



BK BIRLA CENTRE FOR EDUCATION
SARALA BIRLA GROUP OF SCHOOLS
SENIOR SECONDARY CO-ED DAY CUM BOYS' RESIDENTIAL SCHOOL
ANNUAL EXAMINATION- 2024-25



Class : 11 sc.
Date : 18/02/25
Admission No.:

MATHEMATICS (041)

MARKING KEY

Duration: 3hrs
Max. Marks: 80
Roll No.:

General Instructions:

1. This Question paper contains - five sections A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
2. Section A has 18 MCQ's and 02 Assertion-Reason based questions of 1 mark each.
3. Section B has 5 Very Short Answer (VSA)-type questions of 2 marks each.
4. Section C has 6 Short Answer (SA)-type questions of 3 marks each.
5. Section D has 4 Long Answer (LA)-type questions of 5 marks each.
6. Section E has 3 source based/case based/passage based/integrated units of assessment of 4 marks each with Sub-parts.

SECTION A

Each question carries 1 mark

1. Let F_1 be the set of parallelograms, F_2 the set of rectangles, F_3 the set of rhombuses, F_4 is the set of squares and F_5 is the set of trapeziums in a plane. Then F_1 may be equal to
a) $F_2 \cap F_3$ b) $F_3 \cap F_4$ c) $F_2 \cap F_5$ d) $F_2 \cup F_3 \cup F_4 \cup F_5$
2. If A and B are two sets, then $A \cap (A \cup B)$ equal to
a) **A** b) B c) \emptyset d) $A \cap B$
3. Let $n(A) = m$ and $n(B) = n$. Then the total number of non-empty relations that can be defined from A to B is :
a) m^n b) $n^m - 1$ c) $mn - 1$ d) $2^{mn} - 1$
4. Domain of $\sqrt{a^2 - x^2}$ ($a > 0$) is:
a) $(-a, a)$ b) $[-a, a]$ c) $[0, a]$ d) $(-a, 0]$
5. The value of $\tan 75^\circ - \cot 75^\circ$ is
a) $2\sqrt{3}$ b) $2 + \sqrt{3}$ c) $2 - \sqrt{3}$ d) 1
6. If $\sin \theta + \operatorname{cosec} \theta = 2$, then $\sin^2 \theta + \operatorname{cosec}^2 \theta =$ is
a) 1 b) 4 c) **2** d) None of these
7. The real value of α for which the expression $\frac{1 - i \sin \alpha}{1 + 2i \sin \alpha}$ is purely real is:
a) $(n+1)\frac{\pi}{2}$ b) $(2n+1)\frac{\pi}{2}$ c) **$n\pi$** d) None of these
8. If $-3x + 17 < -13$, then
a) $x \in (10, \infty)$ b) $x \in [10, \infty)$ c) $x \in (-\infty, 10]$ d) $x \in [-10, 10)$
9. Everybody in a room shakes hands with everybody else. The total number of handshakes is 66. The total numbers of person in room is:
a) 11 b) **12** c) 13 d) 14
10. If $x, 2y, 3z$ are in A.P. where the distinct numbers x, y, z in G.P. the common ratio of the G.P is:
a) 3 b) **1/3** c) 2 d) 1/2
11. The total number of terms in the expansion of $(x+a)^{100} + (x-a)^{100}$ after simplification is :
a) 50 b) 202 c) **51** d) none of these
12. The equation of straight line passing through the point (3,2) and perpendicular to the line $y=x$ is:
a) $x-y=5$ b) **$x+y=5$** c) $x+y=1$ d) $x-y=1$
13. The area of circle centred at (1,2) and passing through the point (4,6) is:
a) 5π b) 10π c) **25π** d) None of these

