CET (UG)-2016

Sr. No. : 150228

Booklet Series Code : A

Important : Please consult your Admit Card / Roll No. Slip before filling your Roll Number on the Test Booklet and Answer Sheet.

Roll No. *In Figures* *In Words*

O.M.R. Answer Sheet Serial No.

Signature of the Candidate :

Subject : MATHEMATICS

Time : 70 minutes **Number of Questions : 60** **Maximum Marks : 120**

DO NOT OPEN THE SEAL ON THE BOOKLET UNTIL ASKED TO DO SO

INSTRUCTIONS

1. Write your Roll No. on the Question Booklet and also on the OMR Answer Sheet in the space provided and nowhere else.
2. Enter the Subject and Series Code of Question Booklet on the OMR Answer Sheet. Darken the corresponding bubbles with **Black Ball Point / Black Gel pen.**
3. Do not make any identification mark on the Answer Sheet or Question Booklet.
4. To open the Question Booklet remove the Paper Seal gently when asked to do so.
5. Please check that this Question Booklet contains **60** questions. In case of any discrepancy, inform Assistant Superintendent within 10 minutes of the start of test.
6. Each question has four alternative answers (A, B, C, D) of which only one is correct. For each question darken only one bubble (A or B or C or D), whichever you think is the correct answer, on the Answer Sheet with **Black Ball Point / Black Gel pen.**
7. If you do not want to answer a question, leave all the bubbles corresponding to that question blank in the Answer Sheet. No marks will be deducted in such cases.
8. Darken the bubbles in the OMR Answer Sheet according to the Serial No. of the questions given in the Question Booklet.
9. Negative marking will be adopted for evaluation i.e., 1/4th of the marks of the question will be deducted for each wrong answer. A wrong answer means incorrect answer or wrong filling of bubble.
10. For calculations, use of simple log tables is permitted. Borrowing of log tables and any other material is not allowed.
11. For rough work only the sheets marked "Rough Work" at the end of the Question Booklet be used.
12. The Answer Sheet is designed for **computer evaluation**. Therefore, if you do not follow the instructions given on the Answer Sheet, it may make evaluation by the computer difficult. **Any resultant loss to the candidate on the above account, i.e., not following the instructions completely, shall be of the candidate only.**
13. After the test, hand over the Question Booklet and the Answer Sheet to the Assistant Superintendent on duty.
14. In no case the Answer Sheet, the Question Booklet, or its part or any material copied/noted from this Booklet is to be taken out of the examination hall. Any candidate found doing so, would be expelled from the examination.
15. A candidate who creates disturbance of any kind or changes his/her seat or is found in possession of any paper possibly of any assistance or found giving or receiving assistance or found using any other unfair means during the examination will be expelled from the examination by the Centre Superintendent/Observer whose decision shall be final.
16. **Telecommunication equipment such as pager, cellular phone, wireless, scanner, etc., is not permitted inside the examination hall. Use of calculators is not allowed.**

SEAL

1. **If $f(x) = \frac{\cos^2 x + \sin^4 x}{\cos^4 x + \sin^2 x}$, then f(2016) is equal to**

(A) 1 (B) 2

(C) 3 (D) 4

2. **If $f(x) = \begin{cases} x & \text{if } x \text{ is rational} \\ -x & \text{if } x \text{ is irrational} \end{cases}$, then $f : \mathbb{R} \to \mathbb{R}$ is**

(A) one-one and into (B) neither one-one nor onto

(C) many-one and onto (D) one-one and onto

3. **Let R be the relation from {11, 12, 13} to {8, 10, 12}, defined by $y = x - 3$ then R^{-1} is**

(A) {(8, 11), (10, 13)} (B) {(11, 8), (13, 10)}

(C) {(11, 8), (12, 9), (13, 10)} (D) {(8, 11), (9, 12), (10, 13)}

4. **Let $A = \mathbb{R} - \{3\}$, $B = \mathbb{R} - \{1\}$ and let $f : A \to B$ be defined by $f(x) = \frac{x-2}{x-3}$. Then which of the following is not true ?**

