This section contains 26 Single Choice questions. Each question has 4 choices (1), (2), (3), and (4) for its answer, out of which Only One is correct.

1. Area bounded by the curves $x^2 + y^2 = 36$ and outside parabola $y^2 = 9x$ is:
   (1) $24\pi + 15\sqrt{3}$ (2) $12\pi + \frac{15\sqrt{3}}{2}$ (3) $16\pi + \frac{15\sqrt{3}}{2}$ (4) $24\pi + \frac{5\sqrt{3}}{2}$

   Ans. (1)

Sol.
2. Value of $\sum_{i=1}^{15} (-1)^{i+1} C_i + (2^{15} - 2) \text{ is:}$
   
   (1) $2^{16}$
   (2) $2^{15} - 2$
   (3) $2^{15} - 1$
   (4) $2^{14} - 2$

   **Ans.**

   (2)

   **Sol.**

   $\sum_{i=1}^{15} (-1)^{i+1} C_i + (2^{15} - 2)$

   $= 15\sum_{i=1}^{15} (-1)^{i+1} C_{i-1} + (2^{15} - 2)$

   $= 15\left([(-1)^{16} C_0] - [(-1)^{15} C_1] + \ldots + [-1 C_{14}] + (2^{15} - 2)\right)$

   $= 15 (0) + 2^{15} - 2 = 2^{15} - 2$

---

3. The value of $\lim_{x \to 0} \frac{\int_0^x \sin(\sqrt{t}) dt}{x^3}$ is:

   (1) $\frac{2}{3}$
   (2) $\frac{2}{3}$
   (3) $\frac{3}{2}$
   (4) $1$

   **Ans.**

   (2)

   **Sol.**

   $\lim_{x \to 0} \frac{\int_0^x \sin(\sqrt{t}) dt}{x^3}$

   Use Leibnitz theorem

   $\lim_{x \to 0} \frac{\sin \sqrt{2x}}{3x^2} = \frac{2}{3}$ Ans

4. The value of $\lim_{n \to \infty} \tan^{-1} \left( \sum_{r=1}^{n} \frac{1}{1+r + r^2} \right)$ is equal to

   (1) $1$
   (2) $2$
   (3) $0$
   (4) $4$

   **Ans.**

   (1)

   **Sol.**

   $\sum_{r=1}^{n} \frac{1}{1+r + r^2}$

   $= \tan^{-1}(n + 1) - \tan^{-1}(1)$

   $= \tan^{-1}(n + 1) - \tan^{-1}(1)$

   $= \tan^{-1}(n + 1) - \tan^{-1}(1)$

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

5. Two pillars of different heights stand on either side of a roadway which is 150 m wide. At a point in the roadway between the pillars, the angle of elevation of the top of the pillars are complementary angles. If the
height of the larger pillar is 3 times the height of the smaller pillar then the height of the smaller pillar is:

(1) 75
(2) 26\sqrt{3}
(3) 25
(4) 15

Ans.
Sol.
$$\tan x = \frac{x}{75}$$

$$\tan \left(\frac{x}{2} - \theta\right) = \frac{3x}{75}$$

$$\Rightarrow 1 + \frac{3x}{75} = \frac{x}{75} \times 25 \Rightarrow x^2 = 75 \times 25 \Rightarrow x = 25\sqrt{3}$$

---

6. If \( p + aq = 2 \) and \( p^2 - aq^2 = 272 \), then a quadratic equation whose roots are \( p \) and \( q \) is

(1) \( x^2 - 2x + 16 = 0 \)
(2) \( x^2 - 2x + 16 = 0 \)
(3) \( x^2 - 2x + 16 = 0 \)
(4) \( x^2 - 2x + 16 = 0 \)

Ans.
Sol.
$$\left(p^2 + aq^2\right)^2 - 2pq(272) = 272$$

$$\Rightarrow x^2 = 2x + 16 \times 0 \text{ or } x^2 - 2x - 8 = 0$$

7. Tangent at point \( P(t, t^2) \) on the curve \( y = x^2 \) meets curve again at point \( Q \). If a point on \( PQ \) divides it internally in the ratio 1:2 then coordinate of that point is

(1) \( (0, -2t^2) \)
(2) \( (0, 2t^3) \)
(3) \( (0, -4t) \)
(4) \( (0, 4t) \)

