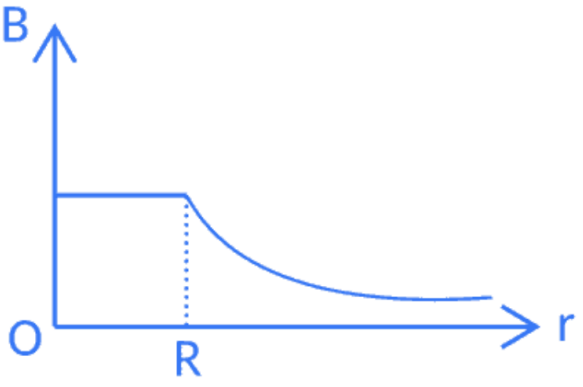
A.



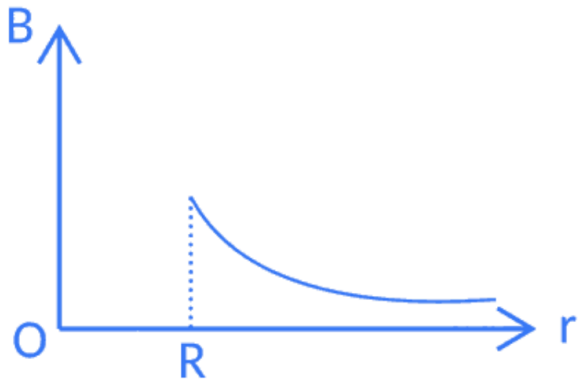
B.



C.



D.



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

A radar sends an electromagnetic signal of electric field (E_0) = 2.25 V/m and magnetic field (B_0) = 1.5×10^{-8} T which strikes a target on line of sight at a distance of 3 km in a medium. After that, a part of signal (echo) reflects back towards the radar with same velocity and by same path. If the signal was transmitted at time t = 0 from radar, then after how much time echo will reach to the radar?

Options :

A. 2.0×10^{-5} s

B. 4.0×10^{-5} s

C. 1.0×10^{-5} s

D. 8.0×10^{-5} s

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

The refracting angle of a prism is A and refractive index of the material of the prism is cot (A/2). Then the angle of minimum deviation will be -

Options :

A. $180 - 2A$

B. $90 - A$

C. $180 + 2A$

D. $180 - 3A$

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

The aperture of the objective is 24.4 cm. The resolving power of this telescope, if a light of wavelength 2440 $\overset{o}{A}$ is used to see th object will be :

Options :

A. 8.1×10^6

B. 10.0×10^7

C. 8.2×10^5

D. 1.0×10^{-8}

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 de Broglie wavelengths for an electron and a photon are λ_e and λ_p respectively. For the same kinetic energy of electron and photon, which of the following presents the correct relation between the de Broglie wavelengths of two ?

Options :

A. $\lambda_p \propto \lambda_e^2$

B. $\lambda_p \propto \lambda_e$

C. $\lambda_p \propto \sqrt{\lambda_e}$

D. $\lambda_p \propto \sqrt{\frac{1}{\lambda_e}}$

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

The Q-value of a nuclear reaction and kinetic energy of the projectile particle, K_p are related as :

Options :

A. $Q = K_p$

B. $(K_p + Q) < 0$

C. $Q < K_p$

D. $(K_p + Q) > 0$

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

For using a multimeter to identify diode from electrical components, choose the correct statement out of the following about the diode :

Options :

A. It is two terminal device which conducts current in both directions.

B. It is two terminal device which conducts current in one direction only.

C. It does not conduct current gives an initial deflection which decays to zero.

D. It is three terminal device which conducts current in one direction only between central terminal and either of the remaining two terminals

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

The velocity of sound in a gas, in which two wavelengths 4.08 m and 4.16 m produce 40 beats in 12s, will be :

Options :

