1. A variable line $\frac{x}{a} + \frac{y}{b} = 1$ is such that $a + b = 4$. The locus of the midpoint of the portion of the line intercepted between the axes is

   1) $x + y = 4$ 2) $x + y = 8$

   3) $x + y = 1$ 4) $x + y = 2$

2. The point $(5, -7)$ lies outside the circle

   1) $x^2 + y^2 - 8x = 0$ 2) $x^2 + y^2 - 5x + 7y = 0$

   3) $x^2 + y^2 - 5x + 7y - 1 = 0$ 4) $x^2 + y^2 - 8x + 7y - 2 = 0$

3. If the circles $x^2 + y^2 = 9$ and $x^2 + y^2 + 2\alpha x + 2y + 1 = 0$ touch each other internally, then $\alpha =$

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

   3) $\frac{4}{3}$ 4) $\frac{-4}{3}$

4. The locus of the midpoints of the line joining the focus and any point on the parabola $y^2 = 4ax$ is a parabola with the equation of directrix as

   1) $x + a = 0$ 2) $2x + a = 0$

   3) $x = 0$ 4) $x = \frac{a}{2}$

5. The tangents drawn at the extremeties of a focal chord of the parabola $y^2 = 16x$

   1) intersect on $x = 0$ 2) intersect on the line $x + 4 = 0$

   3) intersect at an angle of 60^0 4) intersect at an angle of 45^0

(Space for Rough Work)

6. On the set Z, of all integers $*$ is defined by $a*b=a+b-5$. If $2*(x*3)=5$ then $x=$

1) 0
2) 3
3) 5
4) 10

7. Which of the following is false ?

1) Addition is commutative in N.
2) Multiplication is associative in N.
3) If $a*b=a^b$ for all $a,b\in N$ then $*$ is commutative in N.
4) Addition is associative in N.

8. If $\vec{a}\cdot\hat{i}=\vec{a}\cdot(\hat{i}+\hat{j})=\vec{a}\cdot(\hat{i}+\hat{j}+\hat{k})=1$ then $\vec{a}=$

1) $\hat{i}+\hat{j}$
2) $\hat{i}-\hat{k}$
3) $\hat{i}$
4) $\hat{i}+\hat{j}-\hat{k}$

9. If $\vec{a}$ and $\vec{b}$ are unit vectors and $|\vec{a}+\vec{b}|=1$ then $|\vec{a}-\vec{b}|$ is equal to

1) $\sqrt{2}$
2) 1
3) $\sqrt{5}$
4) $\sqrt{3}$

10. The projection of $\vec{a}=3\hat{i}-\hat{j}+5\hat{k}$ on $\vec{b}=2\hat{i}+3\hat{j}+\hat{k}$ is

1) $\frac{8}{\sqrt{35}}$
2) $\frac{8}{\sqrt{39}}$
3) $\frac{8}{\sqrt{14}}$
4) $\sqrt{14}$

(Space for Rough Work)

11. If $f: R \rightarrow R$ is defined by $f(x)=x^3$ then $f^{-1}(8)=$

1) $\{2\}$
2) $\{2, 2w, 2w^2\}$
3) $\{2, -2\}$
4) $\{2, 2\}$

12. R is a relation on N given by $R=\{(x, y) \mid 4x+3y=20\}$. Which of the following belongs to R ?

1) $(-4, 12)$
2) $(5, 0)$
3) $(3, 4)$
4) $(2, 4)$

13. If $Log_{10}7=0.8451$ then the position of the first significant figure of 7^{-20} is

1) 16
2) 17
3) 20
4) 15

14. $\frac{1}{2.5}+\frac{1}{5.8}+\frac{1}{8.11}+\ldots\ldots$ upto n terms =

1) $\frac{n}{4n+6}$
2) $\frac{1}{6n+4}$
3) $\frac{n}{6n+4}$
4) $\frac{n}{3n+7}$

15. The ten's digit in $1!+4!+7!+10!+12!+13!+15!+16!+17!$ is divisible by

1) 4
2) 3!
3) 5
4) 7

(Space for Rough Work)