Ans.
Sol.
Let pt. \( Q \) be \( (t_1, t_1^2) \)

slope = \( \frac{t_1^2 - t^2}{t_1 - t} \)

so \( t_1 = -2t \)

now the point which divides \( PQ \) internally in the ratio 1:2 is \( (0, -2t^2) \)

8. The distance of the point of intersection of plane \( x + y + z = 17 \) and line \( \frac{x-3}{1} = \frac{y-4}{2} = \frac{z-5}{2} \) from the point \( (1, 1, 9) \) is

(1) \( \sqrt{35} \)
(2) \( 6 \)
(3) \( \sqrt{70} \)
(4) \( \sqrt{58} \)

Ans.
Sol.
Let point on line be \( (\lambda + 3, 2\lambda + 4, 2\lambda + 5) \) which lies on \( x + y + z = 17 \Rightarrow 5\lambda + 12 + 17 \Rightarrow \lambda = 1 \)

so, point of intersection of given line and plane is \( (4, 6, 7) \)

9. If arithmetic mean of reciprocal of intercepts of line \( y = mx + c \) on axes is \( \frac{1}{4} \), then this line will pass through the point

(1) \( (1, 1) \)
(2) \( (2, 2) \)
(3) \( (4, 4) \)
(4) All of these

Ans.
Sol.
\( x \) intercept = \( \frac{-c}{m} \)

\( y \) intercept = \( c \)

\( A.M. = \frac{1}{2} = \frac{1}{4} \)

\( 2(1 - m) = c \)
10. Locus of mid point of a focal radius of parabola $y^2 = 4ax$ is a parabola whose focus is

- $(1) \left( -\frac{a}{2}, 0 \right)$
- $(2) \left( \frac{a}{2}, 0 \right)$
- $(3) (a, 0)$
- $(4) (-a, 0)$

Ans. (3)

Sol.

\[
(x, y) = \left( \frac{h + a}{2}, \frac{k}{2} \right)
\]

- $h = a (1 + t^2)$, $k = at$
- $2h = a (1 + t^2)$, $k = at$
- $2h = a \left( 1 - k^2 \right)$

locus of $P(h, k)$ is $y^2 = 2a \left( x - \frac{a}{2} \right)$

Focus $\left( \frac{a}{2}, 0 \right)$ is $(a, 0)$

11. $\int \frac{\cos x - \sin x}{\sin 2x} \, dx = a \sin^{-1} \left( \frac{\sin x \cos x}{b} \right) + C$, then the $(a, b)$ is

- $(1) (1, 3)$
- $(2) (3, 1)$
- $(3) (-1, 3)$
- $(4) (-3, 1)$

Ans. (1)

Sol.

$\sin 2x = (\sin x + \cos x)^2 - 1$

let $\sin x + \cos x = t$

\[
\int \frac{dt}{\sqrt{1 - t^2}} = \sin^{-1} \left( \frac{t}{3} \right) + C = \sin^{-1} \left( \frac{\sin x + \cos x}{3} \right) + C
\]

$\Rightarrow a = 1, b = 3$

12. $f(x) = [x - 1] \cos \left( \frac{2x + 1}{2} \right)$, then $f(x)$ is (Where $[\cdot]$ represent greatest integer function)

- $(1)$ Discontinuous at $x = 1$
- $(2)$ Continuous every where
- $(3)$ Discontinuous at every integer
- $(4)$ Discontinuous at $x = 5$

Ans. (2)

Sol.

$f(x) = [x - 1] \sin(x)$

$\lim_{x \to 1^-} f(x) = 0 = f(1)$

$\therefore f(x)$ is continuous at every integer.
13. Find the minimum value of \( \alpha \), where \( \frac{4}{\sin x} \cdot \frac{1}{1 - \sin x} = \alpha \)

Sol.
\[
\frac{4}{\sin x} \cdot \frac{1}{1 - \sin x} = \alpha \\
\frac{4 \cos x}{\sin x} = \frac{\cos x}{(1 - \sin x)^2} = 0 \\
\Rightarrow 2(1 - \sin x) = \sin x \\
\Rightarrow \sin x = \frac{2}{3} \\
\Rightarrow \alpha = \frac{4}{2/3} = 6 + 3 = 9
\]