A. $282.8\ ms^{-1}$

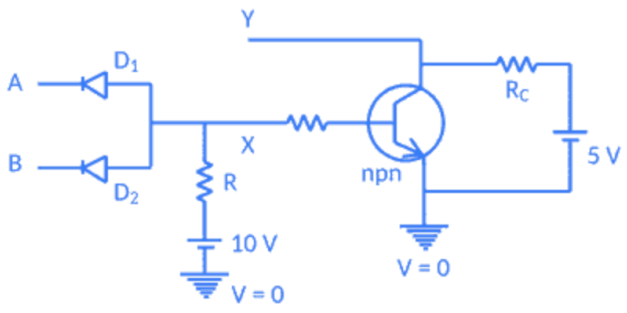
B. $175.5\ ms^{-1}$

C. $353.6\ ms^{-1}$

D. $707.2\ ms^{-1}$

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 the following circuit, the correct relation between output (Y) and inputs A and B will be :



Options :

A. $Y = AB$

B. $Y = A + B$

C. $Y = AB$

D. $Y = A + B$

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

Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : n-p-n transistor permits more current than a p-n-p transistor.

Reason R : Electrons have greater mobility as a charge carrier.

Choose the correct answer from the options given below :

Options :

A. Both A and R are true, and R is 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 : 50 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)	Television signal	(I)	03 KHz
(B)	Radio signal	(II)	20 KHz
(C)	High Quality Music	(III)	02 MHz
(D)	Human speech	(IV)	06 MHz

Options :

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

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

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

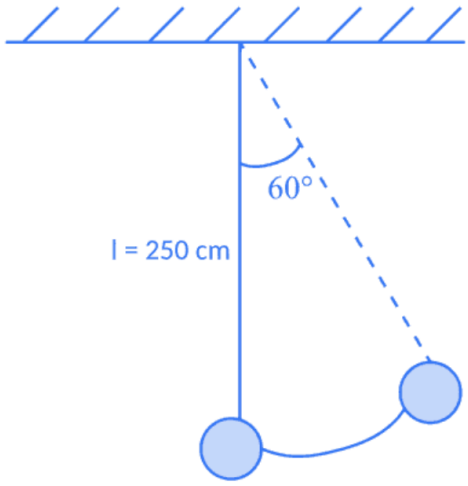
D. A-I, B-II, C-IV, D-III

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

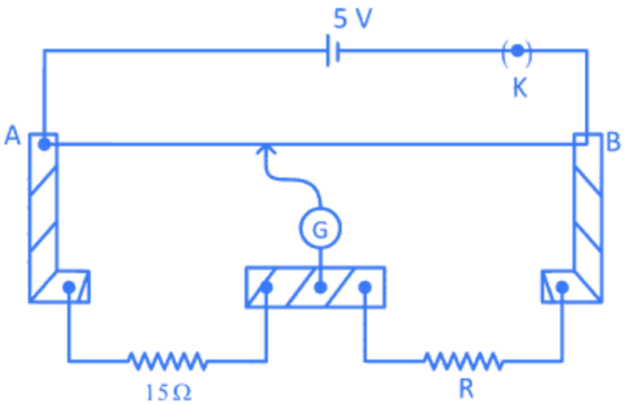
A pendulum is suspended by a string of length 250 cm. The mass of the bob of the pendulum is 200 g. The bob is pulled aside until the string is at 60° with vertical as shown in the figure. After releasing the bob, the maximum velocity attained by the bob will be _____ ms^{-1}. (if g = 10 m/s^2)



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 meter bridge setup is shown in the figure. It is used to determine an unknown resistance R using a given resistor of 15 Ω. The galvanometer (G) shows null deflection when tapping key is at 43 cm mark from end A. If the end correction for end A is 2 cm, then the determined value of R will be _____ Ω.