(A) f is bijective (B) f is one-one

(C) f is onto (D) f is one-one but not onto

5. **The period of the function $f(x) = \frac{\sin x + \sin 3x + \sin 5x + \sin 7x}{\cos x + \cos 3x + \cos 5x + \cos 7x}$ is**

(A) π (B) $\pi/2$

(C) $\pi/3$ (D) $\pi/4$

6. **Let A = {1, 2, 3}. Then the number of equivalence relations containing (1, 2) is**

(A) 1 (B) 2

(C) 3 (D) 4

7. **Which of the following is true ?**

(A) $\tan 1 . \tan^{-1} 1 = 1$ (B) $\tan 1 < \tan^{-1} 1$

(C) $\tan 1 > \tan^{-1} 1$ (D) $\tan 1 = \tan^{-1} 1$

8. **If $[\sin^{-1}\cos^{-1}\sin^{-1}\tan^{-1}x] = 1$, where [ ] denotes the greatest integer value function, then x lies in the interval**

(A) [tan sin cos 1, tan sin cos sin 1]
(B) (tan sin cos 1, tan sin cos sin 1)
(C) [-1, 1]
(D) [sin cos tan 1, sin cos sin tan 1]

9. **If $\tan\theta = \sqrt{n}$ for some non-square natural number n, then sec 2θ is :**

(A) a rational number
(B) an irrational number
(C) a +ve real number
(D) none of the above

10. **$\cot 15^\circ + \cot 75^\circ + \cot 135^\circ - \operatorname{cosec} 30^\circ$ equals**

(A) –1
(B) 0
(C) 1
(D) 1/2

11. **Two rays are drawn through a Point A at an angle of 30°. A point B is taken on one of them at a distance 'a' from the Point A. A perpendicular is drawn from the point B to the other ray, and another perpendicular is drawn from its foot to AB to meet AB at another point from where the similar process is repeated indefinitely. The length of the resulting polygonal line is**

(A) a
(B) $(2+\sqrt{3})a$
(C) $(\sqrt{2}+3)a$
(D) $(\sqrt{2}+\sqrt{3})a$

12. **Let $S(n) = 1 + 3 + 5 + \text{-----} + (2n-1) = 3 + n^2$. Then which of the following is true ?**

(A) S(1) is correct
(B) $S(n) \Rightarrow S(n+1)$
(C) $S(n) \not\Rightarrow S(n+1)$
(D) Principle of mathematical induction can be used to prove the formula

13. **The locus of the inequality $\log_{(1/3)}|z+1| > \log_{(1/3)}|z-1|$ is**

(A) Re z < 0
(B) Re z > 0
(C) Im z < 0
(D) Im z > 0

14. **Let $z_0 = 2 - 2i$ and $a = 2 - i$. If $z_0 + (a - z_0)e^{i\theta}$ is the complex number on $|z - z_0| = 1$ with least absolute value then θ equals**

(A) $-\pi/4$
(B) 0
(C) $\pi/4$
(D) $\pi/2$

15. **The number of real solutions of $\sin(e^x) = e^x + e^{-x}$ is**

(A) 0
(B) 1
(C) 2
(D) infinite

16. **The value of x satisfying the equation $x + \log_{10}(1 + 2^x) = x\log_{10} 5 + \log_{10} 6$ is**

(A) -1
(B) 0
(C) 1
(D) 2

17. **If $a < b < c < d$ then $f(x) = (x - a)(x - c) + \lambda(x - b)(x - d)$ has real roots**

(A) For all λ
(B) Only when $\lambda > 0$
(C) Only when $\lambda < 0$
(D) For no λ

18. **If the coefficients of second, third and fourth terms in the expansion of $(1 + x)^n$ are in AP then n equals**

(A) 2
(B) 3
(C) 5
(D) 7

19. **$\lim_{n\to\infty} \sum_{r=1}^{n} \tan^{-1}\left(\frac{1}{2r^2}\right)$ equals**

(A) $\pi/2$
(B) $\pi/3$
(C) $\pi/4$
(D) $\pi/6$

20. **The sum to $(n + 1)$ terms of the series $3C_0 - 8C_1 + 13C_2 - 18C_3 + \ldots\ldots\ldots$ is**

