Edufest Junior, Pune 7709585248

CHAPTER 06 — NUMBER PLAY

SUBJECT: MATHEMATICS	MAX. MARKS: 40
CLASS: VII	DURATION: 1½ hrs

General Instructions:

(i). All questions are compulsory.

(ii). This question paper contains 20 questions divided into five Sections A, B, C, D and E.

(iii). Section A comprises of 10 MCQs of 1 mark each. Section B comprises of 4 questions of 2 marks each. Section C comprises of 3 questions of 3 marks each. Section D comprises of 1 question of 5 marks each and Section E comprises of 2 Case Study Based Questions of 4 marks each.

SECTION – A Questions 1 to 10 carry 1 mark each.

1. The sum of 5 even numbers and 3 odd numbers is always:

(a) even
(b) odd
(c) prime
(d) cannot be determined

2. What is the parity of the product $253 \times 178 \times 45$?

(a) odd
(b) even
(c) neither odd nor even
(d) cannot be determined

3. Which of the following expressions ALWAYS produces an odd number for any positive integer n?

(a) $4n + 2$
(b) $6n - 1$
(c) $8n + 4$
(d) $10n - 2$

4. The 20th odd number is:

(a) 37
(b) 39
(c) 41
(d) 43

5. In a 3×3 magic square using numbers 1 to 9, the magic constant (row/column/diagonal sum) is 15. If the centre cell must always hold the middle value, what is that value?

(a) 4
(b) 5
(c) 6
(d) 7

6. If Virahāṅka numbers follow $V(n) = V(n-1) + V(n-2)$ and $V(10) = 55$ and $V(11) = 89$, then $V(13)$ is:

(a) 144
(b) 233
(c) 210
(d) 178

7. In the cryptarithm SEND + MORE = MONEY, the digit S represents:

(a) 8
(b) 7
(c) 9
(d) 6

8. What is the parity of the total number of unit squares in a 143×246 grid?

(a) odd
(b) even
(c) prime
(d) cannot be determined

In the following questions 9 and 10, 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.

9. Assertion (A): The product of any two consecutive odd numbers is always odd. Reason (R): The product of two odd numbers is always odd.

10. Assertion (A): In a 4×4 magic square using integers 1 to 16, the magic constant is 34. Reason (R): The sum of integers 1 to 16 is 136, and dividing by 4 rows gives 34.

SECTION – B Questions 11 to 14 carry 2 marks each.

11. Determine the parity of the expression: (sum of first 15 natural numbers) × (sum of first 8 odd numbers). Show reasoning without full computation.

12. Without calculating, determine whether 347 × 211 × 98 is odd or even. Justify.

13. Write two different algebraic expressions (one in terms of n, one in terms of m) that always yield an even number. Verify each with an example.

14. If V(7) = 21 and V(8) = 34 in the Virahāṅka sequence, find V(10) and V(11). State the recurrence relation used.

SECTION – C Questions 15 to 17 carry 3 marks each.

15. Prove algebraically that the sum of any three consecutive odd numbers is always odd. Also verify with a numerical example.

16. Show that for any integer n, the expression $n^2 + n$ is always even. Hence determine the parity of $47^2 + 47$.

17. A 3×3 magic square has row sum R. Explain why R must equal one-third of the sum of all nine numbers placed in the grid. Can a 3×3 magic square be formed using the numbers 2, 4, 6, 8, 10, 12, 14, 16, 18? If yes, what is its magic constant? If no, justify.

SECTION – D Question 18 carries 5 marks.

18. Using the Lo Shu transformation method (or otherwise), construct a 3×3 magic square using 9 consecutive even numbers starting from 4. Verify that all rows, columns, and both main diagonals give the same magic constant. Also find what the magic constant would change to if each number in the square is increased by 7.

SECTION – E (Case Study Based Questions) Questions 19 to 20 carry 4 marks each.

19. Case Study 1: The Tiling Contractor

A construction firm is designing decorative tile panels for a heritage hotel. Each panel is a rectangular grid of square tiles. Four panel designs proposed are: Panel P: 117 × 84, Panel Q: 225 × 63, Panel R: 148 × 216, Panel S: 319 × 450. The designer insists that any panel chosen for the grand lobby must have an EVEN total number of tiles (for symmetric splitting into left–right halves). The junior engineer applies parity rules — odd × odd = odd; even × odd = even; even × even = even — without using a calculator. The firm also wants to know, among qualifying panels, which one has the greatest number of tiles by comparing the dimensions, and whether the total tiles in panels Q and R combined is odd or even.

- **(a)** What is the parity of the total tiles in Panel P (117 × 84)?
- **(b)** What is the parity of the total tiles in Panel Q (225 × 63)?
- **(c)** Which panels qualify for the grand lobby? Which must be redesigned?
- **(d)** What is the parity of (tiles in Panel Q) + (tiles in Panel R)? Show reasoning.

20. Case Study 2: The Drumbeat Composer

A classical music academy is teaching students about rhythmic compositions using only 1-beat (short) and 3-beat (long) syllables instead of the usual 1-beat and 2-beat. The music teacher defines a new sequence: C(1) = 1, C(2) = 1, C(3) = 2, and for n ≥ 4, C(n) = C(n−1) + C(n−3). This is a 'tribonacci-like' recurrence. Students compute: C(4) = C(3) + C(1) = 3, C(5) = C(4) + C(2) = 4, C(6) = C(5) + C(3) = 6. They must now determine the number of possible rhythm patterns for 7, 8, 9, and 10 beats using this recurrence, identify which beat lengths give an odd number of patterns, and find the beat length among 7–10 that allows maximum rhythmic variety.

(a) Using the recurrence $C(n) = C(n-1) + C(n-3)$, find $C(7)$ and $C(8)$.

(b) Find $C(9)$ and $C(10)$.

(c) Which of the beat lengths 7, 8, 9, 10 give an ODD number of rhythm patterns?

(d) Which beat length among 7, 8, 9, 10 allows the maximum rhythmic variety (most patterns)? What is that number of patterns?