16. The equation $\frac{x^2}{2-\lambda}-\frac{y^2}{\lambda-5}-1=0$ represents an ellipse if

1) $\lambda>5$
2) $\lambda<2$
3) $2<\lambda<5$
4) $2>\lambda>5$

17. The equation to the normal to the hyperbola $\frac{x^2}{16}-\frac{y^2}{9}=1$ at $(-4, 0)$ is

1) $2x-3y=1$
2) $x=0$
3) $x=1$
4) $y=0$

18. The converse of the contrapositive of the conditional $p \to \sim q$ is

1) $p \to q$
2) $\sim p \to \sim q$
3) $\sim q \to p$
4) $\sim p \to q$

19. The perimeter of a certain sector of a circle is equal to the length of the arc of the semicircle. Then the angle at the centre of the sector in radians is

1) $\pi-2$
2) $\pi+2$
3) $\frac{\pi}{3}$
4) $\frac{2\pi}{3}$

20. The value of $Tan\ 67\frac{1}{2}^0 + Cot\ 67\frac{1}{2}^0$ is

1) $\sqrt{2}$
2) $3\sqrt{2}$
3) $2\sqrt{2}$
4) $2-\sqrt{2}$

(Space for Rough Work)

21. If e_1 and e_2 are the eccentricities of a hyperbola $3x^2 - 3y^2 = 25$ and its conjugate, then

1) $e_1^2 + e_2^2 = 2$
2) $e_1^2 + e_2^2 = 4$
3) $e_1 + e_2 = 4$
4) $e_1 + e_2 = \sqrt{2}$

22. If p and q are prime numbers satisfying the condition $p^2 - 2q^2 = 1$, then the value of $p^2 + 2q^2$ is

1) 5
2) 15
3) 16
4) 17

23. If $A(adj\ A) = 5I$ where I is the identity matrix of order 3, then $|adj\ A|$ is equal to

1) 125
2) 25
3) 5
4) 10

24. The number of solutions for the equation $Sin\ 2x + Cos\ 4x = 2$ is

1) 0
2) 1
3) 2
4) Infinite

25. $\int e^x \cdot x^5\, dx$ is

1) $e^x\left[x^5 + 5x^4 + 20x^3 + 60x^2 + 120x + 120\right] + C$
2) $e^x\left[x^5 - 5x^4 - 20x^3 - 60x^2 - 120x - 120\right] + C$
3) $e^x\left[x^5 - 5x^4 + 20x^3 - 60x^2 + 120x - 120\right] + C$
4) $e^x\left[x^5 + 5x^4 + 20x^3 - 60x^2 - 120x + 120\right] + C$

(Space for Rough Work)

26. If $f(x)$ is an even function and $f'(x)$ exists, then $f'(e)+f'(-e)$ is

1) >0
2) 0
3) ≥ 0
4) <0

27. If α is a complex number satisfying the equation $\alpha^2+\alpha+1=0$ then α^{31} is equal to

1) α
2) α^2
3) 1
4) i

28. The derivative of $Sin\left(x^3\right)$ w.r.t. $Cos\left(x^3\right)$ is

1) $-Tan\left(x^3\right)$
2) $Tan\left(x^3\right)$
3) $-Cot\left(x^3\right)$
4) $Cot\left(x^3\right)$

29. A unit vector perpendicular to both the vectors $\hat{i}+\hat{j}$ and $\hat{j}+\hat{k}$ is

1) $\dfrac{-\hat{i}-\hat{j}+\hat{k}}{\sqrt{3}}$
2) $\dfrac{\hat{i}+\hat{j}-\hat{k}}{3}$
3) $\dfrac{\hat{i}+\hat{j}+\hat{k}}{\sqrt{3}}$
4) $\dfrac{\hat{i}-\hat{j}+\hat{k}}{\sqrt{3}}$