(A) -1
(B) 0
(C) 1
(D) 5.2^{n-1}

21. **The point of intersection of the lines $\frac{x}{a} + \frac{y}{b} = 1$ and $\frac{x}{b} + \frac{y}{a} = 1$ does not lie on the line**

(A) $x - y = 0$
(B) $(x + y)(a + b) = 2ab$
(C) $(2x + 3y)(a + b) = 5ab$
(D) $(2x + 3y)(a + b) = -ab$

22. **Area of an equilateral triangle inscribed in the circle $x^2 + y^2 - 4x + 6y - 3 = 0$**

(A) 12
(B) $\frac{12}{\sqrt{3}}$
(C) $12\sqrt{3}$
(D) $12\sqrt{2}$

23. **Equation of the hyperbola with foci $\left(0, \pm\sqrt{10}\right)$ and passing through (2, 3) is**

(A) $\frac{x^2}{18}-\frac{y^2}{8}=1$ (B) $\frac{y^2}{18}+\frac{x^2}{8}=1$

(C) $\frac{x^2}{1}-\frac{y^2}{3}=1$ (D) $\frac{x^2}{5}-\frac{y^2}{5}=-1$

24. **If a line segment AM = a moves in the plane XOY remaining parallel to OX so that the left end point A slides along the circle $x^2+y^2=a^2$, the locus of M is**

(A) $x^2+y^2=4a^2$ (B) $x^2+y^2=2ax$

(C) $x^2+y^2=2ay$ (D) $x^2+y^2-2ax-2ay=0$

25. **Shortest distance between the lines $\frac{x+1}{7}=\frac{y+1}{-6}=\frac{z+1}{1}$ and $\frac{x-3}{1}=\frac{y-5}{-2}=\frac{z-7}{1}$ is**

(A) $2\sqrt{29}$ (B) $\frac{3\sqrt{2}}{2}$

(C) $\frac{3}{\sqrt{19}}$ (D) $\frac{8}{\sqrt{29}}$

26. **The centre of the circle given by**

$\vec{r}\cdot\left(\hat{i}+2\hat{j}+2\hat{k}\right)=15$ and

$|\vec{r}-(\hat{j}+2\hat{k})|=4$ is :

(A) (0, 1, 2) (B) (1, 3, 4)

(C) (-1, 3, 4) (D) (1, 0, 2)

27. **The angle between a diagonal and an edge of the cube intersecting the diagonal is :**

(A) $\cos^{-1}\frac{1}{3}$ (B) $\cos^{-1}\sqrt{\frac{2}{3}}$

(C) $\tan^{-1}\sqrt{2}$ (D) $\pi/4$

28. **The range of the function $f(x)=\sin^{-1}\left[x^2+\frac{1}{2}\right]+\cos^{-1}\left[x^2-\frac{1}{2}\right]$, where [.] is the greatest integer function is**

(A) $\left\{\frac{\pi}{2}, \pi\right\}$ (B) $\left\{0, \pi/2\right\}$

(C) $\{\pi\}$ (D) $\left(0, \pi/2\right)$

29. **The domain of the function $f(x) = \cos^{-1} \log_2 (x^2 + 5x - 8)$ is :**

(A) [2, 3]
(B) [–3, –2]
(C) [–2, 2]
(D) [–3, 1]

30. **The number of points at which $f(x) = \frac{1}{\log |x|}$ is discontinuous in its domain is**

(A) 1
(B) 2
(C) 3
(D) 4

31. **If $f(x) = \begin{vmatrix} \sin x & \cos x & \tan x \\ x^3 & x^2 & x \\ 2x & 1 & 1 \end{vmatrix}$ then $\lim_{x \to 0} \frac{f(x)}{x^2}$ equals**

(A) 3
(B) –1
(C) 0
(D) 1

32. **Which of the following is true for any two statements p and q ?**

(A) $\sim[p \vee (\sim q)] = (\sim p) \wedge q$
(B) $(p \vee q) \vee (\sim q)$ is a tautology
(C) $(p \wedge q) \wedge (\sim q)$ is a contradiction
(D) $\sim[p \wedge (\sim p)]$ is a tautology

33. **If a variable x takes values x_j such that $a \le x_j \le b$ for j = 1, 2,.....n then**

