Mathematics

Number of Questions: 50
Display Number Panel: Yes
Group All Questions: No

Question 1: Let $M = (a_{ij})$ be a $10 \times 10$ matrix such that $a_{ij} = \begin{cases} 1, & \text{if } i + j = 11 \\ 0, & \text{otherwise} \end{cases}$. Then, the determinant of $M$ is ______.

Options:
1. 0
2. 1
3. -1
4. 11

Question 2: Let $A$ and $B$ be two square matrices of order $n$. If $AB = A$, $BA = B$ then $A^2 + B^2 = ____$. 

Options:
1. $AB$

2. $A - B$

3. $0$

4. $A + B$

Consider the system of linear equations $x + y + z = 3$, $x - y - z = 4$, $x - 5y + az = 6$. Then, the value of $\alpha$ for which this system has an infinite number of solutions is _______.

Options:
1. -5
2. 5
3. 3
4. 1

If $A(\alpha, \beta) = \begin{pmatrix} \cos \alpha & \sin \alpha & 0 \\ -\sin \alpha & \cos \alpha & 0 \\ 0 & 0 & e^\beta \end{pmatrix}$, then the inverse of the matrix $A(\alpha, \beta)$ is _________.

Options:
1. $A(\alpha, \beta)$
2. $A(\alpha, -\beta)$
3. \( A(-\alpha, -\beta) \)

4. \( A(-\alpha, \beta) \)

Question Number : 5  Question Id : 8946584213  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

The rational fraction \( \frac{x^2 + 1}{(x^2 + 4)(x - 2)} \) is equal to ________

Options :

1. \( \frac{3x + 6}{8(x^2 + 4)} + \frac{5}{4(x - 2)} \)

2. \( \frac{3x + 6}{4(x^2 + 4)} + \frac{5}{8(x - 2)} \)

3. \( \frac{3x + 6}{8(x^2 + 4)} + \frac{5}{8(x - 2)} \)

4. \( \frac{3x + 6}{(x^2 + 4)} + \frac{5}{(x - 2)} \)

Question Number : 6  Question Id : 8946584214  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

If \( \log_2 3 = a, \log_3 5 = b, \log_7 2 = c \), then \( \log_{140} 63 = \) ________.

Options :

1. \( \frac{1 - 2ac}{2c + abc + 1} \)

2. \( \frac{1 - 2ac}{2c - abc - 1} \)
3. \[ \frac{1 + 2ac}{2c - abc - 1} \]

4. \[ \frac{1 + 2ac}{2c + abc + 1} \]

Question Number : 7  Question Id : 8946584215  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

\[ \cos \frac{2\pi}{7} + \cos \frac{4\pi}{7} + \cos \frac{6\pi}{7} = \_\_\_. \]

Options :

1. 1
2. \( \frac{1}{2} \)
3. \( -\frac{1}{2} \)
4. 0

Question Number : 8  Question Id : 8946584216  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

If the angles \( A, B \) and \( C \) of a triangle are in an arithmetic progression and if \( a, b \) and \( c \) denote the lengths of the sides opposite to \( A, B \) and \( C \) respectively, then the value of the expression \( \frac{a}{c} \sin 2C + \frac{c}{a} \sin 2A \) is \( \_\_\_ \).

Options :

1. \( \sqrt{3} \)
2. \( \frac{\sqrt{3}}{2} \)
3. \[ \frac{1}{2} \]

4. \[ \frac{1}{2} \]

Question Number: 9  Question Id: 8946584217  Question Type: MCQ  Option Shuffling: Yes  Display Question Number: Yes  Single Line Question Option: No  Option Orientation: Vertical

If \( \sin x + \sin y = \frac{1}{4} \) and \( \cos x + \cos y = \frac{1}{3} \), then \( \cot(x+y) = \) __________.

Options:

1. \[ \frac{7}{24} \]

2. \[ \frac{24}{7} \]

3. \[ \frac{3}{4} \]

4. \[ \frac{1}{4} \]

Question Number: 10  Question Id: 8946584218  Question Type: MCQ  Option Shuffling: Yes  Display Question Number: Yes  Single Line Question Option: No  Option Orientation: Vertical

If \( \sin(x^\circ + 28^\circ) = \cos(3x^\circ - 78^\circ) \) and \( 0^\circ < x^\circ < 90^\circ \), then, which of the following is the value of \( x^\circ \)?

Options:

1. \[ 50^\circ \]

2. \[ 30^\circ \]

3. \[ 16^\circ \]

4. \[ 8^\circ \]
If \( x = \tan \left( \csc^{-1} \frac{65}{63} \right) \) and \( y = \sec^2 \left( \cot^{-1} \frac{1}{2} \right) + \cos \sec^2 \left( \tan^{-1} \frac{1}{3} \right) \), then \( (x, y) = \) ________.

Options:

1. \( \left( \frac{63}{16}, 15 \right) \)
2. \( \left( \frac{16}{63}, 15 \right) \)
3. \( \left( \frac{63}{16}, 5 \right) \)
4. \( \left( \frac{16}{63}, 5 \right) \)

The equation \( \tan^{-1} \left( \frac{x + 1}{x - 1} \right) + \tan^{-1} \left( \frac{x - 1}{x} \right) = \tan^{-1} (-7) \) has ____________.

Options:

1. unique solution \( x = 2 \)
2. two solutions \( x = 1, 2 \)
3. no solution
4. infinite number of solutions

Question Number : 13  Question Id : 8946584221  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

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In a triangle $ABC$, let $a, b$ and $c$ denote the lengths of the sides opposite to $A, B$ and $C$ respectively. If \[ \frac{1}{a+c} + \frac{1}{b+c} = \frac{3}{a+b+c}, \] then the angle $C$ is ____.

Options:
1. $30^\circ$
2. $90^\circ$
3. $60^\circ$
4. $45^\circ$

Question Number : 14  Question Id : 8946584222  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

If $\sin hx = 3$ then $x = \underline{\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\n
Question Number : 15  Question Id : 8946584223  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

Which of the following is NOT true for the complex numbers $z_1$ and $z_2$?

Options:
1. $\frac{z_1}{z_2} = \frac{z_1 \bar{z}_2}{\left|z_2\right|^2}$
2. \[|z_1 + z_2| \leq |z_1| + |z_2|\]

3. \[|z_1 + z_2| \leq |z_1| - |z_2|\]

4. \[|z_1 + z_2|^2 + |z_1 - z_2|^2 = 2|z_1|^2 + 2|z_2|^2\]

Question Number : 16  Question Id : 8946584224  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

If a complex number \( z = \frac{\sqrt{3}}{2} + i \frac{1}{2} \), then \( z^4 \) is \( \underline{\text{______}} \).

Options:
1. \( 2\sqrt{2} + 2i \)
2. \( -\frac{1}{2} + i \frac{\sqrt{3}}{2} \)
3. \( \frac{\sqrt{3}}{2} - i \frac{1}{2} \)
4. \( \frac{\sqrt{3}}{8} - i \frac{1}{8} \)

Question Number : 17  Question Id : 8946584225  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

The equation of the straight line which makes intercepts \( r \) and \( s \) on the coordinate axes such that \( r + s = 5 \) and \( rs = 6 \) is \( ax + by + c = 0 \), then \( a + b + c = \underline{\text{______}} \).