14. The distance of point (3,4,5) from the YZ- plane is:
 a) **3 units** b) 4 units c) 5 units d) 550
15. $\lim_{x \rightarrow 0} \frac{\operatorname{cosec}x - \cot x}{x}$ is equal to
 a) -1/2 b) 1 **c) 1/2** d) -1
16. When tested, the lives (in hours) of 5 bulbs were noted as follows 1357, 1090, 1666, 1494, 1623 the mean deviation from their mean is:
 a) **178** b) 179 c) 220 d) 356
17. In a non-leap-year, the probability of having 53 Tuesday or 53 Wednesday is:
 a) $\frac{1}{7}$ b) $\frac{2}{7}$ c) $\frac{3}{7}$ d) None of these
18. The probability that at least one of the events A and B occurs is 0.6. If A and B occur simultaneously with probability 0.2, then $P(\bar{A}) + P(\bar{B})$ is equal to:
 a) 0.4 b) 0.8 **c) 1.2** d) 1.6

ASSERTION-REASON BASED QUESTIONS

In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.

- (a) Both A and R are true and R is the correct explanation of A.
 (b) Both A and R are true but R is not the correct explanation of A.
 (c) A is true but R is false.
 (d) A is false but R is true.

19. ASSERTION (A): The points A (-2, 1), B (0, 5), C (-1, 2) are collinear.

REASON (R): Three points are collinear if and only if $AB+BC=AC$.

Ans: D

20. ASSERTION (A): If $f(x) = 1-x+x^2-x^3+\dots-x^{99}+x^{100}$, $f'(1) = 50$.

REASON (R): $f'(x^n) = nx^{n-1}$.

Ans: A

SECTION B

Each question carries 2 mark

21. In a circle of diameter 40cm, the length of the chord is 20cm. find the length of minor arc of the chord.

Ans: $r=20\text{cm}$, since the all three sides of triangle are equal hence, angle = $60^\circ = 60 \times \frac{\pi}{180}$

As we know that, $\theta = \frac{l}{r}$, $l = \frac{20 \times 22}{7 \times 3} = 20.92 \text{ cm}$.

22. Solve: $5x-3 < 7$, when: i) x is an integer, ii) x is a real number

Ans: On solving the in-equation, we get $x < 2$

i) x is an integer solution is $\dots, -3, -2, -1, 0, 1$.

ii) x is a real number solution is $(-\infty, 2)$.

23. How many chords can be drawn through 21 points on a circle?

Ans: ${}^{21}C_2 = \frac{21!}{2!(21-2)!} = 210$ chords

24. The 5th, 8th and 11th terms of G.P. are p, q and s respectively. Show that $q^2 = ps$.

Ans: $T_5 = p = ar^4 - (1)$, $T_8 = q = ar^7 - (2)$, $T_{11} = s = ar^{10} - (3)$

Multiply eqn (1) and (3)

We will have $q^2 = ps$

OR

In a G.P., the 3rd term is 24 and 6th term is 192, Find the 10th term.

Ans: $T_3 = 24$, $T_6 = 192$

$ar^2 = 24$, $ar^5 = 192$

Divide the equations and solve we have, $r=2$ and $a=6$.

$T_{10} = 3072$

25. Find the value of $\lim_{x \rightarrow 0} (x \operatorname{sec} x)$

Ans: $\lim_{x \rightarrow 0} (x/\cos x) = 0/1 = 0$

OR

Evaluate: $\lim_{x \rightarrow 3} \frac{x^2-9}{x-3}$

Ans: $\lim_{x \rightarrow 3} \frac{(x-3)(x+3)}{x-3} = \lim_{x \rightarrow 3} x + 3 = 6$

SECTION C

Each question carries 3 mark

26. Find the domain and range of the real function f defined by $f(x) = \sqrt{x-1}$.

Ans; f is real only when $x-1 \geq 1$, e.i $x \geq 1$, domain is $[1, \infty)$

$Y = \sqrt{x-1}$, $y \geq 0$ and $x=1+y^2$ where x is real number for all $y \in R$.

Range is $[0, \infty)$

OR

Express the following functions as set of ordered pairs and determine their range: $f: x \rightarrow R, f(x) = x^3+1$, where $x \in N$: $f = \{ \dots (-1,0), (0,1), (3,28), (9,730), (7,344) \dots \}$

Range = $\{ \dots, 1, 28, 730, 344 \dots \}$

27. Prove that: $\cos(\frac{\pi}{4} - x)\cos(\frac{\pi}{4} - y) - \sin(\frac{\pi}{4} - x)\sin(\frac{\pi}{4} - y) = \sin(x+y)$.