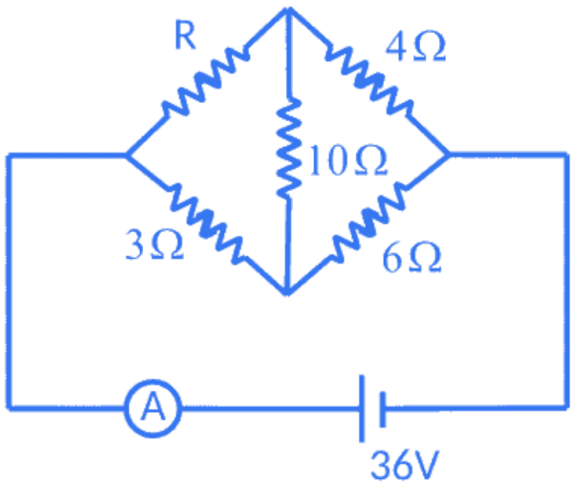


Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes

Answers Type : Equal
Text Areas : PlainText

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

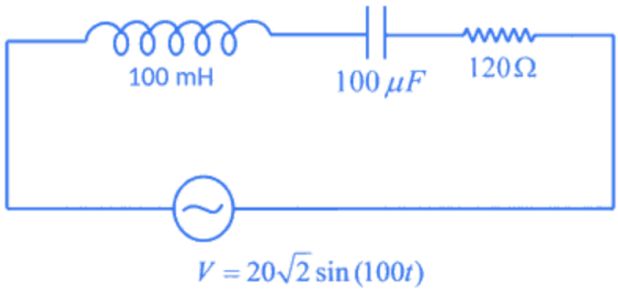
Current measured by the ammeter (A) in the reported circuit when no current flows through 10 Ω resistance, will be _____ A.



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

An AC source is connected to an inductance of 100 mH, a capacitance of 100 μF and a resistance of 120 Ω as shown in figure. The time in which the resistance having a thermal capacity 2 J/°C will get heated by 16°C is _____ s.



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

The position vector of 1 kg object is

$$\vec{r} = \left(3\hat{i} - \hat{j}\right)m$$

and its velocity

$$\vec{v} = \left(3\hat{j} + \hat{k}\right)ms^{-1}$$

. The magnitude of its angular momentum is $\sqrt{x}$ Nm where x is _____.

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

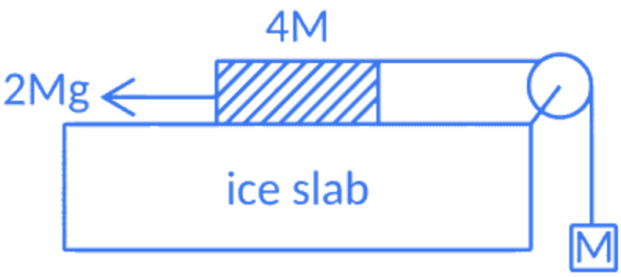
A man of 60 kg is running on the road and suddenly jumps into a stationary trolly car of mass 120 kg. Then, the trolly car starts moving with velocity 2 ms^{-1}. The velocity of the running man was _____ ms^{-1}, when he jumps into the car.

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 hanging mass M is connected to a four times bigger mass by using a string-pulley arrangement, as shown in the figure. The bigger mass is placed on a horizontal ice-slab and being pulled by 2 Mg force. In this situation, tension in the string is $\frac{x}{5}$ Mg for x = _____. Neglect mass of the string and friction of the block (bigger mass) with ice slab.

(Given g = acceleration due to gravity)



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

The total internal energy of two mole monoatomic ideal gas at temperature T = 300 K will be _____ J. (Given R = 8.31 J/mol.K)

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

A singly ionized magnesium atom (A = 24) ion is accelerated to kinetic energy 5 keV, and is projected perpendicularly into a magnetic field B of the magnitude 0.5 T. The radius of path formed 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

A telegraph line of length 100 km has a capacity of 0.01 μF/km and it carries an alternating current at 0.5 kilo cycle per second. If minimum impedance is required, then the value of the inductance that needs to be introduced in series is _____ mH. (if $\pi = \sqrt{10}$)

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

Element "E" belongs to the period 4 and group 16 of the periodic table. The valence shell electron configuration of the element, which is just above "E" in the group is

Options :

A. $3s^2, 3p^4$

B. $3d^{10}, 4s^2, 4p^4$

C. $4d^{10}, 5s^2, 5p^4$

D. $2s^2, 2p^4$

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

Nitrogen gas is obtained by thermal decomposition of :

Options :

A. $Ba(NO_3)_2$

B. $Ba(N_3)_2$

C. $NaNO_2$

D. $NaNO_3$

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

Which one of the lanthanoids given below is the most stable in divalent form?