(A) $a^2 \le var(x) \le b^2$
(B) $a \le var(x) \le b$
(C) $\frac{a^2}{4} \le var(x)$
(D) $(b-a)^2 \ge var(x)$

34. **If a variable takes values 0, 1, 2, ... n with frequencies proportional to the binomial coefficients $^nc_0$ $^nc_1$ ..... ^nc_n respectively then mean of the distribution is**

(A) n/2
(B) $\frac{n(n+1)}{2}$
(C) $\frac{n(n-1)}{2}$
(D) $\frac{n+1}{2}$

35. **If A and B are two events such that P(A) + P(B) – P(A and B) = P(A) then**

(A) P(B | A) = 1
(B) P(A | B) = 1
(C) P(B | A) = 0
(D) P(A | B) = 0

36. **The value of $\sin\left(2\tan^{-1}\frac{1}{3}\right)+\cos\left(\tan^{-1}2\sqrt{2}\right)$ is**

(A) $^{11}/_{12}$ (B) $\frac{12}{13}$

(C) $\frac{13}{14}$ (D) $\frac{14}{15}$

37. **A man in a boat rowing away from a cliff 150m high takes 2 minutes to change the angle of elevation of the top of the cliff from 60° to 45°. The speed of the boat is**

(A) 1 km/hr (B) $\frac{3}{2}\left(3-\sqrt{3}\right)$ km/hr

(C) $\frac{3}{2}\left(\sqrt{3}+3\right)$ km/hr (D) 2 km/hr

38. **If $f(x)=(1+x)^n$ then the value of $f(0)+f'(0)+\frac{f''(0)}{2!}+----+\frac{f^n(0)}{n!}$ is**

(A) n (B) 2^n

(C) 2^{n-1} (D) 2^{n+1}

39. **If $e^{f(x)}=\log x$ then $\left(f^{-1}\right)'(0)$ equals**

(A) e (B) e^{-1}

(C) 1 (D) e^2

40. **If $f'(a)=2$ and $f(a)=4$ then $\lim_{x\to a}\frac{x\,f(a)-a\,f(x)}{x-a}$ equals**

(A) 4 (B) 2a

(C) 4 + 2a (D) 4 – 2a

41. **A function f(x) is defined for all x > 0 and satisfies $f(x^2)=x^3$. Then f is differentiable at x = 4 with $f'(4)$ equal to**

(A) 1 (B) 2

(C) 3 (D) 4

42. **The number of real roots of the equation $e^{x-1}+x-2=0$ is**

(A) 1 (B) 2

(C) 3 (D) 4

43. Equation of normal to the curve $y = (1 + x)^y + \sin^{-1}(\sin^2 x)$ at $x = 0$ (i.e. at (0, 1)) is

(A) $x + y = 1$

(B) $x + y = -1$

(C) $x - y = 1$

(D) $x - y = -1$

44. $\int \frac{\cos 2x}{(\sin x + \cos x)^2} dx$ equals

(A) $\frac{-1}{\sin x + \cos x}$

(B) $\log|\sin x + \cos x|$

(C) $\log|\sin x - \cos x|$

(D) $\frac{1}{(\sin x + \cos x)^2}$

45. If $I_n = \int \cot^n x\, dx$ then $\frac{\cot^{n-1} x}{n-1}$ equals

(A) $I_n + I_{n-2}$

(B) $-(I_n + I_{n-2})$

(C) $I_n - I_{n-2}$

(D) $-I_n + I_{n-2}$ $(n \geq 4)$

46. The value of $\int_0^{1000} e^{x-[x]} dx$ (where [.] is the greatest integer function) equals

(A) $\frac{e^{1000} - 1}{1000}$

(B) $\frac{e^{1000} - 1}{e - 1}$

(C) $1000(e - 1)$

(D) $\frac{e - 1}{1000}$

47. The value of the integral $\int_0^{\infty} e^{-2x}(\sin 2x + \cos 2x)\, dx$ is

(A) 0

(B) 1

(C) 2

(D) $\frac{1}{2}$

48. General solution to the differential equation $y\, dx + (x + x^2 y)\, dy = 0$ is

(A) $-\frac{1}{xy} + \log y = c$

(B) $\frac{1}{xy} - \log y = cx$

(C) $\frac{1}{xy} + \log y = c$

(D) $\frac{1}{xy} + \log y = \frac{c}{x}$

49. **If A is a square matrix such that $A^2 = A$, then $(I + A)^3 - 7A$ is equal to**