Options:
1. \( 11 \)
2. \( 5 \)
3. \(-7\)

4. \(-1\)

Question Number : 18  Question Id : 8946584226  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

If a straight line \(ax + by + \sqrt{5} = 0\) touches the circle \(x^2 + y^2 = 5\), then which of the following is TRUE?

Options :

1. \(5(a^2 + b^2) = 1\)

2. \(a^2 + b^2 = \sqrt{5}\)

3. \(a^2 + b^2 = 1\)

4. \(\sqrt{a^2 + b^2} = 5\)

Question Number : 19  Question Id : 8946584227  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

If a chord of length 12 cm is at a distance of \(4\sqrt{10}\) cm from the centre of the circle, then the radius of the circle is _____.

Options :

1. 14 cm

2. \(\sqrt{304}\) cm

3. 4 cm

4. \(\sqrt{124}\) cm
Question Number : 20  Question Id : 8946584228  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

The $2019^{th}$ derivative of the function $(x-1)e^{-x}$ is ________

Options :

\[
\frac{x - 2019}{e^x}
\]

1.

\[
\frac{2019 - x}{e^x}
\]

2.

\[
\frac{x - 2020}{e^x}
\]

3.

\[
\frac{2020 - x}{e^x}
\]

4.

Question Number : 21  Question Id : 8946584229  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

If $z = f(x + ct) + \varphi(x - ct)$, then $\frac{\partial^2 z}{\partial t^2} = \text{__________}.$

Options :

\[
\frac{c^2 \partial^2 z}{\partial x^2}
\]

1.

\[-c^2 \frac{\partial^2 z}{\partial x^2}
\]

2.

\[
\frac{1}{c^2} \frac{\partial^2 z}{\partial x^2}
\]

3.

\[-\frac{1}{c^2} \frac{\partial^2 z}{\partial x^2}
\]

4.
If \( x = r \cos \theta, \ y = r \sin \theta \) and \( U = \frac{f(\theta)}{r} \) then \( x \frac{\partial U}{\partial x} + y \frac{\partial U}{\partial y} = \underline{} \).

Options:
1. 0
2. \( U \)
3. \( -U \)
4. \( 2U \)

Let \( f(x+y) = f(x)f(y), \ \forall x, y \) and \( f'(0) = 5, \ f(2019) = 15 \). Then the value of \( f'(2019) \) is \underline{}.

Options:
1. 3
2. 75
3. \( \frac{1}{3} \)
4. \( \frac{1}{75} \)

The set of values of \( x \) for which the function \( f(x) = 2x^3 - 9x^2 + 12x + 4 \) is increasing is \underline{}.

Options:
1. \( 1 < x < 2 \)
2. \( x \in \mathbb{R} \)

3. \( \mathbb{R} - [1, 2] \)

4. \( x \geq 2 \)

Question Number : 25  Question Id : 8946584233  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

\[
\lim_{x \to \infty} \left( \log \left(1 + \frac{x}{2}\right) - \log \left(\frac{x}{2}\right) \right) = \ldots.
\]

Options :

1. \( e^3 \)

2. \( \infty \)

3. 1

4. 2

Question Number : 26  Question Id : 8946584234  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

If \( f(x, y, z) = x^3 + xz^2 + y^3 + yz, \quad x = e^t, \quad y = \cos t, \quad z = t^3 \) then \( \frac{df}{dt} \) at \( t = 0 \) is \( \ldots \).

Options :

1. 2

2. 4

3. \( e \)

4. 3

Question Number : 27  Question Id : 8946584235  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Which of the following is the value of \(5050 \times \frac{\int_0^1 (1 - (1-x)^{50})^{100} x^{49} \, dx}{\int_0^1 (1-x^{50})^{101} x^{49} \, dx}\)?

Options:
1. 5100
2. 1
3. 5050
4. \(\frac{1}{2}\)

Question Number : 28  Question Id : 8946584236  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes
Single Line Question Option : No  Option Orientation : Vertical

\[\int_0^1 \max \left\{ x, \frac{1}{2} - x \right\} \, dx = \ldots.\]

Options:
1. 0
2. \(\frac{1}{2}\)
3. \(\frac{9}{16}\)
4. \(\frac{9}{8}\)

Question Number : 29  Question Id : 8946584237  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes
Single Line Question Option : No  Option Orientation : Vertical

\[\lim_{n \to \infty} \frac{1}{n^6} \sum_{k=1}^n k^5 = \ldots.\]

Options:
1. \( \frac{1}{6} \)

2. \( \frac{1}{5} \)

3. 1

4. 6

Question Number : 30  Question Id : 8946584238  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

\[ \int_{-1}^{1} \frac{x^{15}(1-x^{2})^{12}}{(1+x^{2})^{8}} \, dx = \ldots \]

Options :
1. 0
2. \( \frac{22}{7} - \pi \)
3. \( \frac{2}{105} \)
4. \( \frac{71}{15} - \frac{3\pi}{4} \)

Question Number : 31  Question Id : 8946584239  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

The area of the region bounded by the curves \( y = 2 - x^{2} \) and \( y = -x \) is \ldots

Options :
1. 1
2. \( \frac{8}{19} \)
3. \[ \frac{35}{4} \]

4. \[ \frac{27}{6} \]

Question Number : 32  Question Id : 8946584240  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

The volume of the solid obtained by revolving the region bounded by the curves \( y = x^3 \), \( y = 8 \) and \( x = 0 \) about the y-axis is _______.

Options :

1. \[ \frac{96}{5} \]

2. \[ \frac{96\pi}{5} \]

3. \[ \frac{32\pi}{5} \]

4. \[ \frac{32}{5} \]

Question Number : 33  Question Id : 8946584241  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

The value of \( \int_0^\pi \theta \sin^2 \theta \cos^4 \theta d\theta \) is _______.

Options :

1. \[ \frac{\pi^2}{32} \]

2. \[ \frac{\pi}{32} \]

3. \[ \frac{\pi^3}{16} \]
4. \[ \frac{\pi}{16} \]

**Question Number : 34  Question Id : 8946584242  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes Single Line Question Option : No  Option Orientation : Vertical**

The average value of the function \( f(x) = 4-x^2 \) over the interval \([-1, 3]\) is _____.

**Options:**

1. 5

2. \[ \frac{20}{3} \]

3. \[ \frac{5}{3} \]

4. 1

**Question Number : 35  Question Id : 8946584243  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes Single Line Question Option : No  Option Orientation : Vertical**

The differential equation \( x \frac{dy}{dx} = y + x^2, \ x > 0 \) satisfying \( y(0) = 0 \) has ________.

**Options:**

1. infinitely many solutions

2. no solution

3. a unique solution

4. exactly two solutions

**Question Number : 36  Question Id : 8946584244  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes Single Line Question Option : No  Option Orientation : Vertical**

The differential equation \( (a \cdot y^3 + y \cos x) \, dx + (x^2 y^2 + b \sin x) \, dy = 0 \) is an exact differential equation for ________.

