SUBJECT	TIME
MATHEMATICS	02.30 P.M. TO 03.50 P.M.

MAXIMUM MARKS	TOTAL DURATION	MAXIMUM TIME FOR ANSWERING
60	80 MINUTES	70 MINUTES

MENTION YOUR CET NUMBER					QUESTION BOOKLET DETAILS	
					VERSION CODE	SERIAL NUMBER
					A - 1	203889

DO's :

1. Check whether the CET No. has been entered and shaded in the respective circles on the OMR answer sheet.
2. This Question Booklet is issued to you by the invigilator after the 2nd Bell i.e., after 02.30 p.m.
3. The Serial Number of this question booklet should be entered on the OMR answer sheet.
4. The Version Code of this question booklet should be entered on the OMR answer sheet and the respective circles should also be shaded completely.
5. Compulsorily sign at the bottom portion of the OMR answer sheet in the space provided.

DON'TS :

1. **THE TIMING MARKS PRINTED ON THE OMR ANSWER SHEET SHOULD NOT BE DAMAGED / MUTILATED / SPOILED.**
2. Until the 3rd Bell is rung at 02.40 p.m.:
   - Do not remove the seal / staple present on the right hand side of this question booklet.
   - Do not look inside this question booklet.
   - Do not start answering on the OMR answer sheet.

INSTRUCTIONS TO CANDIDATES

1. This question booklet contains 60 questions and each question will have four different options / choices.
2. After the 3rd Bell is rung at 02.40 p.m., remove the seal / staple present on the right hand side of this question booklet and start answering on the OMR answer sheet.
3. During the subsequent 70 minutes:
   - Read each question carefully.
   - Choose the correct answer from out of the four available options / choices given under each question.
   - **Completely darken / shade the relevant circle with a BLUE OR BLACK INK BALL POINT PEN against the question number on the OMR answer sheet.**

CORRECT METHOD OF SHADING THE CIRCLE ON THE OMR SHEET IS SHOWN BELOW :

① ② ● ④

4. Please note that even a minute unintended ink dot on the OMR sheet will also be recognised and recorded by the scanner. Therefore, avoid multiple markings of any kind on the OMR answer sheet.
5. Use the space provided on each page of the question booklet for Rough work AND do not use the OMR answer sheet for the same.
6. After the last bell is rung at 03.50 p.m., stop writing on the OMR answer sheet and affix your LEFT HAND THUMB IMPRESSION on the OMR answer sheet as per the instructions.
7. Hand over the OMR ANSWER SHEET to the room invigilator as it is.
8. After separating and retaining the top sheet (KEA Copy), the invigilator will return the bottom sheet replica (Candidate's copy) to you to carry home for self-evaluation.
9. Preserve the replica of the OMR answer sheet for a minimum period of One year.

M

SEAL

1. If ax + by = 1, where a, b, x and y are integers, then which one of the following is not true ?

(1) (a, b) = 1
(2) (a, y) = 1
(3) (x, y) = 1
(4) (b, y) = 1

2. The digit in the unit place of the number $\underline{|2009} + 3^{7886}$ is

(1) 9
(2) 7
(3) 3
(4) 1

3. If $\begin{vmatrix} x+1 & x+2 & x+a \\ x+2 & x+3 & x+b \\ x+3 & x+4 & x+c \end{vmatrix} = 0$, then a, b, c are

(1) in A.P.
(2) in G.P.
(3) in H.P.
(4) equal

4. The value of $\begin{vmatrix} 1 & \log_x y & \log_x z \\ \log_y x & 1 & \log_y z \\ \log_z x & \log_z y & 1 \end{vmatrix} =$