Options :

A. Ce (Atomic Number 58)

B. Sm (Atomic number 62)

C. Eu (Atomic Number 63)

D. Yb (Atomic Number 70)

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

Given below are two statements :

Statement I : $[Ni(CN)_4]^{2-}$ is square planar and diamagnetic complex, with dsp^2 hybridization for Ni but $[Ni(CO)_4]$ is tetrahedral, paramagnetic and with sp^3-hybridication for Ni.

Statement II : $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ both have same d-electron configuration have same geometry and are paramagnetic.

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

Options :

A. Both Statement I and Statement II are true.

B. Both Statement I and Statement II are false.

C. Statement I is correct but Statement II is false.

D. Statement I is false but Statement II is correct.

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

Which one of the following techniques is not used to spot components of a mixture separated on thin layer chromatographic plate?

Options :

A. I_2 (Solid)

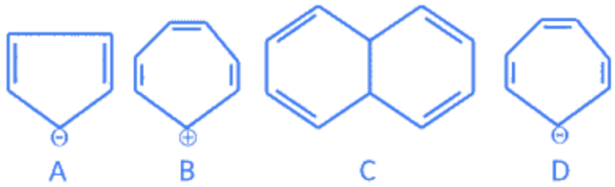
B. U.V. Light

C. Visualisation agent as a component of mobile phase

D. Spraying of an appropriate reagent

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

Which of the following structure are aromatic in nature?



Options :

A. A, B, C, and D

B. Only A and B

C. Only A and C

D. Only B, C and D

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

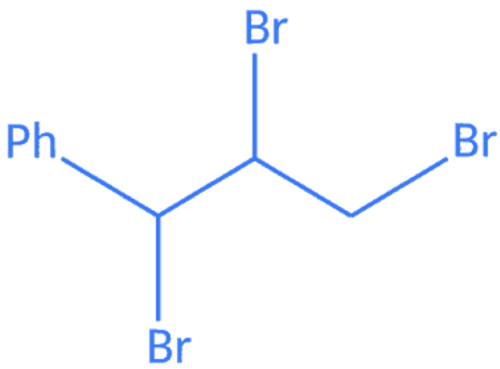
The major product (P) in the reaction



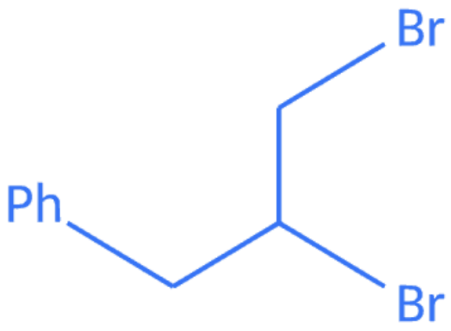
is

Options :

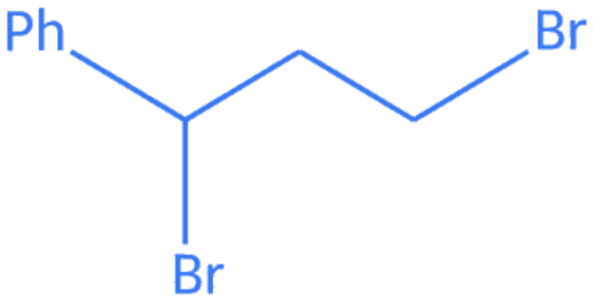
A.