**Options:**
1. \[ a = 1, \ b = \frac{3}{2} \]

2. \[ a = \frac{3}{2}, \ b = 1 \]

3. \[ a = \frac{2}{3}, \ b = 1 \]

4. \[ a = 1, \ b = \frac{2}{3} \]

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**Question Number : 37  Question Id : 8946584245  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes**

**Single Line Question Option : No  Option Orientation : Vertical**

If \( \sin x \) is a solution of the differential equation \( \frac{d^4 y}{dx^4} + 2 \frac{d^3 y}{dx^3} + 6 \frac{d^2 y}{dx^2} + 2 \frac{dy}{dx} + 5y = 0 \), then the general solution is __________.

Options:
1. \[ y = c_1 \sin x + c_2 \cos x + e^{-x}(c_3 \sin 2x + c_4 \cos 2x) \]
2. \[ y = c_1 \sin x + c_2 \cos x + c_3 \sin 2x + c_4 \cos 2x \]
3. \[ y = c_1 \sin x + c_2 \cos x + c_3 e^{-3x} + c_4 e^{-2x} \]
4. \[ y = c_1 \sin x + c_2 \cos x + c_3 e^{3x} + c_4 e^{2x} \]

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**Question Number : 38  Question Id : 8946584246  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes**

**Single Line Question Option : No  Option Orientation : Vertical**

If \( D = \frac{d}{dx} \), then \( \frac{1}{D^2 - 4D + 13}(6e^{2x} \sin 3x) \) is __________.

Options:
1. \[ -xe^{3x} \cos 3x \]

---
2. \( xe^{2x} \cos 3x \)

3. \( -xe^{2x} \sin 3x \)

4. \( xe^{2x} \sin 3x \)

The general solution of \( \left( \frac{e^{-2\sqrt{x}}}{\sqrt{x}} - \frac{y}{\sqrt{x}} \right) \frac{dx}{dy} = 1 \) is \[ \boxed{} \].

Options:

1. \( y = e^{2\sqrt{x}} (2\sqrt{x} + c) \)

2. \( y = 2\sqrt{x} e^{2\sqrt{x}} + c \)

3. \( y = 2\sqrt{x} e^{-2\sqrt{x}} + c \)

4. \( y = e^{-2\sqrt{x}} (2\sqrt{x} + c) \)

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Question Number : 40  Question Id : 8946584248  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

Let \( y \) be the solution of the differential equation \( \frac{dy}{dx} + y = x, \ x \in \mathbb{R} \) and \( y(-1) = 0 \).

Then, \( y(1) \) is equal to \[ \boxed{} \].

Options:

1. \( \frac{2}{e} - \frac{2}{e^2} \)

2. \( 2e^{-2} \)
3. \( \frac{2 - \frac{2}{e}}{e} \)

4. \( 2 - 2e \)

Question Number : 41  Question Id : 8946584249  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

If the substitution \( x = X + h, y = Y + k \) transforms the differential equation \((y-x+1)dy - (y+x+2)dx = 0\) into a homogeneous equation, then the value of \((h, k)\) is \(\ldots\).

Options:

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

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

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

4. \(\left( \frac{-3}{2}, \frac{-1}{2} \right)\)

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Question Number : 42  Question Id : 8946584250  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

The general solution of \( \frac{dy}{dx} - y = y^2 (\sin x + \cos x) \) is \(\ldots\).

Options:

1. \( y = \frac{1}{ce^x - \sin x} \)

2. \( y = ce^{-x} - e^x \sin x \)
3. \[ y = ce^{-x} - \sin x \]

4. \[ y = \frac{1}{ce^{-x} - \sin x} \]

The Laplace transform of the function \( f(t) = \begin{cases} \sin t, & \text{for } 0 \leq t \leq \pi \\ 0, & \text{for } t > \pi \end{cases} \)

is \[ \text{_____________}. \]

Options:

1. \[ \frac{1}{(1 + s^2)} \text{ for all } s > 0 \]

2. \[ \frac{1}{(1 + s^2)} \text{ for all } s < \pi \]

3. \[ \frac{(1 + e^{-\pi s})}{(1 + s^2)} \text{ for all } s > 0 \]

4. \[ \frac{e^{-\pi s}}{(1 + s^2)} \text{ for all } s > 0 \]

The inverse Laplace transform of \( \frac{5}{s} - \frac{3e^{-3s}}{s} - \frac{2e^{-7s}}{s} \) is \[ \text{_____________}. \]

Options:

1. \[ f(x) = \begin{cases} 5, & 0 < x < 3 \\ 0, & 3 < x < 7 \\ 2, & x > 7 \end{cases} \]
2. 
\[ f(x) = \begin{cases} 
5, & 0 < x < 7 \\
2, & x > 7 
\end{cases} \]

3. 
\[ f(x) = \begin{cases} 
5, & 0 < x < 3 \\
2, & 3 < x < 7 \\
0, & x > 7 
\end{cases} \]

4. 
\[ f(x) = \begin{cases} 
5, & 0 < x < 7 \\
0, & x > 7 
\end{cases} \]

The Laplace transform of a function \( f(x) \) is \( F(s) = \frac{1}{s^3 + 2s^2 + 2s} \). Then, \( \lim_{x \to 0} f(x) = \) ________

Options:
1. 0
2. 3
3. \( \infty \)
4. \( \frac{1}{2} \)

The Laplace transform of the solution of the differential equation \( \frac{dy}{dx} - 2y = e^{5x} \) with the initial condition \( y(0) = 3 \) is ________.

Options:
1. \( \frac{1}{3(s-2)} + \frac{1}{3(s-5)} \)

2. \( \frac{8}{3(s-2)} + \frac{1}{s-5} \)

3. \( \frac{8}{3(s-2)} + \frac{1}{3(s-5)} \)

4. \( \frac{8}{s-2} + \frac{1}{3(s-5)} \)

If \( L(y(x)) = Y(s) \) and \( y(x) = x^3 + \int_0^x \sin(x-t)y(t)dt \) then \( \frac{1}{6}Y(s) = \) ________.

Options:

1. \( \frac{1}{s^3} + \frac{1}{s^5} \)

2. \( \frac{1}{s^4} + \frac{1}{s^6} \)

3. \( \frac{1}{s^3} + \frac{1}{s^7} \)

4. \( \frac{1}{s} + \frac{1}{s^5} \)

For \( x > 0, \int_0^\infty \frac{\sin xt}{t} dt \) is ________.

Options:
1. \( \frac{\pi}{2x} \)

2. \( \frac{1}{x} \)

3. \( \frac{\pi}{2} \)

4. \( \frac{\pi}{2} \)

Question Number : 49  Question Id : 8946584257  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

If \( f(x) = \frac{1}{2}a_0 + \sum_{n=1}^{\infty} (a_n \cos nx + b_n \sin nx) \) is the Fourier series of the function

\[
 f(x) = \begin{cases} 
 0, & -\pi < x < 0 \\
 \frac{\pi}{2}, & 0 \leq x \leq \pi 
\end{cases}
\]

then, which of the following is TRUE?

Options:

1. \( a_n = 0, \) for all \( n \geq 0 \)

2. \( a_0 = \frac{\pi}{2} \) and \( a_n = 0, \) for all \( n \geq 1 \)

3. \( b_n = 0, \) for all \( n \geq 1 \)

4. \( a_0 = \pi \) and \( a_n = 0, \) for all \( n \geq 1 \)

Question Number : 50  Question Id : 8946584258  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

A function \( f(x) \) is such that \( f(x + 2\pi) = f(x) \) and \( f(x) = x, -\pi \leq x \leq \pi. \) The Fourier series of \( f(x) \) is ______________.

