1. If f(x) is a continuous and differentiable function and $f\left(\frac{1}{n}\right)=0\ \forall n \geq 1$ and $n \in I$, then

(a) f(x) = 0, $x \in (0,1]$
(b) f(0) = 0, $f'(0)=0$
(c) $f'(0)=0=f''(0), x \in (0,1]$
(d) f(0) = 0 and $f'(0)$ need not to be zero

2. A variable plane at a distance of 1 unit from the origin cuts the co-ordinate axes at A, B and C. If the centroid D (x, y, z) of triangle ABC satisfies the relation $\frac{1}{x^2}+\frac{1}{y^2}+\frac{1}{z^2}=k$, then the value of k is

(a) 3
(b) 1
(c) 1/3
(d) 9

3. If a, b, c are integers not all equal and ω is a cube root of unity $(\omega \neq 1)$, then the minimum value of $|a + b\omega + c\omega^2|$ is

(a) 0
(b) 1
(c) $\frac{\sqrt{3}}{2}$
(d) $\frac{1}{2}$

4. If P(x) is a polynomial of degree less than or equal to 2 and S is the set of all such polynomials so that P(1) = 1. P(0) = 0 and $P'(x) > 0\ \forall\ x \in [0, 1]$, then

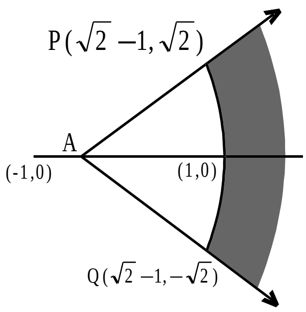
(a) $S = \phi$
(b) $S = \{(1 - a) x^2 + ax \quad 0 < a < 2\}$
(c) $S = \{(1 - a) x^2 + ax \quad a \in (0, \infty)\}$
(d) $S = \{(1 - a) x^2 + ax \quad 0 < a < 1\}$

5. A circle is given by $x^2 + (y - 1)^2 = 1$, another circle C touches it externally and also the x-axis, then the locus of its centre is

(a) $\{(x, y) : x^2 = 4y\} \cup \{(x, y) : y \leq 0\}$
(b) $\{(x, y) : x^2 + (y - 1)^2 = 4\} \cup \{(x, y) : y \leq 0\}$
(c) $\{(x, y) : x^2 = y\} \cup \{(0, y) : y \leq 0\}$
(d) $\{(x, y) : x^2 = 4y\} \cup \{(0, y) : y \leq 0\}$

6. The locus of z which lies in shaded region is best represented by

(a) $z : |z + 1| > 2, |\arg (z + 1)| < \pi/4$
(b) $z : |z - 1| > 2, |\arg (z - 1)| < \pi/4$
(c) $z : |z + 1| < 2, |\arg (z + 1)| < \pi/2$
(d) $z : |z - 1| < 2, |\arg (z - 1)| < \pi/2$



7. $\cos(\alpha-\beta)$ and $\cos(\alpha+\beta)$ = 1/e, where $\alpha, \beta \in [-\pi, \pi]$. Pairs of α, β which satisfy both the equations is/are

(a) 0
(b) 1
(c) 2
(d) 4

8. In ΔABC, a, b, c are the lengths of its sides and A, B, C are the angles of triangle ABC. The correct relation is given by

(a) $(b-c)\sin\left(\frac{B-C}{2}\right)=a\cos\frac{A}{2}$
(b) $(b-c)\cos\frac{A}{2}=a\sin\left(\frac{B-C}{2}\right)$
(c) $(b+c)\sin\left(\frac{B+C}{2}\right)=a\cos\frac{A}{2}$
(d) $(b-c)\cos\left(\frac{A}{2}\right)=2a\sin\left(\frac{B+C}{2}\right)$.