Ans: Using Identity: $\cos A \cos B - \sin A \sin B = \cos(A+B)$

$\cos(\frac{\pi}{2} - (A + B)) = \sin(A+B)$

28. Solve the system of inequalities graphically: $3x+2y \leq 2, x \geq 1, y \geq 2$.

Ans: Proper graph

OR

Find all the pair of consecutive even positive integer, both of which are larger than 5 such that their sum is less than 23.

Ans: Let the no. be x, x+2

Such that $x > 5$ and $x+x+2 < 23$

Hence, $x < 11$,

Pair of number would be (6, 8), (8, 10), (10, 12)

29. Find the equation of circle which touches x-axis and whose centre is (1, 2).

Ans: Equation of circle is $(x-h)^2 + (y-k)^2 = r^2, (x-1)^2 + (y-2)^2 = 2^2$,

$x^2 + y^2 - 2x - 4y + 1 = 0$.

OR

Find the coordinates of foci and the vertices, the eccentricity and length of latus rectum of the hyperbola.

$\frac{x^2}{16} - \frac{y^2}{9} = 1$

Ans: Foci $(\pm 5, 0)$, Vertices $(\pm 4, 0)$, Eccentricity $= \frac{5}{4}$, Length of latus rectum $= \frac{9}{2}$ cm.

30. Find the derivative of the given function: $f(x) = \sin x + x^3 + 4x - 5$.

Ans: $f'(x) = \cos x + 3x^2 + 4$

31. Fair coin with 1 marked on one face and 6 on the other and a die are both tossed. Find the probability that the sum of numbers that turn up (i) 3, (ii) 12.

Ans; Total outcome = 12, (i) $P(A) = 1/12$, (ii) $P(B) = 1/12$

SECTION D

Each question carries 5 mark

32. In a survey of 200 students of a school, it was found that 120 study Mathematics, 90 study physics and 70 study chemistry 40 study Mathematics and Physics, 30 study Physics and Chemistry, 50 study Chemistry and Mathematics and 20 none of these subjects. Find the number of students who study all three subjects.

Ans: $n(\text{MUPUC}) = 200 - 20 = 180$,

$$n(M \cup P \cup C) = n(M) + n(P) + n(C) - n(M \cap P) - n(P \cap C) - n(M \cap C) + n(M \cap P \cap C)$$

$$n(M \cap P \cap C) = 300 - 280 = 20$$

OR

In a survey of 600 students in a school, 150 students were found to be taking tea and 225 taking coffee, 100 were taking both tea and coffee. Find how many students were taking neither tea nor coffee.

Ans: $n(\text{CUT}) = 275$

$$n(\text{CUT})' = n(U) - n(\text{CUT}) = 600 - 275 = 325$$

33. Prove that : $\sin x + \sin 3x + \sin 5x + \sin 7x = 4 \cos x \cos 2x \sin 4x$

Ans: $(\sin 7x + \sin x) + (\sin 5x + \sin 3x)$ (use allied angle formulae)

$$2 \sin 4x \cos 3x + 2 \sin 4x \cos x = 2 \sin 4x (\cos 3x + \cos x)$$
 (use allied angle formulae)

$$4 \sin 4x \cos 2x \cos x.$$

OR

Prove that: $(\cos x + \cos y)^2 + (\sin x - \sin y)^2 = 4 \cos^2 \left(\frac{x+y}{2}\right)$

Ans: use allied angle formulae $(2 \cos \left(\frac{x+y}{2}\right) \cos \left(\frac{x-y}{2}\right))^2 + (2 \cos \left(\frac{x+y}{2}\right) \sin \left(\frac{x-y}{2}\right))^2$

$$4 \cos^2 \left(\frac{x+y}{2}\right) \left[\cos^2 \left(\frac{x-y}{2}\right) + \sin^2 \left(\frac{x-y}{2}\right) \right] = 4 \cos^2 \left(\frac{x+y}{2}\right)$$