Options:
\[ 2(\sin x - \frac{1}{2}\sin 2x + \frac{1}{3}\sin 3x - \ldots) \]

2. \[ 2(\sin x + \frac{1}{2}\sin 2x + \frac{1}{3}\sin 3x + \ldots) \]

3. \[ 2(\cos x - \frac{1}{2}\cos 2x + \frac{1}{3}\cos 3x - \ldots) \]

4. \[ 2(\cos x + \frac{1}{2}\cos 2x + \frac{1}{3}\cos 3x + \ldots) \]

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**Physics**

Number of Questions: 25
Display Number Panel: Yes
Group All Questions: No

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The dimensional formula for gravitational constant is \[____\].

Options:

1. \[L^3T^{-2}M^{-1}\]

2. \[L^3T^2M^{-1}\]

3. \[L^2T^3M^{-2}\]

4. \[L^3T^1M^3\]

---

The dimensions of the quantities in one of the following pairs are same. Identify the pairs.

Options:
1. torque and work
2. angular momentum and work
3. energy and Young’s modules
4. light year and wavelength

Which of the following is not correct?

Options:
1. \( j \times i = -k \)
2. \( k \times j = -i \)
3. \( i \times k = -j \)
4. \( k \times i = -j \)

If \( 0.5 \mathbf{i} + 0.8 \mathbf{j} + c \mathbf{k} \) is a unit vector then \( c \) is______.

Options:
1. \( \sqrt{0.89} \)
2. 0.2
3. 0.3
4. \( \sqrt{0.11} \)
Which of the following is correct?

Options:
1. \( A.B \neq B.A \)
2. \( A.(B+C) = A.B + C.A \)
3. \( A.B = A.B - A.C \)
4. \( A.B = -B.A \)

The acceleration due to gravity on the surface of the earth is given by______

Options:
1. \( G \)
2. \( GM/R^2 \)
3. \( GM/R \)
4. \( GM \)

The value of \( g \) is maximum at______.

Options:
1. equator
2. Pole
3. higher altitudes
at the centre of the earth

4.

Question Number : 58  Question Id : 8946584266  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

When the speed of rotation of earth increases your weight_______

Options :
1. increases
2. decreases
   remains constant
3. becomes zero

Question Number : 59  Question Id : 8946584267  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

The value of G is zero at ______

Options :
1. nowhere
2. the centre of the earth
3. surface of the earth
4. pole

Question Number : 60  Question Id : 8946584268  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

If the linear momentum is increased by 50%, the kinetic energy will be increased by_______

Options :
1. 50%
A metallic block slides down a smooth inclined plane when released from the top, while the other falls freely from the same point, then______

Options:
1. both will reach the ground with the same velocity
2. both will reach the ground together
3. both will reach the ground travelling with same acceleration
4. the block sliding down the plane will strike earlier

A long spring is stretched by 2 cm and its potential energy is u. If the spring is stretched by 10 cm, then the potential energy stored in it will be______.

Options:
1. u/24
2. u/5
3. 5u
4. 25u
Two masses of 1 gm and 4 gm are moving with equal kinetic energies. The ratio of the magnitudes of their linear momentum is \[\text{______} \].

Options:
1. 4:1
2. \[\sqrt{2}:1\]
3. 1:2
4. 1:16

A body is dropped from rest at height 0.5 m. What will be its velocity when it just strikes the ground?

Options:
1. 7 m/s
2. 9.8 m/s
3. 4.9 m/s
4. \[\sqrt{9.8} \text{ m/s}\]

A particle moves such that its acceleration \(a\) is given by \(a = -bx\) where \(x\) is the displacement from equilibrium and \(b\) is a constant. The period of oscillation is \[\text{______} \].

Options:
1. \(2\pi b\)
2. $2\pi \sqrt{b}$
3. $2\pi/b$
4. $2\sqrt{\pi}/b$

Question Number : 66  Question Id : 8946584274  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

A particle is vibrating in simple harmonic motion with amplitude of 4 cm. At what displacement from the equilibrium position is its energy half potential and half kinetic?

Options:
1. 1 cm
2. $\sqrt{2}$ cm
3. 2 cm
4. $2\sqrt{2}$ cm

Question Number : 67  Question Id : 8946584275  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

When a star approaches the earth, the waves are shifted towards ________

Options:
1. green colour
2. yellow colour
3. blue end
4. red end

Question Number : 68  Question Id : 8946584276  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
If a tuning fork of frequency 90 is sounded and moved towards an observer with a velocity equal to one tenth the velocity of sound, then the note heard by the observer will have frequency______.

Options:
1. 100
2. 90
3. 80
4. 900

What is the most important factor which helps to recognise a person by his/her voice alone______

Options:
1. quality
2. pitch
3. intensity
4. quality, pitch and intensity

The quality of tone______

Options:
1. decreases with loudness
2. varies inversely as amplitude
3. varies directly as pitch

4. depends on the overtones present

Question Number : 71  Question Id : 8946584279  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

The conduction of heat from a hot body to a cold body is an example of___________.

Options :
1. reversible process
2. irreversible process
3. isothermal process
4. isobaric process

Question Number : 72  Question Id : 8946584280  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

From the isothermal drawn from Andrews experiment, it can be inferred that_______

Options :
1. CO₂ is a perfect gas
2. there is continuity of state
3. there is discontinuity of state
4. gases like CO₂ and H₂ cannot be liquefied

Question Number : 73  Question Id : 8946584281  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

A diesel cycle works at________

Options :
1. constant volume
2. constant pressure
3. constant temperature
4. both constant volume and constant temperature

The transition temperature of most low temperature superconducting elements is in the range of ________

Options:
1. zero to 10 k
2. 10 k to 20 k
3. 20 k to 50 k
4. 50 k alone

Propagation of light through fiber core is due to ________

Options:
1. diffraction
2. interference
3. total internal reflection
4. reflection
Question Number: 76  Question Id: 8946584284  Question Type: MCQ  Option Shuffling: Yes  Display Question Number: Yes  Single Line Question Option: No  Option Orientation: Vertical

Which of the following energy orders is correct?

Options:
1. $6s < 4f < 5d < 6p$
2. $4f < 5d < 6s < 6p$
3. $4f < 6s < 6p < 5d$
4. $6s < 6p < 5d < 4f$

Question Number: 77  Question Id: 8946584285  Question Type: MCQ  Option Shuffling: Yes  Display Question Number: Yes  Single Line Question Option: No  Option Orientation: Vertical

An element A of atomic number 11 combines with an element B of atomic number 17. The compound formed is ____________.

Options:
1. Covalent AB
2. Ionic AB
3. Covalent AB$_2$
4. Ionic AB$_2$

Question Number: 78  Question Id: 8946584286  Question Type: MCQ  Option Shuffling: Yes  Display Question Number: Yes  Single Line Question Option: No  Option Orientation: Vertical

The oxidation number of ‘S’ in S$_8$, S$_2$F$_2$, H$_2$S respectively are ____________.