30. If $A=\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$ and $B=\begin{vmatrix} c_1 & c_2 & c_3 \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$ then

1) $A=-B$
2) $A=B$
3) $B=0$
4) $B=A^2$

(Space for Rough Work)

31. The locus of a point which moves such that the sum of its distances from two fixed points is a constant is

1) a circle
2) a parabola
3) an ellipse
4) a hyperbola

32. The centroid of the triangle ABC where $A \equiv (2, 3)$, $B \equiv (8, 10)$ and $C \equiv (5, 5)$ is

1) $(5, 6)$
2) $(6, 5)$
3) $(6, 6)$
4) $(15, 18)$

33. If $3x^2 + xy - y^2 - 3x + 6y + K = 0$ represents a pair of lines, then $K =$

1) 0
2) 9
3) 1
4) -9

34. The equation of the smallest circle passing through the points $(2, 2)$ and $(3, 3)$ is

1) $x^2 + y^2 + 5x + 5y + 12 = 0$
2) $x^2 + y^2 - 5x - 5y + 12 = 0$
3) $x^2 + y^2 + 5x - 5y + 12 = 0$
4) $x^2 + y^2 - 5x + 5y - 12 = 0$

35. The characteristic roots of the matrix $\begin{bmatrix} 1 & 0 & 0 \\ 2 & 3 & 0 \\ 4 & 5 & 6 \end{bmatrix}$ are

1) 1, 3, 6
2) 1, 2, 4
3) 4, 5, 6
4) 2, 4, 6

(Space for Rough Work)

36. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, then $A^{-1} =$

1) $\frac{-1}{2}\begin{bmatrix} 4 & -2 \\ -3 & 1 \end{bmatrix}$
2) $\frac{1}{2}\begin{bmatrix} 4 & -2 \\ -3 & 1 \end{bmatrix}$
3) $\begin{bmatrix} -2 & 4 \\ 1 & 3 \end{bmatrix}$
4) $\begin{bmatrix} 2 & 4 \\ 1 & 3 \end{bmatrix}$

37. The set $\{-1, 0, 1\}$ is not a multiplicative group because of the failure of

1) Closure law
2) Associative law
3) Identity law
4) Inverse law

38 The angle of elevation of the top of a TV tower from three points A, B and C in a straight line through the foot of the tower are α, 2α and 3α respectively. If $AB = a$, the height of the tower is

1) $a \, Tan \, \alpha$
2) $a \, Sin \, \alpha$
3) $a \, Sin \, 2\alpha$
4) $a \, Sin \, 3\alpha$

39. The angles A, B and C of a triangle ABC are in A.P. If $b : c = \sqrt{3} : \sqrt{2}$, then the angle A is

1) 30^0
2) 15^0
3) 75^0
4) 45^0

40. $Sin\left(2Sin^{-1}\sqrt{\frac{63}{65}}\right) =$

1) $\frac{2\sqrt{126}}{65}$
2) $\frac{4\sqrt{65}}{65}$
3) $\frac{8\sqrt{63}}{65}$
4) $\frac{\sqrt{63}}{65}$

(Space for Rough Work)

41. The general solution of $|Sin\, x| = Cos\, x$ is (when $n \in Z$) given by

1) $n\pi + \frac{\pi}{4}$
2) $2n\pi \pm \frac{\pi}{4}$
3) $n\pi \pm \frac{\pi}{4}$
4) $n\pi - \frac{\pi}{4}$

42. The real root of the equation $x^3 - 6x + 9 = 0$ is

1) -6
2) -9
3) 6
4) -3

43. The digit in the unit's place of 5^{834} is

1) 0
2) 1
3) 3
4) 5

44. The remainder when $3^{100} \times 2^{50}$ is divided by 5 is

1) 1
2) 2
3) 3
4) 4

45. $\int \frac{Sin\, x\, Cos\, x}{\sqrt{1 - Sin^4 x}}\, dx =$

1) $\frac{1}{2} Sin^{-1}\left(Sin^2 x\right) + C$
2) $\frac{1}{2} Cos^{-1}\left(Sin^2 x\right) + C$
3) $Tan^{-1}\left(Sin^2 x\right) + C$
4) $Tan^{-1}(2\, Sin\, x) + C$