34. Find a positive value of m for which the coefficient of x^2 in the expansion of $(1+x)^m$ is 6.

Ans: $T_{r+1} = {}^n C_r x^r$, $T_{2+1} = {}^m C_2 x^2$, Coefficient of $x^2 = {}^m C_2$

$$6 = {}^m C_2, \frac{m(m-1)}{2} = 6, m^2 - m - 12 = 0, (m-4)(m+3) = 0,$$

$$m=4, m=-3, -3 \text{ rejected.}$$

OR

If the coefficient of second, third and fourth term in the expansion of $(1+x)^{2n}$ are in A.P. Then show that $2n^2 - 9n + 7 = 0$.

Ans: Coefficient of 2nd term = ${}^{2n} C_1$

Coefficient of 3rd term = ${}^{2n} C_2$, Coefficient of 4th term = ${}^{2n} C_3$

Then $2 \cdot {}^{2n} C_2 = {}^{2n} C_1 + {}^{2n} C_3$ (Use combination concept and expand)

$$12n - 6 = (4n^2 - 6n + 8), 2n^2 - 9n + 7 = 0$$

35. Find the derivative of $f(x) = \sin x$ by first principle.

Ans: $\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h} = \lim_{h \rightarrow 0} \frac{\sin(x+h) - \sin x}{h} = \lim_{h \rightarrow 0} \frac{\sin x \cosh + \cos x \sinh - \sin x}{h} = \lim_{h \rightarrow 0} \frac{(\sin x \cosh - \sin x) + \cos x \sinh}{h}$

$$\lim_{h \rightarrow 0} \frac{\cos x \sinh}{h} = \cos x.$$

SECTION E

Each question carries 4 mark

(This section comprises of with two sub-parts. First two case study questions have three sub of marks 1, 1, 2 respectively. The third case study question has two sub marks each.)

36. In a class of 60 students, 30 opted for NCC, 32 opted for NSS and 24 opted for both NCC and NSS. If one of these students is selected at random.

On the basis of above information Find the probability that:



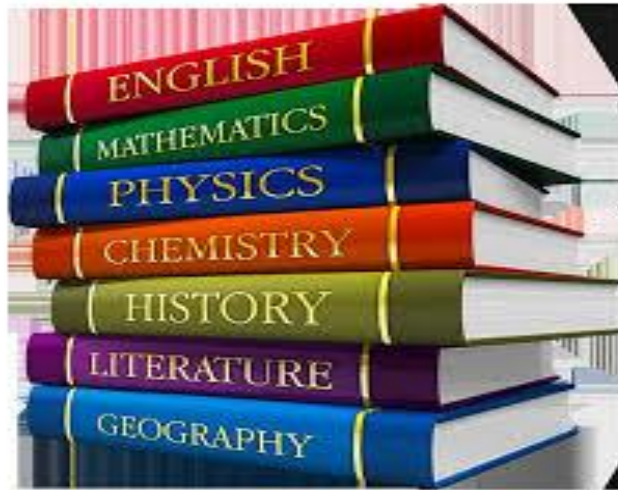
- i) The student opted for NCC or NSS.
- ii) The student has opted for neither NCC nor NSS.
- iii) The student has opted for NSS but not NCC.

Ans: i) 19/30

ii) 11/30

iii) 2/15

37. In a class of 26 students, 16 had taken Biology, 13 had physics and 12 had chemistry. 6 had Biology and Chemistry, 10 had Biology and Physics and 5 had physics and chemistry. 4 of them had all three subjects. The school needed to find out more about the various grouping of the students in order to organize classroom with the appropriate amount of lab kits for each subjects.



- i) How many students had only chemistry?
- ii) How many students had only one subject?
- iii) How many students had Biology and Physics?

Ans: i) 24

ii) 24

iii) 120

38. A committee of 7 has to be formed from 9 boys and 4 girls.

On the basis of above information, in how many ways can this be done when the committee consists of:



- i) Exactly 3 girls?
- ii) At least 3 girls?
- iii) At most 3 girls?

Ans: i) 504 ways

- ii) 588 ways
- iii) 1632 ways

*****End of Paper*****