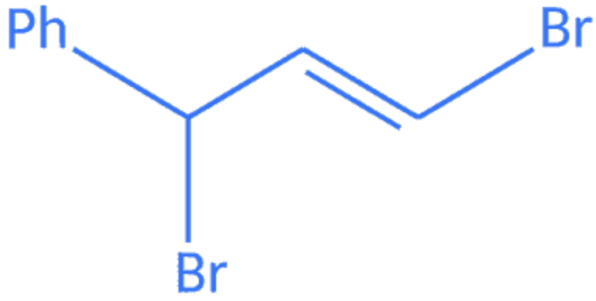
B.



C.

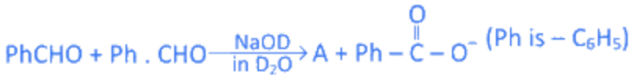


D.



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

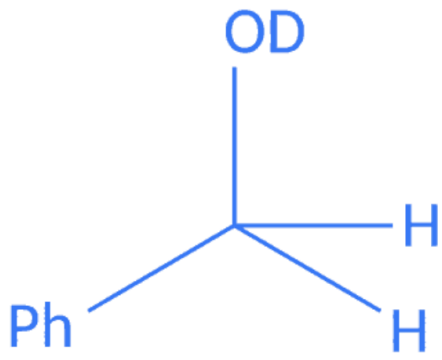
The correct structure of product 'A' formed in the following reaction.



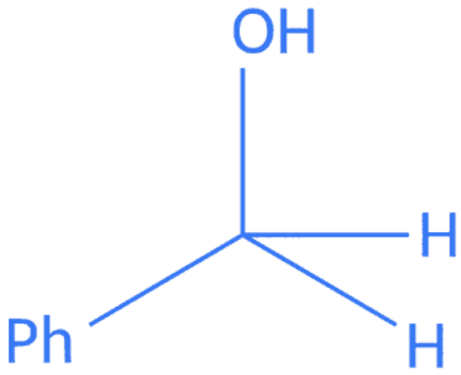
is

Options :

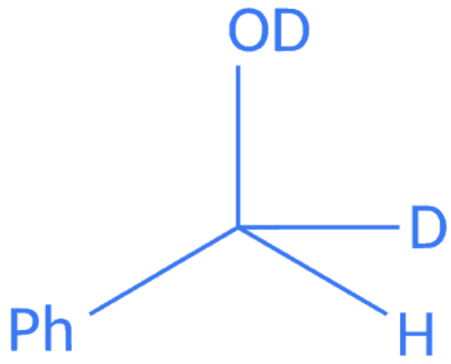
A.



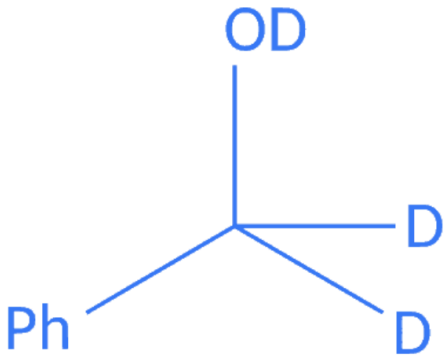
B.



C.



D.

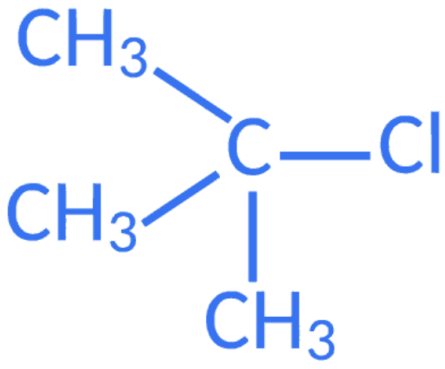


Question Number : 69 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which one of the following compounds is inactive towards S_N1 reaction?