(Space for Rough Work)

46. The value of $\int_{-2}^{2}\left(ax^3+bx+c\right)dx$ depends on the

1) value of b
2) value of c
3) value of a
4) values of a and b

47. The area of the region bounded by $y=2x-x^2$ and the x-axis is

1) $\frac{8}{3}$ sq. units
2) $\frac{4}{3}$ sq. units
3) $\frac{7}{3}$ sq. units
4) $\frac{2}{3}$ sq. units

48. The differential equation $y\frac{dy}{dx}+x=c$ represents

1) a family of hyperbolas
2) a family of circles whose centres are on the y-axis
3) a family of parabolas
4) a family of circles whose centres are on the x-axis

49. If $f\left(x^5\right)=5x^3$, then $f'(x)=$

1) $\frac{3}{\sqrt[5]{x^2}}$
2) $\frac{3}{\sqrt[5]{x}}$
3) $\frac{3}{x}$
4) $\sqrt[5]{x}$

50. $f(x)=2a-x$ in $-a<x<a$
$=3x-2a$ in $a\le x$.

Then which of the following is true?

1) $f(x)$ is discontinuous at $x=a$
2) $f(x)$ is not differentiable at x
3) $f(x)$ is differentiable at all $x\ge a$
4) $f(x)$ is continuous at all $x<a$

(Space for Rough Work)

51. The maximum area of a rectangle that can be inscribed in a circle of radius 2 units is (in square units)

1) 4 2) 8π

3) 8 4) 5

52. If Z is a complex number such that $Z = -\overline{Z}$, then

1) Z is purely real
2) Z is purely imaginary
3) Z is any complex number
4) Real part of Z is the same as its imaginary part

53. The value of $\sum_{K=1}^{6}\left[Sin\frac{2K\Pi}{7} - i\,Cos\frac{2K\Pi}{7}\right]$ is

1) i 2) 0

3) $-i$ 4) -1

54. $\underset{x \to \infty}{Lt}\; x\,Sin\left(\frac{2}{x}\right)$ is equal to

1) ∞ 2) 0

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

55. A stone is thrown vertically upwards and the height x ft. reached by the stone in t seconds is given by $x = 80t - 16t^2$. The stone reaches the maximum height in

1) 2 seconds 2) 2.5 seconds

3) 3 seconds 4) 1.5 seconds

(Space for Rough Work)

56. The maximum value of $\frac{Log\ x}{x}$ in $(2, \infty)$ is

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

57. If $f(x) = be^{ax} + ae^{bx}$, then $f''(0) =$

1) 0
2) $2ab$
3) $ab(a+b)$
4) ab

58. If $\sqrt{\frac{1+Cos\ A}{1-Cos\ A}} = \frac{x}{y}$, then the value of $Tan\ A =$

1) $\frac{x^2+y^2}{x^2-y^2}$
2) $\frac{2xy}{x^2+y^2}$
3) $\frac{2xy}{x^2-y^2}$
4) $\frac{2xy}{y^2-x^2}$

59. $\int \frac{Sec\ x}{Sec\ x + Tan\ x} dx =$

1) $Tan\ x - Sec\ x + C$
2) $Log\ (1 + Sin\ x) + C$
3) $Sec\ x + Tan\ x + C$
4) $Log\ Sin\ x + Log\ Cos\ x + C$

60. If $\int f(x)\,dx = g(x)$, then $\int f(x)\,g(x)\,dx =$

1) $\frac{1}{2} f^2(x)$
2) $\frac{1}{2} g^2(x)$
3) $\frac{1}{2}[g'(x)]^2$
4) $f'(x)\ g(x)$

(Space for Rough Work)