Ans. 9

14. If \( f: \mathbb{R} \rightarrow \mathbb{R} \), \( f(x) = 2x - 1 \) and \( g: \mathbb{R} \rightarrow \mathbb{R} \), \( g(x) = \frac{x - 1}{x - 1} \) then \( f \circ g(x) \) is

(1) one one and onto  
(2) one one but not onto  
(3) onto but not one one  
(4) not one one and not onto

Ans. (2)

Sol.
\[
f \circ g(x) = 2g(x) - 1 = 2 \left( \frac{x - 1}{x - 1} \right) - 1 = \frac{x}{x - 1}
\]

\[
y = f \circ g(x) = \frac{x}{x - 1}
\]

\[
dy = \frac{(x - 1)(x) - (x)(x - 1)}{(x - 1)^2} = \frac{1}{(x - 1)^2} < 0
\]

Graph of \( f \circ g(x) \)

R one = \( \mathbb{R} - \{1\} \)

one-one but not onto

15. From a group of 6 Indians and 8 foreigners a committee is formed then number of committee in which at least 2 Indians are always selected and number of committee is double of number of Indian is

(1) 1625  
(2) 1615  
(3) 1525  
(4) 1610

Ans. (1)

Sol. Indian foreigners

Resonance Eduventures Ltd.
Reg. Office & Corp. Office: CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005
Ph. No.: +91-744-2777777, 2777700 | FAX No.: +91-22-39167222

This solution was downloaded from Resonance JEE (MAIN) 2021 Solution portal PAGE # 5

16. If \( \int_{a}^{b} [x + 2] \, dx = 22 \) and \( a > 2 \) then value of \( \int_{a}^{a} [x] \, dx \) is (Where \([\cdot]\) represent greatest integer function)

(1) 3  
(2) 2  
(3) 4  
(4) 5

Ans. (1)
Sol.\[ \int \frac{2}{y} \, dx + \int (x-2) \, dx + \int (x-2) \, dx = 22\]
\[ a^2 - \left( \frac{x^2}{2} \right)^2 + (2x)^2 + \left( \frac{x^2}{2} \right)^2 - (2x)^2 = 22\]
\[ a^2 - 2 \left( \frac{a^2}{2} + 4 + 2a + \frac{a^2}{2} \right) = 22 \]
\[ 2a^2 = 18 \implies a = 3\]
\[ \int x \, dx = \int x \, dx\]
\[ \left( \frac{2}{3} x^2 \right) - \int \left( \frac{2}{3} x^2 \right) \, dx + \left( \int x \, dx \right) + \frac{1}{2} \left( \int 1 \, dx + \frac{1}{2} \int 2 \, dx \right) = \left( -3 - 2 \cdot 1 + 1 \cdot 2 \right) = 3\]

17. \( a, a, \ldots, a \) are in G.P. \( \frac{a_1}{a_6} = 25 \) find \( \frac{a_6}{a_1} \)

An. \( (1) \)

Sol. \( \frac{a_6}{a_1} = 25 \ there \ r^2 = 5 \)
\( \therefore r = 5 \)

18. \( \vec{a}, \vec{b}, \vec{b} \) are coplanar and \( \vec{b} \) is to \( \vec{c} \)

\[ \vec{a} \cdot \vec{b} = 7, \vec{a} = -\vec{i} + \vec{j} + \vec{k}, \vec{b} = 2\vec{i} + \vec{k} \]
find \( 2(\vec{a} \cdot \vec{b} + \vec{c}) \)

An. 75
\[ \vec{c} = \lambda (\vec{b} \times \vec{a}) \times \vec{b} \]
\[ \vec{c} = \lambda \left( \vec{b} \times (\vec{a} - (\vec{a} \cdot \vec{b})) \right) \]
\[ \vec{c} = \lambda (5\vec{a} + \vec{b}) \]
\[ \vec{a} \cdot \vec{c} = 7 \implies \vec{a} \cdot (5\vec{a} + \vec{b}) \]
\[ \lambda (5\vec{a}^2 + \vec{a} \cdot \vec{b})) = 7 \]
\[ \lambda \left( 15 - 1 \right) = 7 \implies \lambda = \frac{1}{2} \]