(1) log xyz
(2) 0
(3) 1
(4) xyz

Space For Rough Work

5. If $A = \begin{bmatrix} 2 & 1 & 0 \\ 0 & 2 & 1 \\ 1 & 0 & 2 \end{bmatrix}$ then $|\text{adj } A| =$

(1) 81 (2) 0

(3) 9 (4) $\frac{1}{9}$

6. If A and B are square matrices of the same order such that $(A + B)(A - B) = A^2 - B^2$, then $(ABA^{-1})^2 =$

(1) A^2 (2) B^2

(3) I (4) A^2B^2

7. If $\vec{a} \cdot \vec{b} = -|\vec{a}|\,|\vec{b}|$, then the angle between $\vec{a}$ and $\vec{b}$ is

(1) 60° (2) 45°

(3) 180° (4) 90°

8. If $\vec{a} + 2\vec{b} + 3\vec{c} = \vec{O}$, then $\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a} =$

(1) $6\left(\vec{b} \times \vec{c}\right)$ (2) $2\left(\vec{b} \times \vec{c}\right)$

(3) $3\left(\vec{c} \times \vec{a}\right)$ (4) $\vec{O}$

Space For Rough Work

9. If the volume of the parallelopiped with $\vec{a}$, $\vec{b}$ and $\vec{c}$ as coterminous edges is 40 cubic units, then the volume of the parallelopiped having $\vec{b} + \vec{c}$, $\vec{c} + \vec{a}$ and $\vec{a} + \vec{b}$ as coterminous edges in cubic units is

(1) 40 (2) 80

(3) 120 (4) 160

10. In the group G = {0, 1, 2, 3, 4, 5} under addition modulo 6, $(2 \oplus_6 3^{-1} \oplus_6 4)^{-1} =$

(1) 0 (2) 2

(3) 3 (4) 5

11. Which one of the following is not true ?

(1) Identity element in a group is unique.

(2) Inverse of an element in a group is unique.

(3) Fourth roots of unity form an additive abelian group.

(4) Cancellation laws hold in a group.

12. The number of subgroups of the group $(Z_5, \oplus_5)$ is

(1) 2 (2) 1

(3) 3 (4) 4

13. The negation of $p \wedge (1 \rightarrow \sim r)$ is

(1) $\sim p \vee (q \wedge r)$ (2) $\sim p \wedge (q \wedge r)$

(3) $p \vee (q \vee r)$ (4) $p \vee (q \wedge r)$

Space For Rough Work

14. If $n = \lfloor 2020$, then

$$\frac{1}{\log_2 n} + \frac{1}{\log_3 n} + \frac{1}{\log_4 n} + \ldots + \frac{1}{\log_{2020} n} =$$

(1) 0 (2) 2020

(3) 1 (4) $\lfloor 2020$

15. If 'n' is a positive integer, then $n^3 + 2n$ is divisible by

(1) 3 (2) 2

(3) 6 (4) 15

16. On the set of integers Z, define $f : Z \to Z$ as $f(n) = \begin{cases} \frac{n}{2}, & n \text{ is even} \\ 0, & n \text{ is odd} \end{cases}$ then 'f' is

(1) bijective (2) injective but not surjective

(3) neither injective nor surjective (4) surjective but not injective

17. If α and β are the roots of $x^2 + x + 1 = 0$, then $\alpha^{16} + \beta^{16} =$

(1) 0 (2) 1

(3) -1 (4) 2

18. The total number of terms in the expansion of $(x + y)^{100} + (x - y)^{100}$ after simplification is

(1) 50 (2) 51

(3) 202 (4) 100

Space For Rough Work

19. $\cot^{-1}(2 \cdot 1^2) + \cot^{-1}(2 \cdot 2^2) + \cot^{-1}(2 \cdot 3^2) + \ldots$ up to $\infty =$

(1) $\frac{\pi}{5}$ (2) $\frac{\pi}{4}$

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

20. If 'x' takes negative permissible value, then $\sin^{-1} x$ is equal to

(1) $\cos^{-1}\sqrt{1-x^2}$ (2) $-\cos^{-1}\sqrt{1-x^2}$

(3) $\cos^{-1}\sqrt{x^2-1}$ (4) $\pi - \cos^{-1}\sqrt{1-x^2}$

21. If $1 + \sin x + \sin^2 x + \ldots$ up to $\infty = 4 + 2\sqrt{3}$, $0 < x < \pi$ and $x \neq \frac{\pi}{2}$, then $x =$

