1. If \( \vec{a} \) and \( \vec{b} \) are perpendicular, then
\[
\vec{a} \times (\vec{a} \times (\vec{a} \times \vec{b}))
\]
is equal to
(1) \( 0 \)  
(2) \( \frac{1}{2} |\vec{a}|^2 \vec{b} \)  
(3) \( \vec{a} \times \vec{b} \)  
(4) \( |\vec{a}|^4 \vec{b} \)

**Official Ans. by NTA (4)**

2. A fair coin is tossed a fixed number of times. If the probability of getting 7 heads is equal to the probability of getting 9 heads, then the probability of getting 2 heads is
\[
1 + \frac{2}{3} + \frac{7}{3^2} + \frac{12}{3^3} + \frac{17}{3^4} + \frac{22}{3^5} + \ldots \text{ is equal to}
\]
(1) \( \frac{13}{4} \)  
(2) \( \frac{9}{4} \)  
(3) \( \frac{15}{4} \)  
(4) \( \frac{11}{4} \)

**Official Ans. by NTA (1)**

3. Let \( A \) be a symmetric matrix of order 2 with integer entries. If the sum of the diagonal elements of \( A^2 \) is 1, then the possible number of such matrices is
(1) 4  
(2) 1  
(3) 6  
(4) 12

**Official Ans. by NTA (1)**

4. In an increasing geometric series, the sum of the second and the sixth term is \( \frac{25}{2} \) and the product of the third and fifth term is 25. Then, the sum of 4th, 6th and 8th terms is equal to
(1) 30  
(2) 26  
(3) 35  
(4) 32

**Official Ans. by NTA (3)**

5. The value of \( \sum_{n=1}^{100} \int_{n-1}^{n} e^{x-[x]} \, dx \), where \([x]\) is the greatest integer \( \leq x \), is
(1) 100(e - 1)  
(2) 100(1 - e)  
(3) 100e  
(4) 100(1 + e)

**Official Ans. by NTA (1)**

6. In the circle given below, let \( OA = 1 \) unit, \( OB = 13 \) unit and \( PQ \perp OB \). Then, the area of the triangle \( PQB \) (in square units) is

**Official Ans. by NTA (2)**

7. The sum of the infinite series
\[
1 + \frac{2}{3} + \frac{7}{3^2} + \frac{12}{3^3} + \frac{17}{3^4} + \frac{22}{3^5} + \ldots \text{ is equal to}
\]
(1) \( \frac{13}{4} \)  
(2) \( \frac{9}{4} \)  
(3) \( \frac{15}{4} \)  
(4) \( \frac{11}{4} \)

**Official Ans. by NTA (1)**

8. The value of
\[
\lim_{h \to 0} \left( \frac{\sqrt{3} \sin \left( \frac{\pi}{6} + h \right) - \cos \left( \frac{\pi}{6} + h \right)}{\sqrt{3}h \left( \sqrt{3} \cosh - \sinh \right)} \right)
\]
is
(1) \( \frac{4}{3} \)  
(2) \( \frac{2}{\sqrt{3}} \)  
(3) \( \frac{3}{4} \)  
(4) \( \frac{2}{3} \)

**Official Ans. by NTA (1)**

9. The maximum value of the term independent of \( t \) in the expansion of
\[
\left( tx^3 + \frac{(1-x)^{10}}{t} \right)^{10}
\]
where \( x \in (0,1) \) is
(1) \( \sqrt{3} (5!)^2 \)  
(2) \( \frac{2.10!}{3\sqrt{3} (5!)^3} \)  
(3) \( \frac{2.10!}{3 (5!)^3} \)  
(4) \( \frac{10!}{3 (5!)^2} \)

**Official Ans. by NTA (2)**
10. The rate of growth of bacteria in a culture is proportional to the number of bacteria present and the bacteria count is 1000 at initial time \( t = 0 \). The number of bacteria is increased by 20% in 2 hours. If the population of bacteria is 2000 after \( e^{k \log_{5} \frac{6}{5}} \) hours, then
\[
\frac{k}{\log_{e} \frac{6}{5}} \text{ hours, then } \left( \frac{k}{\log_{e} \frac{6}{5}} \right)^2
\]
is equal to
(1) 4  (2) 8  (3) 2  (4) 16
Official Ans. by NTA (1)

11. If \((1,5,35), (7,5,5), (1,\lambda,7)\) and \((2\lambda,1,2)\) are coplanar, then the sum of all possible values of \( \lambda \) is
(1) \(\frac{39}{5}\)  (2) \(-\frac{39}{5}\)  (3) \(\frac{44}{5}\)  (4) \(-\frac{44}{5}\)
Official Ans. by NTA (3)

12. If \(\sin^{-1} \frac{x}{a} = \cos^{-1} \frac{y}{b} = \tan^{-1} \frac{y}{c} \); \(0 < x < 1\), then the value of \(\cos \left( \frac{\pi c}{a+b} \right)\) is
(1) \(\frac{1-y^2}{y\sqrt{y}}\)  (2) \(1-y^2\)  (3) \(\frac{1-y^2}{1+y^2}\)  (4) \(\frac{1-y^2}{2y}\)
Official Ans. by NTA (3)

13. The number of seven digit integers with sum of the digits equal to 10 and formed by using the digits 1,2 and 3 only is
(1) 42  (2) 82  (3) 77  (4) 35
Official Ans. by NTA (3)