Options:
1. 0, +1 and -2
2. +2, +1 and -2

3. 0, +1 and +2

4. -2, +1 and -2

The elements A, B, C and D have the following electronic configurations:

A: 1S\(^2\), 2S\(^2\), 2P\(^1\)

B: 1S\(^2\), 2S\(^2\), 2P\(^6\), 3S\(^2\), 3P\(^1\)

C: 1S\(^2\), 2S\(^2\), 2P\(^6\), 3S\(^2\), 3P\(^3\)

D: 1S\(^2\), 2S\(^2\), 2P\(^6\), 3S\(^2\), 3P\(^5\)

The elements that belong to same group are ________.

Options:
1. A and C
2. C and D
3. A and D
4. A and B

4.9 gm of H\(_2\)SO\(_4\) is present in 2 lit of its solution. The molarity of the solution is ________.

Options:
1. 0.1 M
2. 0.025 M
3. 0.25 M
4. 0.01 M

Question Number : 81  Question Id : 8946584289  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

The molecular weight of \( \text{H}_3\text{PO}_4 \) is 98. The equivalent weight is ________ gram / equivalents.

Options :
1. 98
2. 49
3. 32.66
4. 24.5

Question Number : 82  Question Id : 8946584290  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

Which of the following is the Bronsted acid?

Options :
1. \( \text{Cl}^- \)
2. \( \text{NH}_2^- \)
3. \( \text{CH}_3\text{COO}^- \)
4. \( \text{NH}_4^+ \)
Question Number : 83  Question Id : 8946584291  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

The pH of 1 M KOH is _____.

Options :
1. 12
2. 11
3. 14
4. 13

Question Number : 84  Question Id : 8946584292  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

Froth floatation process is used for the ____________.

Options :
1. Oxide ores
2. Sulphide ores
3. Chloride ores
4. Oxide ores and Chloride ores

Question Number : 85  Question Id : 8946584293  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

The composition of brass is ____________.

Options :
1. Cu and Zn
2. Cu and Ni
3. Cu and Mn
4. Cu and Fe

Which of the following statements is correct?

Options:
1. Cathode is positive terminal in an electrolytic cell
2. Cathode is negative terminal in a galvanic cell
3. Reduction occurs at cathode in either of cells
4. Oxidation occurs at cathode in either of cells

In the electrolysis of CuCl₂ solution using copper electrode, if 2.5 gm of Cu is deposited at cathode, then at anode ________________.

Options:
1. 890 mL of Cl₂ at STP is liberated
2. 445 mL of O₂ at STP is liberated
3. 2.5 gm of copper is deposited
4. a decrease of 2.5 gm of mass takes place

The unit of resistivity is __________.

Options:
1. Ω
2. \( \Omega \ m \)
3. \( \Omega /m \)
4. \( \Omega \ m^2 \)

**Question Number : 89  Question Id : 8946584297  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical**

Which of the following metals provide cathodic protection to iron?

**Options :**
1. Cu and Ni
2. Al and Zn
3. Al and Cu
4. Co and Ni

**Question Number : 90  Question Id : 8946584298  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical**

The chemical composition of rust is ___________.

**Options :**
1. \( \text{Fe}_3\text{O}_4 \)
2. \( \text{Fe}_3\text{O}_3 \)
3. \( \text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O} \)
4. \( \text{Fe}_3\text{O}_3 \cdot x\text{H}_2\text{O} \)

**Question Number : 91  Question Id : 8946584299  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical**

1 ppm of hardness of water is equal to _________________.

**Options :**
1. 1 part of CaCO₃ hardness in 10⁶ parts of water

2. 1 part of CaCO₃ hardness in 10⁸ parts of water

3. 1 part of CaCO₃ hardness in 10⁷ parts of water

4. 1 part of CaCO₃ hardness in 10⁵ parts of water

The temporary hardness of water is due to the presence of ____________.

Options:
1. MgCl₂ and CaCl₂

2. Ca(NO₃)₂ and Mg(NO₃)₂

3. CaSO₄ and MgSO₄

4. Ca(HCO₃)₂ and Mg(HCO₃)₂

The basic buffer solution is a mixture of ____________.

Options:
1. NH₃ + NH₄Cl

2. HCl + NH₄Cl

3. NaCl + NH₄Cl

4. KOH + NH₄Cl
Which of the following polymers has amide linkage?

Options:
1. Terylene
2. Bakelite
3. Nylon
4. PVC

The monomer of natural rubber is ____________.

Options:
1. Butadiene
2. Chloroprene
3. 2-methyl 1,2 butadiene
4. 2-methyl 1,3 butadiene

Which of the following is a thermo setting?

Options:
1. Bakelite
2. Polyethylene
3. Nylon-6
4. Natural rubber
The composition of water gas is _______________________.

Options:
1. CO and H₂ are combustible gases and CO₂ and N₂ are non-combustible gases
2. CO + CO₂ are combustible gases and H₂O and N₂ non-combustible gases
3. CO + N₂ are combustible gases and H₂O and H₂ are non-combustible gases
4. N₂ + H₂ are combustible gases and CO + H₂O are non-combustible gases

Earth is protected from UV radiation by _________________.

Options:
1. Nitrogen layer
2. Ozone layer
3. Carbon dioxide layer
4. Oxygen layer

Which of following statements is not correct?

Options:
1. CO is the main air pollutant
2. All pollutants are not wastes
3. Water is polluted by dissolved Oxygen
4. Lichens are pollution indicators.

Minamata disease is caused due to the presence of ____________.

Options:
1. Cd
2. Pb
3. As
4. Hg

The purpose of dies used in fitting trade is for ________________.

Options:
1. cutting internal threads
2. making external threads
3. filing
4. finishing
Hammers are specified by the ________.
Options:
1. length of handle
2. thickness of face
3. weight
4. width of flat face

The cutting saw blade which is very thin and stiffened with a thick back strip is ________.
Options:
1. tenon saw
2. rip saw
3. compass saw
4. coping saw

Casting defect caused by mixing of two streams of molten metal that are too cold to fuse properly is ________.
Options:
1. scab
2. swell
3. cold shuts
4. shrinkage
Property of sand due to which it evolves a large amount of steam and other gases is known as _______.

Options:
1. permeability
2. cohesiveness
3. adhesiveness
4. collapsibility

Cold working of metal increases ________.

Options:
1. tensile strength
2. ductility
3. scale formation
4. plastic deformation

The riser is provided to compensate ____________.