(1) $\frac{\pi}{6}, \frac{\pi}{3}$ (2) $\frac{\pi}{3}, \frac{5\pi}{6}$

(3) $\frac{2\pi}{3}, \frac{\pi}{6}$ (4) $\frac{\pi}{3}, \frac{2\pi}{3}$

22. The complex number $\frac{1+2i}{1-i}$ lies in

(1) first quadrant (2) second quadrant

(3) third quadrant (4) fourth quadrant

23. If P is the point in the Argand diagram corresponding to the complex number $\sqrt{3} + i$ and if OPQ is an isosceles right angled triangle, right angled at 'O', then Q represents the complex number

(1) $-1 \pm i\sqrt{3}$ (2) $-1 + i\sqrt{3}$ or $1 - i\sqrt{3}$

(3) $1 \pm i\sqrt{3}$ (4) $\sqrt{3} - i$ or $1 - i\sqrt{3}$

Space For Rough Work

24. The smallest positive integral value of 'n' such that $\left[\dfrac{1+\sin\frac{\pi}{8}+i\cos\frac{\pi}{8}}{1+\sin\frac{\pi}{8}-i\cos\frac{\pi}{8}}\right]^n$ is purely imaginary is, n =

(1) 8 (2) 4

(3) 3 (4) 2

25. Which one of the following is possible ?

(1) $\cos\theta = \frac{7}{3}$ (2) $\sin\theta = \frac{a^2+b^2}{a^2-b^2}, (a \neq b)$

(3) $\sec\theta = \frac{4}{5}$ (4) $\tan\theta = 45$

26. If one side of a triangle is double the other and the angles opposite to these sides differ by 60°, then the triangle is

(1) right angled (2) obtuse angled

(3) acute angled (4) isosceles

27. $3(\sin x - \cos x)^4 + 6(\sin x + \cos x)^2 + 4(\sin^6 x + \cos^6 x) =$

(1) 11 (2) 12

(3) 13 (4) 14

Space For Rough Work

28. A cow is tied to a post by a rope. The cow moves along the circular path always keeping the rope tight. If it describes 44 metres, when it has traced out 72° at the centre, the length of the rope is

(1) 35 metres (2) 22 metres

(3) 56 metres (4) 45 metres

29. If $\begin{vmatrix} 1+\sin^2\theta & \cos^2\theta & 4\sin 2\theta \\ \sin^2\theta & 1+\cos^2\theta & 4\sin 2\theta \\ \sin^2\theta & \cos^2\theta & 4\sin 2\theta - 1 \end{vmatrix} = 0$ and $0 < \theta < \frac{\pi}{2}$, then $\cos 4\theta =$

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

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

30. The locus of the mid points of the chords of the circle $x^2 + y^2 = 4$ which subtend a right angle at the origin is

(1) $x + y = 2$ (2) $x^2 + y^2 = 1$

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

31. The length of the chord joining the points $(4\cos\theta, 4\sin\theta)$ and $(4\cos(\theta + 60°), 4\sin(\theta + 60°))$ of the circle $x^2 + y^2 = 16$ is

(1) 2 (2) 4

(3) 8 (4) 16

Space For Rough Work

32. The number of common tangents to the circles $x^2 + y^2 - y = 0$ and $x^2 + y^2 + y = 0$ is

(1) 1 (2) 2

(3) 3 (4) 0

33. The co-ordinates of the centre of the smallest circle passing through the origin and having $y = x + 1$ as a diameter are

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

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

34. The length of the diameter of the circle which cuts three circles

$x^2 + y^2 - x - y - 14 = 0$;

$x^2 + y^2 + 3x - 5y - 10 = 0$;