Options :

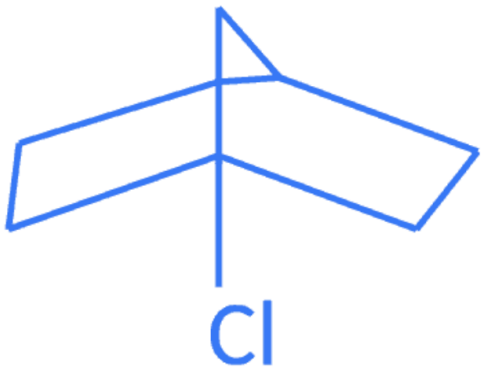
A.



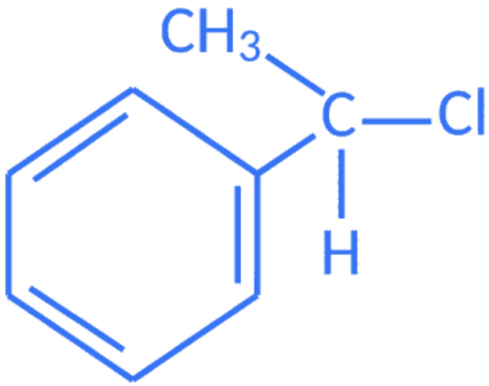
B.



C.



D.



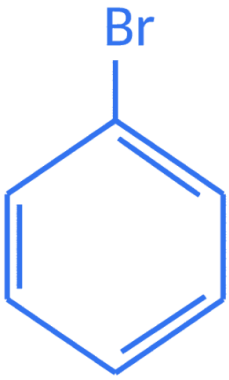
Question Number : 70 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Identify the major product formed in the following sequence of reactions:

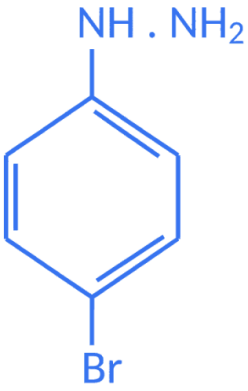


Options :

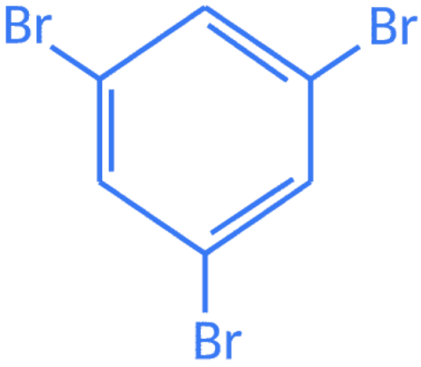
A.



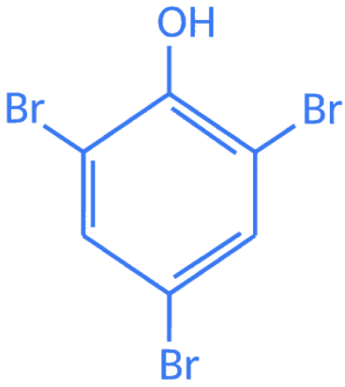
B.



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

A primary aliphatic amine on reaction with nitrous acid in cold (273 K) and there after raising temperature of reaction mixture to room temperature (298 K), gives a/an

Options :

A. nitrile

B. alcohol

C. diazonium salt

D. secondary amine

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

Stability of α-Helix structure of proteins depends upon

Options :

A. dipolar interaction

B. H-bonding interaction

C. van der Waals forces

D. π-stacking interaction

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 formula of the purple colour formed in Laissaigne's test for sulphur using sodium nitroprusside is :

Options :

A. $NaFe[Fe(CN)_6]$

B. $Na[Cr(NH_3)_2(NCS)_4]$

C. $Na_2[Fe(CN)_5(NO)]$

D. $Na_4[Fe(CN)_5(NOS)]$

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

The incorrect statement about the imperfections in solids is :

Options :

A. Schottky defect decreases the density of the substance.

B. Interstitial defect increases the density of the substance.

C. Frenkel defect does not alter the density of the substance.

D. Vacancy defect increases the density of the substance.

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

The Zeta potential is related to which property of colloids?