Options:
1. solidification shrinkage
2. solid shrinkage
3. machining allowance

4. distortion

When size of smallest shaft is more than size of biggest hole then it is ________.
Options:
1. clearance fit

2. interference fit

3. transition fit

4. both transition and clearance

In foundry, the tool made of iron rods bent at one end or both ends is used for reinforcement of sand in the top of the moulding box and to support hanging bodies of sand is known as ________.
Options:
1. gagger

2. gate cutter

3. flask

4. trovel

A screw is specified as M20. Then 20 refers to ________.
Options:
1. diameter (in mm) of the rod on which the screw is cut

2. root diameter (in mm)

3. core diameter (in mm)

4. mean diameter (in mm) of the screw thread

The phenomenon of slow and progressive deformation with time at high temperature is called _________

Options:
1. breaking

2. yielding

3. creeping

4. fatigue

Corrosion resistance of steel is increased by adding _________

Options:
1. chromium

2. nickel

3. aluminum

4. tungsten
The materials with the following crystal structures are more ductile

Options:
1. BCC
2. FCC
3. HCP
4. CUBIC

Question Number : 114  Question Id : 8946584322  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

Alpha iron exists ________

Options:
1. below $768^\circ$C
2. from $769^\circ$C to $900^\circ$C
3. from $901^\circ$C to $1400^\circ$C
4. from $1401^\circ$C to $1530^\circ$C

Question Number : 115  Question Id : 8946584323  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

Degradation of Mechanical properties leading to failure of component due to cyclic loading is called ________

Options:
1. breaking
2. yielding
3. creeping
4. fatigue
What is applied on the cap while opening the cap of a tooth paste tube?
Options:
1. force
2. moment
3. couple
4. force and moment

A block weighing 100 N is resting on a horizontal rough surface with coefficient of friction of 0.1. The friction force would be ________
Options:
1. 0 N
2. 2 N
3. 8 N
4. 10 N

What is the condition for a lifting machine to be reversible?
Options:
1. efficiency should be less than 50%
2. efficiency should be more than 50%
3. mechanical advantage is greater than the velocity ratio
4. maximum efficiency = $1/\text{velocity ratio}$

The kinetic energy of the body becomes four times of its initial value, then the momentum will be ____________.

Options:
1. unchanged
2. four times of its initial value
3. twice its initial value
4. eight times of its initial value

A ping pong ball is kept in a spherical bowl. The ball is in ____________.

Options:
1. stable equilibrium
2. unstable equilibrium
3. neutral equilibrium
4. nothing can be said with the given information

A steel rod of diameter 20 mm is carrying an axial load of 12 kN. If the yield point stress of the material is 350 MPa, what would be the factor of safety?

Options:
1. 2
When an axial load of 23 kN was applied on a rod, an elongation of 2 mm was observed. What was the strain energy stored in the rod?

Options:
1. 64 J
2. 46 J
3. 32 J
4. 23 J

A simply supported beam of span length 2 m is carrying a uniformly distributed load of intensity 300 N/m.

(a) The maximum shear force is 300 N
(b) The maximum shear force occurs at the mid span
(c) The maximum bending moment is 150 N.m
(d) The maximum bending moment occurs at the mid span

Which of the following is true with regard to the above?

Options:
1. (a), (b) and (c) are correct
2. (b), (c) and (d) are correct
3. (c), (d) and (a) are correct
4. (d), (a) and (b) are correct

The bending moment (in N.m) for a particular beam is expressed as,

\[ M(x) = 600x - 500(x - 0.2) - 300x^2 \quad 0 \leq x \leq 0.4 \text{ m}. \]

What is the shear force at \( x = 0.3 \text{ m} \)?

Options:
1. \(-80 \text{ N}\)
2. \(80 \text{ N}\)
3. \(92 \text{ N}\)
4. \(-140 \text{ N}\)

A solid steel rod of diameter 50 mm is to transmit a torque of 200 N.m. What is the maximum shear stress induced?
Options:
1. \(16.2 \text{ MPa}\)
2. \(8.1 \text{ MPa}\)
3. \(6.5 \text{ MPa}\)
4. \(4.2 \text{ MPa}\)
Question Number : 126  Question Id : 8946584334  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
A steel cantilever beam (E = 200 GPa) of length 1 m carrying some load showed a maximum deflection of 2 mm. If the free end is provided with a simple support, what would be the reaction at this support? (The cross sectional dimensions are, width 100 mm and depth 200 mm)
Options:
1. 20 kN
2. 40 kN
3. 80 kN
4. 90 kN

Question Number : 127  Question Id : 8946584335  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
A helical spring is applied with an axial tensile load causing an elongation. The nature of stresses induced in the material of the spring wire is _________
Options:
1. tensile stresses
2. compressive stresses
3. shear stresses
4. crushing stresses

Question Number : 128  Question Id : 8946584336  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
A hydraulic cylinder of diameter 1.5 m and wall thickness 10 mm is containing a fluid under a pressure 0.5 MPa. What is the hoop stress induced?
Options:
1. 9.38 MPa
2. 18.75 MPa
3. 37.50 MPa

4. 75.00 MPa

The advantage of adaptive control used in CNC is_________

Options:
1. it improves machinability

2. it improves surface finish

3. it adjusts feed rate depending upon cutting tool conditions and work piece

4. it improves stability

Which source of energy is used to move and regulate the robot's drive mechanism, have high pay load capacities and are relatively easy to maintain?

Options:
1. electric

2. hydraulic

3. pneumatic

4. manual

The principal stresses at a point in a tri-axially loaded member are 50 MPa (tensile), 80 MPa (compressive) and 150 MPa (compressive). What is the maximum shear stress?

Options:
1. 35 MPa
2. 65 MPa
3. 100 MPa
4. 150 MPa

Question Number: 132  Question Id: 8946584340  Question Type: MCQ  Option Shuffling: Yes  Display Question Number: Yes  Single Line Question Option: No  Option Orientation: Vertical

Which of the following keys transmits turning moment and permits axial movement also?

Options:
1. Woodruff Key
2. Kennedy Key
3. Square Key
4. Feather Key

Question Number: 133  Question Id: 8946584341  Question Type: MCQ  Option Shuffling: Yes  Display Question Number: Yes  Single Line Question Option: No  Option Orientation: Vertical

Doctor’s injection syringe can be an example of ________

Options:
1. a revolute pair
2. a prismatic pair
3. a cylindrical pair
4. a spherical pair

Question Number: 134  Question Id: 8946584342  Question Type: MCQ  Option Shuffling: Yes  Display Question Number: Yes  Single Line Question Option: No  Option Orientation: Vertical
A flange coupling is with $n$ clamping bolts each of diameter $d$, arranged on a pitch circle of diameter $D$. If $T$ is the torque transmitted by the coupling, what is the shear stress induced in the bolt body?

Options:

1. $2T / (n D \pi d^2)$

2. $4T / (n D \pi d^2)$

3. $8T / (n D \pi d^2)$

4. $8T / (n D^2 \pi d)$

Consider the following statements in the context of belt drives

(a) In a cross belt arrangement, the pulleys rotate in opposite directions

(b) In a cross belt arrangement, the angle of wrap is same for both the pulleys

(c) The belt experiences compressive stress on the slack side

(d) Speed of the larger pulley is always more than the speed of the smaller pulley

Which of the following is true with regard to the above?

Options:

1. (a) and (b) are correct

2. (b) and (c) are correct

3. (c) and (d) are correct

4. (d) and (a) are correct

The motion between the contact surfaces of two gear teeth is_________
The purpose of using a flywheel in an IC engine is to minimize the fluctuations in the speed of the engine which are due to variations in ________.

Options:
1. the load on the engine
2. the properties of the fuel input
3. the torque produced
4. the compression ratio

The sensitivity of an isochronous governor is ________

Options:
1. zero
2. one
3. infinity
4. indeterminate
In a disc type cam drive, the pitch point is a point ________________.