14. Let \( f \) be any function defined on \( R \) and let it satisfy the condition : 
\( |f(x) - f(y)| \leq |(x - y)|^{2}, \forall (x,y) \in R \)
If \( f(0) = 1 \), then:
(1) \( f(x) \) can take any value in \( R \)
(2) \( f(x) < 0, \forall x \in R \)
(3) \( f(x) = 0, \forall x \in R \)
(4) \( f(x) > 0, \forall x \in R \)
Official Ans. by NTA (4)

15. The maximum slope of the curve \( y = \frac{1}{2}x^4 - 5x^3 + 18x^2 - 19x \) occurs at the point
(1) \((2,2)\)  (2) \((0,0)\)
(3) \((2,9)\)  (4) \(\left( \frac{3}{2}, \frac{21}{2} \right)\)
Official Ans. by NTA (1)

16. The intersection of three lines \( x - y = 0, x + 2y = 3 \) and \( 2x + y = 6 \) is a
(1) Right angled triangle  (2) Equilateral triangle  (3) Isosceles triangle  (4) None of the above
Official Ans. by NTA (3)

17. Consider the three planes \( P_1 : 3x + 15y + 21z = 9, P_2 : x - 3y - z = 5, \) and \( P_3 : 2x + 10y + 14z = 5 \)
Then, which one of the following is true ?
(1) \( P_1 \) and \( P_2 \) are parallel  (2) \( P_1 \) and \( P_3 \) are parallel  (3) \( P_2 \) and \( P_3 \) are parallel  (4) \( P_1, P_2 \) and \( P_3 \) all are parallel
Official Ans. by NTA (2)

18. The value of \( \int_{-\pi/2}^{\pi/2} \cos^3 x \frac{dx}{1+3x} \) is
(1) \((a+1)(a+2)\) \((a+2)(a+3)\) \(a+2\) \(1\)
(2) \(-2\)
(3) \((a+1)(a+2)(a+3)\)
(4) \(0\)
Official Ans. by NTA (2)

19. The value of \( \int_{-\pi/2}^{\pi/2} \cos^3 x \frac{dx}{1+3x} \) is
(1) \(\frac{\pi}{4}\)  (2) \(4\pi\)  (3) \(\frac{\pi}{2}\)  (4) \(2\pi\)
Official Ans. by NTA (1)
20. Let \( R = \{(P,Q) \mid P \text{ and } Q \text{ are at the same distance from the origin}\} \) be a relation, then the equivalence class of \((1,-1)\) is the set:

1. \( S = \{(x,y) \mid x^2 + y^2 = 4\} \)
2. \( S = \{(x,y) \mid x^2 + y^2 = 1\} \)
3. \( S = \{(x,y) \mid x^2 + y^2 = \sqrt{2}\} \)
4. \( S = \{(x,y) \mid x^2 + y^2 = 2\} \)

**Official Ans. by NTA (4)**

**SECTION-B**

1. The difference between degree and order of a differential equation that represents the family of curves given by \( y^2 = a \left( x + \frac{\sqrt{a}}{2} \right), a > 0 \) is

**Official Ans. by NTA (2)**

2. The number of integral values of 'k' for which the equation \( 3 \sin x + 4 \cos x = k + 1 \) has a solution, \( k \in \mathbb{R} \) is

**Official Ans. by NTA (11)**

3. The number of solutions of the equation \( \log_2(x - 1) = \log_2(x - 3) \) is

**Official Ans. by NTA (1)**

4. The sum of 162\(^{\text{th}} \) power of the roots of the equation \( x^3 - 2x^2 + 2x - 1 = 0 \) is

**Official Ans. by NTA (3)**

5. Let \( m,n \in \mathbb{N} \) and \( \gcd(2,n) = 1 \). If

\[
30 \binom{30}{0} + 29 \binom{30}{1} + \ldots + 2 \binom{30}{28} + 1 \binom{30}{29} = n \cdot 2^m ,
\]

then \( n + m \) is equal to

**Official Ans. by NTA (45)**

6. If \( y = y(x) \) is the solution of the equation

\[
e^{iny} \cos y \frac{dy}{dx} + e^{-iny} \cos x = \cos x , y(0) = 0 ;
\]

then

\[
1 + y \left(\frac{\pi}{6}\right) + \frac{\sqrt{3}}{2} y \left(\frac{\pi}{3}\right) + \frac{1}{\sqrt{2}} y \left(\frac{\pi}{4}\right)
\]

is equal to

**Official Ans. by NTA (1)**

7. Let \((\lambda, 2, 1)\) be a point on the plane which passes through the point \((4, -2, 2)\). If the plane is perpendicular to the line joining the points \((-2, -21, 29)\) and \((-1, -16, 23)\), then

\[
\left(\frac{\lambda}{11}\right)^2 - \frac{4\lambda}{11} - 4
\]

is equal to

**Official Ans. by NTA (8)**

8. The area bounded by the lines \( y = ||x - 1| - 2| \) is

**Official Ans. by NTA (8)**

**Ans. By ALLEN (BONUS)**

9. The value of the integral \( \int_0^\pi \sin 2x \, dx \) is

**Official Ans. by NTA (2)**

10. If \( \sqrt{3} (\cos^2 x) = (\sqrt{3} - 1) \cos x + 1 \), the number of solutions of the given equation when \( x \in \left[0, \frac{\pi}{2}\right] \) is

**Official Ans. by NTA (1)**