Note: Based on the memory

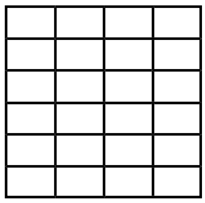
9. If $\int_{\sin x}^{1} t^2 (f(t))dt = (1 - \sin x)$, then $f\left(\frac{1}{\sqrt{3}}\right)$ is

(a) 1/3 (b) $1/\sqrt{3}$ (c) 3 (d) $\sqrt{3}$

10. The value of $\binom{30}{0}\binom{30}{10} - \binom{30}{1}\binom{30}{11} + \binom{30}{2}\binom{30}{12} \ldots\ldots\ldots\ldots + \binom{30}{20}\binom{30}{30}$ is, where $\binom{n}{r} = {}^{n}C_{r}$

(a) $\binom{30}{10}$ (b) $\binom{30}{15}$ (c) $\binom{60}{30}$ (d) $\binom{31}{10}$

11. A rectangle with sides 2m - 1 and 2n - 1 is divided into squares of unit length by drawing parallel lines as shown in the diagram, then the number of rectangles possible with odd side lengths is



(a) $(m + n + 1)^2$ (b) 4^{m+n-1} (c) $m^2 n^2$ (d) $mn(m + 1)(n + 1)$

12. If f(x) is a twice differentiable function and given that f(1) = 1, f(2) = 4, f(3) = 9, then

(a) $f''(x) = 2$, for $\forall x \in (1, 3)$ (b) $f''(x) = f'(x) = 5$ for some $x \in (2, 3)$

(c) $f''(x) = 3$, $\forall\ x \in (2, 3)$ (d) $f''(x) = 2$, for some $x \in (1, 3)$

13. The solution of primitive integral equation $(x^2 + y^2)\, dy = xy\, dx$, is y = y(x). If y(1) = 1 and $y(x_0) = e$, then x_0 is

(a) $\sqrt{2(e^2 - 1)}$ (b) $\sqrt{2(e^2 + 1)}$ (c) $\sqrt{3}e$ (d) $\sqrt{\frac{e^2 + 1}{2}}$

14. $\int_{-2}^{0} \left(x^3 + 3x^2 + 3x + 3 + (x + 1)\cos(x + 1)\right)dx$ is equal to

(a) -4 (b) 0 (c) 4 (d) 6

15. In the quadratic equation $ax^2 + bx + c = 0$, if $\Delta = b^2 - 4ac$ and $\alpha + \beta$, $\alpha^2 + \beta^2$, $\alpha^3 + \beta^3$ are in G.P. where α, β are the roots of $ax^2 + bx + c = 0$, then

(a) $\Delta \neq 0$ (b) $b\Delta = 0$ (c) $c\Delta = 0$ (d) $\Delta = 0$

16. If the functions f(x) and g(x) are defined on $R \to R$ such that

$f(x) = \begin{cases} 0, & x \in \text{rational} \\ x, & x \in \text{irrational} \end{cases}$, $g(x) = \begin{cases} 0, & x \in \text{irrational} \\ x, & x \in \text{rational} \end{cases}$, then $(f - g)(x)$ is

(a) one-one and onto (b) neither one-one nor onto

(c) one-one but not onto (d) onto but not one-one

17. The function given by y = | |x| - 1 | is differentiable for all real numbers except the points

(a) {0, 1, -1} (b) ± 1 (c) 1 (d) -1

18. If y = y(x) and it follows the relation x cos y + y cos x = π, then $y''(0)$

(a) 1 (b) -1 (c) π (d) $-\pi$

19. X and Y are two sets and f : $X \to Y$. If {f(c) = y; $c \subset X$, $y \to Y$ } and

{$f^{-1}(d)$ = x: $d \subset Y$, $x \subset X$}, then the true statement is

(a) $f(f^{-1}(b)) = b$ (b) $f^{-1}(f(a)) = a$ (c) $f(f^{-1}(b)) = b$, $b \subset y$ (d) $f^{-1}(f(a)) = a$, $a \subset x$

Note: Based on the memory

20. $A=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 1\\ 0 & -2 & 4\end{bmatrix}$, $I=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix}$ and $A^{-1}=\left[\frac{1}{6}(A^2+cA+dI)\right]$, then the value of c and d are

(a) -6, -11 (b) 6, 11 (c) -6, 11 (d) 6, -11

21. The area bounded by the parabolas $y = (x + 1)^2$ and $y = (x - 1)^2$ and the line y = 1/4 is

(a) 4 sq. units (b) 1/6 sq. units (c) 4/3 sq. units (d) 1/3 sq. units

22. Tangent to the curve $y = x^2 + 6$ at a point P(1, 7) touches the circle $x^2 + y^2 + 16x + 12y + c = 0$ at a point Q. Then the coordinates of Q are