Options:
1. on the base circle where pressure angle is zero
2. on the pitch curve where pressure angle is zero
3. on the pitch curve where pressure angle is maximum
4. on the prime circle where pressure angle is maximum

In a band brake arrangement, the tensions are $T_1$ and $T_2$. If the angle of wrap is $\theta$, then the coefficient of friction would be ________

Options:
1. $\left(\frac{1}{\theta}\right) e^{\left(\frac{T_1}{T_2}\right)}$
2. $\theta e^{\left(\frac{T_1}{T_2}\right)}$
3. $\left(\frac{1}{\theta}\right) \ln\left(\frac{T_1}{T_2}\right)$
4. $\theta \ln\left(\frac{T_1}{T_2}\right)$

The relationship between tool life ($T$) and cutting speed ($V$) m/min is given as ________

Options:
1. $V^n T = C$
2. $VT^n = C$
3. $V^n/T = C$
4. \( T^n/V = C \)

Ceramic tools are fixed to tool body by__________

Options:
1. soldering
2. welding
3. clamping
4. brazing

The process of enlarging the already drilled hole is known as__________

Options:
1. boring
2. reaming
3. drilling
4. Swaging

Very hard grade grinding wheels are denoted by the letters from__________

Options:
1. A to E
2. G to K
3. L to O

4. T to Z

Question Number : 145  Question Id : 8946584353  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  
Single Line Question Option : No  Option Orientation : Vertical

For welding of thin plates, the power source used is__________

Options :
1. DCSP
2. AC
3. DCRP
4. Half wave AC

Question Number : 146  Question Id : 8946584354  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  
Single Line Question Option : No  Option Orientation : Vertical

In oxy-acetylene flame cutting, the metal is cut by__________

Options :
1. burning metal
2. intensive oxidation
3. reduction process
4. molecular transfer

Question Number : 147  Question Id : 8946584355  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  
Single Line Question Option : No  Option Orientation : Vertical

Oxidizing flame is used to weld__________

Options :
1. magnesium
2. steel

3. brass

4. aluminum

**Question Number : 148  Question Id : 8946584356  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical**

Process in which two or more cutters are used simultaneously is known as _________

Options:
1. gang milling

2. face milling

3. saw milling

4. helical milling

**Question Number : 149  Question Id : 8946584357  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical**

Knurling is an operation of _________

Options:
1. cutting smooth collars

2. under cutting

3. roughing the surface for hand grip

4. smoothening the surface

**Question Number : 150  Question Id : 8946584358  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical**

Weld penetration is increased by _________

Options:
1. increasing welding current and welding speed

2. increasing welding current and decreasing welding speed

3. decreasing welding current and welding speed

4. decreasing welding current and increasing welding speed

In thermodynamic parlance, Heat and work are__________

Options:

1. intensive properties

2. extensive properties

3. point functions

4. path functions

A Carnot cycle is having an efficiency of 75%. If the temperature of the high temperature reservoir is 727 °C, then what is the temperature of the low temperature reservoir?

Options:

1. 23 °C

2. -23 °C

3. 0 °C

4. 250 °C
A mass ‘m’ of a perfect gas at pressure $p_1$ and volume $V_1$ undergoes an isothermal process. The final pressure is $p_2$ and the final volume is $V_2$. If $R$ is the Gas constant and $T$ is the temperature, then the work done in the process is $\Box$.

Options:
1. $p_1 V_1 \ln (V_2 / V_1)$
2. $p_1 V_1 \ln (V_1 / V_2)$
3. $RT \ln (V_2 / V_1)$
4. $RT \ln (V_1 / V_2)$

An air-standard Otto cycle consists of the following reversible processes

Options:
1. two isobaric processes and two adiabatic processes
2. two isochoric processes and two adiabatic processes
3. two isothermal processes and two adiabatic processes
4. one isobaric process, one isochoric process and two adiabatic processes

Knocking tendency in an S.I. engine reduces with increasing $\Box$.

Options:
1. compression ratio
2. wall temperature
3. supercharging
4. engine speed

Question Number : 156  Question Id : 8946584364  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
In order to burn 1 kilogram of CH₄ completely, the minimum number of kilograms of Oxygen needed is (take the atomic weights of H, C and O as 1, 12 and 16 respectively) _______.
Options :
1. 3
2. 4
3. 5
4. 6

Question Number : 157  Question Id : 8946584365  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Brake thermal efficiency of three types of reciprocating engines commonly used in road vehicles are given in the increasing order as______________________.
Options :
1. 2 stroke SI engine, 4 stroke SI engine, 4 stroke CI engine
2. 2 stroke SI engine, 4 stroke CI engine, 4 stroke SI engine
3. 4 stroke SI engine, 2 stroke SI engine, 4 stroke CI engine
4. 4 stroke CI engine, 4 stroke SI engine, 2 stroke SI engine

Question Number : 158  Question Id : 8946584366  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
For determining the ignition quality of compression ignition engine fuels, the reference fuels used are__________
Options :
1. Iso-octane and n-heptane

2. Cetane and α-methylnaphthalene

3. Hexadecane and n-heptane

4. Cetane and iso-octane

During Morse test on a 4 cylinder engine, the following measurements of brake power were taken at constant speed:

All cylinders firing: 3037 kW.
Number 1 cylinder not firing: 2102 kW.
Number 2 cylinder not firing: 2102 kW.
Number 3 cylinder not firing: 2100 kW.
Number 4 cylinder not firing: 2098 kW.

The mechanical efficiency of the engine is _________

Options:
1. 91.53%
2. 71.65%
3. 81.07%
4. 61.22%

Valve overlapping in a 4-stroke S.I. Engine results in _________.

Options:
1. increasing the brake thermal efficiency
2. increasing the indicated thermal efficiency
3. effective scavenging
4. effective cooling

When wet steam flows through a throttle valve and remains wet at exit, __________.

Options:
1. its temperature and quality increase
2. its temperature decreases but quality increases
3. its temperature increases but quality decreases
4. its temperature and quality decrease

Select the correct statement for a stage of Parsons reaction steam turbine

Options:
1. the rotor blade is symmetrical
2. the stator blade is symmetrical
3. the absolute inlet flow angle is equal to absolute exit flow angle
4. the absolute exit flow angle is equal to inlet angle of rotor blade
In a power plant, water (density = 1000 kg/m$^3$) is pumped from 80 kPa to 3 MPa. The isentropic work input to the pump in kJ/kg is \[ \text{__________} \].

Options:
1. 0.34
2. 2.48
3. 3.43
4. 2.92

Considering the variation of static pressure and absolute velocity in an impulse steam turbine, across one row of moving blades \[ \text{__________} \].

Options:
1. both pressure and velocity decrease
2. both pressure and velocity increase
3. pressure decreases and velocity increases
4. pressure remains constant, while velocity decreases

Which of the following is a boiler mounting?

Options:
1. Blow off clock
2. Feed pump
3. Economizer
4. Superheater

Question Number : 166  Question Id : 8946584374  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

Diverging portion of a convergent divergent nozzle will act as nozzle only when the Mach Number at throat is __________.