$x^2 + y^2 - 2x + 3y - 27 = 0$

orthogonally, is

(1) 2 (2) 8

(3) 6 (4) 4

35. For the parabola $y^2 = 4x$, the point P whose focal distance is 17, is

(1) (16, 8) or (16, –8) (2) (8, 8) or (8, –8)

(3) (4, 8) or (4, –8) (4) (2, 8) or (2, –8)

Space For Rough Work

36. The angle between the tangents drawn to the parabola $y^2 = 12x$ from the point $(-3, 2)$ is

(1) 45° (2) 90°

(3) 60° (4) 30°

37. The number of values of 'c' such that the line $y = 4x + c$ touches the curve $\frac{x^2}{4} + y^2 = 1$ is

(1) 0 (2) 1

(3) 2 (4) infinite

38. If the circle $x^2 + y^2 = a^2$ intersects the hyperbola $xy = c^2$ in four points $P(x_1, y_1)$, $Q(x_2, y_2)$, $R(x_3, y_3)$ and $S(x_4, y_4)$, then

(1) $x_1 + x_2 + x_3 + x_4 = 0$ (2) $y_1 + y_2 + y_3 + y_4 = 2$

(3) $x_1 x_2 x_3 x_4 = 2c^4$ (4) $y_1 y_2 y_3 y_4 = 2c^4$

39. The foot of the perpendicular from the point (2, 4) upon $x + y = 4$ is

(1) (3, –1) (2) (2, 2)

(3) (4, 0) (4) (1, 3)

40. The vertices of a triangle are (6, 0), (0, 6) and (6, 6). The distance between its circumcentre and centroid is

(1) $2\sqrt{2}$ (2) 2

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

Space For Rough Work

41. The angle between the pair of lines

$$x^2 + 2xy - y^2 = 0$$

is

(1) $\frac{\pi}{3}$ (2) $\frac{\pi}{6}$

(3) $\frac{\pi}{2}$ (4) 0

42. $\lim\limits_{n \to \infty} \frac{3 \cdot 2^{n+1} - 4 \cdot 5^{n+1}}{5 \cdot 2^n + 7 \cdot 5^n} =$

(1) 0 (2) $\frac{3}{5}$

(3) $\frac{-4}{7}$ (4) $\frac{-20}{7}$

43. The function

$$f(x) = \frac{\log(1 + ax) - \log(1 - bx)}{x}$$

is not defined at $x = 0$. The value which should be assigned to 'f' at $x = 0$ so that it is continuous at $x = 0$ is

(1) 0 (2) a – b

(3) a + b (4) log a + log b

44. If $f(x) = 1 + nx + \frac{n(n-1)}{2}x^2 + \frac{n(n-1)(n-2)}{6}x^3 + ... + x^n$, then $f''(1) =$

(1) $n(n-1)2^n$ (2) $n(n-1)2^{n-1}$

(3) $(n-1)2^{n-1}$ (4) $n(n-1)2^{n-2}$

Space For Rough Work

45. If $f(x) = \log_x 2 (\log_e x)$, then $f'(x)$ at $x = e$ is

(1) 0 (2) 1

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

46. If $y = \sin^n x \cos nx$, then $\frac{dy}{dx}$ is

(1) $n \sin^{n-1} x \cos (n + 1) x$ (2) $n \sin^{n-1} x \sin(n + 1) x$

(3) $n \sin^{n-1} x \cos(n - 1) x$ (4) $n \sin^{n-1} x \cos nx$

47. If $f(x) = \frac{g(x) + g(-x)}{2} + \frac{2}{[h(x) + h(-x)]^{-1}}$ where g and h are differentiable functions, then $f'(0)$

(1) 0 (2) 1

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

48. The tangent to a given curve $y = f(x)$ is perpendicular to the x-axis if

(1) $\frac{dy}{dx} = 0$ (2) $\frac{dy}{dx} = 1$

(3) $\frac{dx}{dy} = 0$ (4) $\frac{dx}{dy} = 1$

Space For Rough Work

49. The minimum value of $27^{\cos 2x}\ 81^{\sin 2x}$ is

(1) $\frac{1}{27}$ (2) -5

(3) $\frac{1}{5}$ (4) $\frac{1}{243}$

50. A stone is thrown vertically upwards from the top of a tower 64 metres high according to the law $s = 48t - 16t^2$. The greatest height attained by the stone above the ground is