---

**Resonance Eduventures Ltd.**

Reg. Office & Corp. Office: CG Tower, A-46 & 52, IPHA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

To Know more: www.resonance.ac.in | Email: contact@resonance.ac.in | CIN: U80791 Rajasthan 2001007 | CD 26079

---

**JEE MAIN-2021 | DATE: 24-02-2021 (SHIFT-1) | PAPER-1 | MEMORY BASED | MATHEMATICS**

\[ \vec{c} = -\frac{1}{2} \left( -3\vec{i} + 5 \right) + 6\vec{k} \]

\[ 2(\vec{a} + \vec{b} + \vec{c})^2 = 2 \left( \frac{1}{2} - \frac{1}{2} + \frac{1}{2} + 5\vec{k} \right)^2 \]

\[ \left( \frac{1}{4} \left( \frac{2}{4} + \frac{25}{4} \right) \right) - 75 \]

19. Solution of differential equation \( xy - ydx = \sqrt{x^2 + y^2} \, dx \) is:

(1) \( y + \sqrt{x^2 + y^2} = cx^2 \)

(2) \( y - \sqrt{x^2 + y^2} = cx^2 \)

(3) \( y + \sqrt{x^2 + y^2} = cx^2 \)

(4) \( y - \sqrt{x^2 + y^2} = cx^2 \)

An. (1)

Sol. \( xy - ydx = \sqrt{x^2 + y^2} \, dx \)

\[ \frac{dx}{\sqrt{1 + x^2}} \cdot \frac{x}{\sqrt{1 + x^2}} \]

\[ \frac{dx}{x} \cdot \frac{x}{\sqrt{1 + x^2}} \]

\[ \left( \frac{1}{x} \right) \cdot \left( \frac{1}{\sqrt{1 + x^2}} \right) = \frac{1}{x} + \frac{mc}{x} \]
20. Let \( f(x) = \frac{4x^3 - 3x^2}{6} - 2\sin x + (2x - 1)\cos x \) then \( f(x) \) is

1. Increases in \( \left( \frac{1}{2}, \infty \right) \)
2. Decreases in \( \left( 0, \frac{1}{2} \right) \)
3. Increases in \( \left( -\frac{1}{2}, \frac{1}{2} \right) \)
4. Decreases in \( \left( -\frac{3}{2}, \frac{1}{2} \right) \)

**Ans.** (1)

**Sol.**

\[ f(x) = 2x^2 - x - 2\cos x = -(2x-1) \sin x + 2 \cos x \]

\[ = (2x-1)(x - \sin x) > 0 \Rightarrow x > \frac{1}{2} \]

Increasing

21. A die is rolled \( n \) times. If the probability of getting odd number 2 times is equal to the probability of getting even number 3 times. Find the probability of getting odd number odd times

**Ans.** 0.5

**Sol.**

\[ \binom{n}{2} \left( \frac{1}{2} \right)^2 \left( \frac{1}{2} \right)^{n-2} = \binom{n}{3} \left( \frac{1}{2} \right)^3 \left( \frac{1}{2} \right)^{n-3} \]

\[ 5 \binom{n}{2} \left( \frac{1}{2} \right)^{n-2} = \frac{1}{4} \binom{n}{3} \left( \frac{1}{2} \right)^{n-3} \]

22. Number of matrices \( M \) of order \( 3 \times 3 \) whose element are taken from \( \{0, 1, 2\} \) such that sum of diagonal element of \( M \). M' is 7, are (\( M' \) is transpose of matrix \( M \))

**Ans.** 540

**Sol.**

Let \( M = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} \)

\[ M' = \begin{bmatrix} a & d & g \\ b & e & h \\ c & f & i \end{bmatrix} \]

\[ \text{Sum of diagonal elements} = a + e + i = 7 \]

**Case I**

<table>
<thead>
<tr>
<th>5 times 0</th>
<th>3 times 1</th>
<th>1 times 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>( g )</td>
<td>( g )</td>
<td>( g )</td>
</tr>
</tbody>
</table>

\[ 2g = 504 \]

**Case II**

<table>
<thead>
<tr>
<th>2 times 0</th>
<th>7 times 1</th>
<th>0 times 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>( g )</td>
<td>( g )</td>
<td>( g )</td>
</tr>
</tbody>
</table>

\[ 2g = 36 \]