Options :
1. less than 1
2. equal to 1
3. greater than 1
4. equal to 0

Question Number : 167  Question Id : 8946584375  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

A single acting two stage air compressor with perfect intercooling delivers air at 16 bar. Assuming an intake state of 1 bar at 15 °C, the pressure ratio per stage is __________

Options :
1. 16
2. 8
3. 4
4. 2

Question Number : 168  Question Id : 8946584376  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

An aeroplane is cruising at a speed of 800 kmph at an altitude of 4000 m. The air temperature at this altitude is 0 °C and the local sonic velocity is 331.2 m/s. The flight Mach number is nearly __________

Options :
1. 1.5
2. 0.25
3. 0.67
4. 0.90

Question Number : 169  Question Id : 8946584377  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

Clearance volume of a reciprocating compressor is 100 ml and the volume of the cylinder at the bottom dead centre is 1.0 litre. The ratio of the clearance volume to the stroke volume is ________.

Options :
1. 1/11
2. 1/10
3. 1/9
4. 1/12

Question Number : 170  Question Id : 8946584378  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

In a shell and tube type of steam condenser, baffles are mainly used to ________

Options :
1. increase the mixing of fluids
2. increase the heat transfer area
3. deflect the flow in desired direction
4. reduce the fouling of the tube surface

For a Newtonian fluid ________.

Options:
1. shear stress is proportional to shear strain
2. rate of shear stress is proportional to shear strain
3. shear stress is proportional to rate of shear strain
4. rate of shear stress is proportional to rate of shear strain

The parameters which determine the friction factor for turbulent flow in a rough pipe are ________

Options:
1. Froude number and relative roughness
2. Froude number and Mach number
3. Reynolds number and relative roughness
4. Mach number and relative roughness

For laminar flow through a pipe of diameter 0.04 m, having a centre line velocity of 1.5 m/s, the discharge in m³/s is ________

Options:
1. \(3 \pi / 50\)
2. \( \frac{3\pi}{2,500} \)

3. \( \frac{3\pi}{5,000} \)

4. \( \frac{3\pi}{10,000} \)

In order to have the maximum power from Pelton wheel, the bucket speed must be ________

Options:
1. equal to the jet speed
2. equal to half the jet speed
3. equal to twice the jet speed
4. independent of the jet speed

Specific speed of a Kaplan turbine ranges between ________

Options:
1. 30 and 60
2. 61 and 300
3. 301 and 600
4. 601 and 1000

Cavitation in a turbine is most likely to occur at the turbine ________

Options:
The ratio of normal force of jet of water on a plane inclined at an angle of 30° as compared to that when plate is normal to jet is ______.

Options:
1. 1
2. 1/2
3. 1/√2
4. √2

A hydraulic accumulator is a device used for storing ___________ energy, which may be supplied to a machine later.

Options:
1. potential
2. kinetic
3. strain
4. pressure
Question Number : 179  Question Id : 8946584387  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

In a hydraulic coupling_________

Options:
1. the magnitudes of input and output torques are equal
2. the magnitude of input torque is greater than output torque
3. the magnitude of input torque is less than output torque
4. the magnitude of input torque is negligible as compared to output torque

Question Number : 180  Question Id : 8946584388  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

A hydraulic press has a ram of 20 cm diameter and a plunger of 5 cm diameter. The force required at the plunger to lift a weight of $16 \times 10^4$ N will be_________.

Options:
1. $256 \times 10^4$ N
2. $64 \times 10^4$ N
3. $4 \times 10^4$ N
4. $1 \times 10^4$ N

Question Number : 181  Question Id : 8946584389  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

In breakeven analysis, the total cost consists of_________.

Options:
1. fixed cost + variable cost
2. fixed cost + profits
3. fixed cost + sales revenue
4. fixed cost + variable cost + profits

F.W. Taylor introduced a system of working, known as_________.

Options:
1. line organization
2. line and staff organization
3. effective organization
4. functional organization

Objective of time study is to determine the time taken by___________.

Options:
1. expert worker
2. new employer
3. apprentice
4. average worker

The economic order quantity is obtained by the quantity, whose procurement cost is equal to inventory carrying cost, in___________.

Options:
1. inventory control
2. perpetual inventory control

3. A-B-C Analysis

4. Scheduling

Question Number : 185  Question Id : 8946584393  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

In process layout, __________

Options :
1. all machines of similar nature are grouped together in one area of production facility
2. machines are located in order of operations to be performed upon the product
3. mass production of articles is convenient
4. fixed cost is higher than that of product layout

Question Number : 186  Question Id : 8946584394  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

Gantt chart provides information on __________

Options :
1. proper utilization of men and machine
2. proper flow of material
3. production schedule
4. material handling devices

Question Number : 187  Question Id : 8946584395  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

SIMO charts are used in __________.

Options :
1. method study

2. micro motion study

3. process analysis

4. layout analysis

Question Number : 188  Question Id : 8946584396  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Principles related to the use of human body and arrangement of the work place is known as
as _________.
Options :
1. motion study

2. work study

3. time study

4. motion economy

Question Number : 189  Question Id : 8946584397  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
CPM is a technique that is based on

Options :
1. event

2. event and activity

3. neither event nor activity

4. activity

Question Number : 190  Question Id : 8946584398  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Large inventories are permitted in case of ________

Options:
1. A and B items
2. only B items
3. B and C items
4. only C items

In a vapour compression refrigeration system, liquid to suction heat exchanger is used to ________

Options:
1. keep the COP constant
2. prevent the liquid refrigerant from entering the compressor
3. superheat the vapour entering the condenser
4. subcool the vapour entering the condenser

The Electrolux refrigerator is also called as ________ fluid absorption system.

Options:
1. four
2. three
3. two
4. single

Question Number : 193  Question Id : 8946584401  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

Which one of the following is CFC refrigerant?

Options :

1. R744

2. R290

3. R502

4. R718

Question Number : 194  Question Id : 8946584402  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

Global warming is caused by ________

Options :

1. Ozone

2. Carbon dioxide

3. Nitrogen

4. Oxygen

Question Number : 195  Question Id : 8946584403  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical

If a mass of moist air contained in a closed metallic vessel is heated, then its ________.

Options :

1. relative humidity decreases

2. relative humidity increases
3. specific humidity decreases
4. specific humidity increases

Question Number : 196  Question Id : 8946584404  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Moist air at 35 °C and 100% relative humidity is entering a psychrometric device and leaving at 25 °C and 100% relative humidity. The name of this psychrometric device is_______.
Options:
1. humidifier
2. dehumidifier
3. sensible heater
4. sensible cooler

Question Number : 197  Question Id : 8946584405  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Water at 42 °C is sprayed into a stream of air at atmospheric pressure and dry bulb temperature 40 °C and wet bulb temperature of 20 °C. The air leaving the humidifier is not saturated. Which of the following statements is TRUE?
Options:
1. air gets cooled and humidified
2. air gets heated and humidified
3. air gets heated and dehumidified
4. air gets cooled and dehumidified

Question Number : 198  Question Id : 8946584406  Question Type : MCQ  Option Shuffling : Yes  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
In the window air-conditioner, the expansion device used is _________.

Options:
1. capillary tube
2. thermostatic expansion valve
3. automatic expansion valve
4. float valve

Uranium 238 is represented by $^{238}\text{U}$. It represents _________.

Options:
1. 92 neutrons and 238 protons
2. 92 protons and 238 neutrons
3. 92 neutrons and 146 protons
4. 92 protons and 146 neutrons

Moderator in a nuclear plant is used to _________.

Options:
1. protect against the neutrons and gamma rays
2. absorb excess neutrons
3. slow down the speed of fast-moving neutrons
return the neutrons back into the core of the reactor