(1) 64 metre (2) 36 metre

(3) 32 metre (4) 100 metre

51. The length of the subtangent at 't'on the curve $x = a(t + \sin t)$, $y = a(1 - \cos t)$ is

(1) $2a \sin^3\left(\frac{t}{2}\right) \sec\left(\frac{t}{2}\right)$ (2) $a \sin t$

(3) $2a \sin\left(\frac{t}{2}\right) \tan\left(\frac{t}{2}\right)$ (4) $2a \sin\frac{t}{2}$

52. $\int e^{\tan^{-1}x}\left(1 + \frac{x}{1 + x^2}\right) dx$ is equal to

(1) $\frac{1}{2} x\, e^{\tan^{-1}x} + c$ (2) $x\, e^{\tan^{-1}x} + c$

(3) $e^{\tan^{-1}x} + c$ (4) $\frac{1}{2} e^{\tan^{-1}x} + c$

Space For Rough Work

53. $\int \text{cosec}\,(x - \text{a})\,\text{cosec}\,x\,\mathrm{d}x =$

(1) $\dfrac{1}{\sin \text{a}} \log\,[\sin\,(x - \text{a})\,\sin x] + \text{C}$

(2) $\dfrac{-1}{\sin \text{a}} \log\,\left|\sin x\,\text{cosec}\,(x - \text{a})\right| + \text{C}$

(3) $\dfrac{-1}{\sin \text{a}} \log\,[\sin\,(x - \text{a})\,\sin x] + \text{C}$

(4) $\dfrac{1}{\sin \text{a}} \log\,[\sin\,(x - \text{a})\,\text{cosec}\,x] + \text{C}$

54. If $f(x) = \int_{-1}^{x} |\mathrm{t}|\,\mathrm{dt}$, then for any $x \geq 0$, $f(x) =$

(1) $\frac{1}{2}(1 - x^2)$

(2) $1 - x^2$

(3) $\frac{1}{2}(1 + x^2)$

(4) $1 + x^2$

55. $\int_{1}^{3} \dfrac{\sqrt{4-x}}{\sqrt{x} + \sqrt{4-x}}\,\mathrm{d}x =$

(1) 0

(2) 1

(3) 3

(4) 2

56. The area bounded between the parabola $\mathrm{y}^2 = 4x$ and the line $\mathrm{y} = 2x - 4$ is equal to

(1) 15 sq. units

(2) $\frac{17}{3}$ sq. units

(3) $\frac{19}{3}$ sq. units

(4) 9 sq. units

Space For Rough Work

57. The differential equation of the family of circles passing through the orign and having their centres on the x-axis is

(1) $x^2 = y^2 + 3xy\frac{dy}{dx}$ (2) $y^2 = x^2 + 2xy\frac{dy}{dx}$

(3) $y^2 = x^2 - 2xy\frac{dy}{dx}$ (4) $x^2 = y^2 + xy\frac{dy}{dx}$

58. A population grows at the rate of 10% of the population per year. How long does it take for the population to double ?

(1) 2 log 10 years (2) 20 log 2 years

(3) 10 log 2 years (4) 5 log 2 years

59. On the set of all natural numbers N, which one of the following $*$ is a binary operation ?

(1) $a * b = 3a - 4b$ (2) $a * b = \sqrt{ab}$

(3) $a * b = \frac{a-b}{a+b}$ (4) $a * b = a + 3b$

60. If $\int_0^1 f(x)\,dx = 5$, then the value of $\ldots.. + 100\int_0^1 x^9 f(x^{10})\,dx$ is equal to

(1) 55 (2) 125

(3) 625 (4) 275

Space For Rough Work