Options :

A. Colour

B. Tyndall effect

C. Charge on the surface of colloidal particles

D. Brownian movement

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

Given are two statements one is labelled as Assertion A and other is labelled as Reason R.

Assertion A : Magnesium can reduce Al_2O_3 at a temperature below 1350°C, while above 1350°C, while above 1350°C aluminium can reduce MgO.

Reason R : The melting and boiling points of magnesium are lower than those of aluminium.

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

Options :

A. Both A and R are correct, and R is correct explanation of A.

B. Both A and R are correct, but R is NOT the correct explanation of A.

C. A is correct R is not correct.

D. A is not correct, R is correct.

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

Dihydrogen reacts with CuO to give :

Options :

A. CuH_2

B. Cu

C. Cu_2O

D. $Cu(OH)_2$

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

Given below are two statements :

Statement I : The pentavalent oxide of group-15 element, E_2O_5, is less acidic than trivalent oxide, E_2O_3, of the same element.

Statement II : The acidic character of trivalent oxide of group 15 elements, E_2O_3, decreases down the group.

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

Options :

A. Both Statement I and Statement II are true.

B. Both Statement I and Statement II are false.

C. Statement I is true, but Statement II is false.

D. Statement I is false, but Statement II is true.

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

Which amongst the following is not a pesticide?

Options :

A. DDT

B. Organophosphates

C. Dieldrin

D. Sodium arsenite

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

Which one of the following is NOT a copolymer?

Options :

A. Buna-S

B. Neoprene

C. PHBV

D. Butadiene-styrene

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

A 2.0 g sample containing MnO_2 is treated with HCl liberating Cl_2. The Cl_2 gas is passed into a solution of KI and 60.0 mL of 0.1 M $Na_2S_2O_3$ is required to titrate the liberated iodine. The percentage of MnO_2 in the sample is _____. (Nearest integer)

[Atomic masses (in u) Mn = 55; Cl = 35.5; O = 16, I = 127, Na = 23, K = 39, S = 32]

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

If the work function of a metal is 6.63×10^{-19}J, the maximum wavelength of the photon required to remove a photoelectron from the metal is _____ nm. (Nearest integer)

[Given : h = 6.63×10^{-34} J s, and c = 3×10^{8} m s^{-1}]

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

The hybridization of P exhibited in PF_5 is sp^xd^y. The value of y is _____.

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

4.0 L of an ideal gas is allowed to expand isothermally into vacuum until the total volume is 2.0 L. The amount of heat absorbed in this expansion is _____ L atm.

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 vapour pressures of two volatile liquids A and B at 25°C are 50 Torr and 100 Torr, respectively. If the liquid mixture contains 0.3 mole fraction of A, then the mole fraction of liquid B in the vapour phase is $\frac{x}{17}$. 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 : 86 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

The solubility product of a sparingly soluble salt A_2X_3 is 1.1×10^{-23}. If specific conductance of the solution is 3×10^{-5} S m^{-1}, the limiting molar conductivity of the solution is $x \times 10^{-3}$ S m^2 mol^{-1}. 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 : 87 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

The quantity of electricity in Faraday needed to reduce 1 mol of $Cr_2O_7^{2-}$ to Cr^{3+} is _____.

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

For a first order reaction A → B, the rate constant, k = 5.5×10^{-14} s^{-1}. The time required for 67% completion of reaction is x × 10^{-1} times the half life of reaction. The value of x is _____ (Nearest integer)

(Given : log 3 = 0.4771)

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

Number of complexes which will exhibit synergic bonding amongst, $[Cr(CO)_6]$, $[Mn(CO)_5]$ and $[Mn_2(CO)_{10}]$ 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

In the estimation of bromine, 0.5 g of an organic compound gave 0.40 g of silver bromide. The percentage of bromine in the given compound is _____ % (nearest integer)

(Relative atomic masses of Ag and Br are 108u and 80u, respectively).

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