(a) (-6, -11) (b) (-9, -13) (c) (-10, -15) (d) (-6, -7)

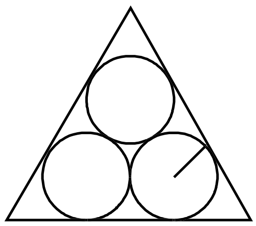
23. If $P=\begin{bmatrix}\frac{\sqrt{3}}{2} & \frac{1}{2}\\ -\frac{1}{2} & \frac{\sqrt{3}}{2}\end{bmatrix}$, $A=\begin{bmatrix}1 & 1\\ 0 & 1\end{bmatrix}$ and $Q=PAP^T$ and $x=P^TQ^{2005}P$, then x is equal to

(a) $\begin{bmatrix}1 & 2005\\ 0 & 1\end{bmatrix}$ (b) $\begin{bmatrix}4+2005\sqrt{3} & 6015\\ 2005 & 4-2005\sqrt{3}\end{bmatrix}$ (c) $\frac{1}{4}\begin{bmatrix}2+\sqrt{3} & 1\\ -1 & 2-\sqrt{3}\end{bmatrix}$ (d) $\frac{1}{4}\begin{bmatrix}2005 & 2-\sqrt{3}\\ 2+\sqrt{3} & 2005\end{bmatrix}$

24. For the primitive integral equation $ydx + y^2dy = x\,dy$; $x\in R,\ y>0,\ y=y(x), y(1)=1$, then $y(-3)$ is

(a) 3 (b) 2 (c) 1 (d) 5

25. In an equilateral triangle, 3 coins of radii 1 unit each are kept so that they touch each other and also the sides of the triangle. Area of the triangle is



(a) $4+2\sqrt{3}$ (b) $6+4\sqrt{3}$ (c) $12+\frac{7\sqrt{3}}{4}$ (d) $3+\frac{7\sqrt{3}}{4}$

26. The minimum area of triangle formed by the tangent to the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ and coordinate axes is

(a) ab sq. units (b) $\frac{a^2+b^2}{2}$ sq.units (c) $\frac{(a+b)^2}{2}$ sq.units (d) $\frac{a^2+ab+b^2}{3}$ sq.units

27. If $\vec{a},\vec{b},\vec{c}$ are three non-zero, non-coplanar vectors are $\vec{b}_1=\vec{b}-\frac{\vec{b}.\vec{a}}{|\vec{a}|^2}\vec{a}$, $\vec{b}_2=\vec{b}+\frac{\vec{b}.\vec{a}}{|\vec{a}|^2}\vec{a}$,

$\vec{c}_1=\vec{c}-\frac{\vec{c}.\vec{a}}{|\vec{a}|^2}\vec{a}+\frac{\vec{b}.\vec{c}}{|\vec{c}|^2}\vec{b}_1$, $\vec{c}_2=\vec{c}-\frac{\vec{c}.\vec{a}}{|\vec{a}|^2}\vec{a}-\frac{\vec{b}_1.\vec{c}}{|\vec{b}_1|^2}\vec{b}_1$, $\vec{c}_3=\vec{c}-\frac{\vec{c}.\vec{a}}{|\vec{c}|^2}\vec{a}+\frac{\vec{b}.\vec{c}}{|\vec{c}|^2}\vec{b}_1$, $\vec{c}_4=\vec{c}-\frac{\vec{c}.\vec{a}}{|\vec{c}|^2}\vec{a}-\frac{\vec{b}.\vec{c}}{|\vec{b}|^2}\vec{b}_1$, then the set of orthogonal vector is

(a) $(\vec{a},\vec{b}_1,\vec{c}_3)$ (b) $(\vec{a},\vec{b}_1,\vec{c}_2)$ (c) $(\vec{a},\vec{b}_1,\vec{c}_1)$ (d) $(\vec{a},\vec{b}_2,\vec{c}_2)$

28. A six faced fair dice is thrown until 1 comes, then the probability that 1 comes in even no.of trials is

(a) 5/11 (b) 5/6 (c) 6/11 (d) 1/6