Total = 504 + 36 = 540

23. Let \( e^{\cos x - \cos x - \cos x + \cdots} = p \), where \( p \) is a root of \( x^2 - 9x + 8 = 0 \) then find value of

\[ \frac{2\sin x}{\sin x + \sqrt{3} \cos x} \]

**Ans.** 0.50

**Sol.**

\[ e^{\cos x - \cos x - \cos x + \cdots} = p \]

\[ x^2 - 9x + 8 = 0 \]

\[ (x - 1)(x - 8) = 0 \]

\[ x = 8 \text{ or } x = 1 \]

\[ \cos x = \sqrt{3} \]

\[ x = \frac{\pi}{6} \]

\[ \frac{2\sin x}{\sin x + \sqrt{3} \cos x} = \frac{2}{2} \]

\[ \frac{1}{2} \cdot \frac{3}{2} = \frac{1}{2} \]
24. The population \( p(t) \) at time \( t \) of a certain mouse species satisfies the differential equation

\[
\frac{dp(t)}{dt} = 0.5 \cdot p(t) - 450.
\]

If \( p(0) = 850 \), then the time at which the population becomes zero is:

1. \( 2 \text{ / } n \text{ / } 18 \)
2. \( 2 \text{ / } n \text{ / } 9 \)
3. \( \frac{1}{2} \text{ / } n \text{ / } 18 \)
4. \( n \text{ / } 18 \)

Ans. (1)

Sol.

\[
\frac{dp(t)}{900 - p(t)} = -\frac{dt}{2n}.
\]

\[
\ln(900 - p(t)) = -\frac{t}{2n} + \ln(c).
\]

When \( t = 0 \), \( p(0) = 850 \)

\[
-\frac{2n(50)}{50} = c.
\]

\[
2n \left( \frac{50}{900 - p(t)} \right) = -t
\]

\[
0 = 900 - 50 \cdot e^{\frac{t}{2n}}.
\]

\[
\frac{t}{2n} = \ln(18) \Rightarrow t = 2n \cdot 18.
\]

25. If the midpoint of the common chord of circle \( x^2 + y^2 - 2x - 6y + 6 = 0 \) and the circle \( C \) is \((1, 3)\) then find the radius of circle \( C \) (where the centre of circle \( C \) is \((2, 1)\))

Ans. 03.00

Sol.

\[
\text{radius of } S = \sqrt{r^2 - 9} = 2.
\]

\[
r^2 - 4 \cdot 5 = 9 \Rightarrow r = 3.
\]

26. Which of the following is a tautology

1. \( a \land (a \land b) \)
2. \( a \land (a \lor b) \)
3. \( a \land (a \lor b) \to a \)
4. \( a \land (a \lor b) \)

Ans. (1)

Sol.

| T | T | T | T |
| T | F | F | F |
| F | T | T | F |
| F | F | T | T |
RESULT: JEE (Advanced), JEE (Main), NEET

HIGHEST No. of Classroom Selections in JEE (Advanced) 2020 from any Institute of Kota

5 AIRs in TOP-50 in JEE (Adv.) 2020 from Classroom

AIR-2 (GEN-EWS) Dhananjay Kejriwal
With us Since Class 9th

AIR-15 Zonal Topper IIT-Kharagpur
Samarth Agarwal
With us Since Class 10th

AIR-25 2nd Rank in IIT-Kharagpur Zone
Sankalp Parshar
With us Since Class 11th

AIR-29 Aaryan K. Gupta
With us Since Class 9th

AIR-30 Utkarsh P. Singh
With us Since Class 10th

Total Selections in JEE (Advanced) 2020: 4505
Classroom: 3441 | Distance: 1064

Eligible for JEE (Advanced) Through JEE (Main) 2020: 14755
Classroom: 11047 | Distance: 3708

NEET 2020: 2646
Classroom: 1833 | Distance: 813

ADMISSION OPEN for Session 2021-22
ONLINE + OFFLINE PROGRAMS

CLASS 11, 12 & 12+
Target: JEE (Main+Adv.) | JEE (Main) | NEET

Scholarship Upto 90%*

Toll Free: 1800 258 5555 | Visit us: www.resonance.ac.in