(A) A

(B) I − A

(C) I

(D) 3A

50. **The function** $\Delta = \begin{vmatrix} x & a & a \\ b & x & a \\ b & b & x \end{vmatrix}$ **(a, b are +ve constants) has**

(A) Local maxima at both $-\sqrt{ab}$ and $\sqrt{ab}$

(B) Local minima at both $-\sqrt{ab}$ and $\sqrt{ab}$

(C) Local maxima at $-\sqrt{ab}$ and local minima at $\sqrt{ab}$

(D) Local minima at $-\sqrt{ab}$ and local maxima at $\sqrt{ab}$

51. **If a^{-1}, b^{-1}, c^{-1} are p^{th}, q^{th} and r^{th} terms of an AP then the value of** $\begin{vmatrix} bc & ca & ab \\ p & q & r \\ 1 & 1 & 1 \end{vmatrix}$ **is**

(A) −1

(B) 0

(C) 1

(D) 2

52. **If** $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$ **then the matrix $A^2 - 5A + 8I$ is**

(A) 0

(B) I

(C) 2I

(D) 3I

53. **If $a + b + c \neq 0$ then the number of solutions (x, y, z) to the system**

$(b + c)(y + z) - ax = b - c$

$(c + a)(z + x) - by = c - a$

$(a + b)(x + y) - cz = a - b$ **is**

(A) 0

(B) 1

(C) 3

(D) infinite

54. **Inverse of** $f(x) = \begin{bmatrix} \cos x & \sin x & 0 \\ -\sin x & \cos x & 0 \\ 0 & 0 & 1 \end{bmatrix}$ **is :**

(A) f(x)

(B) −f(x)

(C) f(−x)

(D) −f(−x)

55. **If $\vec{a}$ and $\vec{b}$ are vectors such that $|\bar{a}| = 3$, $|\bar{b}| = \frac{\sqrt{2}}{3}$ and $|\bar{a} \times \bar{b}| = 1$ then an angle between $\bar{a}$ and $\bar{b}$ could be**

(A) $\pi/6$ (B) $\pi/4$

(C) $\pi/3$ (D) $\pi/2$

56. **Three vectors $\hat{i} + \hat{j}, \hat{j} + \hat{k}$ and $\hat{k} + \hat{i}$ taken two at a time form three planes. The three unit vectors drawn perpendicular to these three planes form a parallelopiped of volume**

(A) $\frac{1}{3}$ (B) 4

(C) $\frac{3\sqrt{3}}{4}$ (D) $\frac{4}{3\sqrt{3}}$

57. **The random variable X has a probability distribution P(X) of the form** $P(X) = \begin{cases} k & \text{if } X = 0 \\ 2k & \text{if } X = 1 \\ 3k & \text{if } X = 2 \\ 0 & \text{otherwise} \end{cases}$

with k being some positive constant. The $P(X \leq 2)$ is

(A) $\frac{1}{2}$ (B) $\frac{1}{3}$

(C) $\frac{1}{4}$ (D) $\frac{1}{6}$

58. **The variance of the number obtained on a throw of an unbiased die is**

(A) $\frac{21}{6}$ (B) $\frac{91}{6}$

(C) $\frac{35}{12}$ (D) $\frac{12}{35}$

59. **Maximum value of the objective function $x + 2y$ subject to the constraints $2x + 3y \leq 6$, $x + 4y \leq 4$, $x \geq 0$, $y \geq 0$ is**

(A) 3.2 (B) 4.2

(C) 2.3 (D) 2.4

60. **Consider the feasible region R as given by $x + y \geq 1$, $7x + 9y \leq 63$, $x \leq 6$, $y \leq 5$, $x \geq 0$, $y \geq 0$. The number of points in R at which the objective function $3.5x + 4.5y$ obtains maximum value is**

(A) 0 (B) 1

(C) 2 (D) infinite