CLASS 8 · MATHEMATICS

Algebra Play

Sample paper · 15 questions · 22 marks

10 objective questions × 1 mark. Five written-response questions: 12 marks. Write your working where needed. Suggested time: 45 minutes. Answers and marking guidance follow the questions.

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Section A · Objective questions (10 marks)

1. In this number trick: think of a number, double it, add 6, divide by 2, subtract your original number. The result is always:

A. 3

B. 0

C. 6

D. The original number

2. In a sum pyramid, a brick contains 14 and one of the two bricks directly beneath it contains 9. What is the other lower number?

A. 14

B. 23

C. 126

D. 5

3. Use the rule: each upper brick is the sum of the two directly below it. A two-row number pyramid has 3 and 5 in the bottom row. The number at the top is:

A. 35

B. 15

C. 2

D. 8

4. Use the rule: each upper brick is the sum of the two directly below it. A three-row pyramid has 1, 2 and 3 in its bottom row. The number at the top is:

A. 8

B. 7

C. 6

D. 9

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5. Use the rule: each upper brick is the sum of the two directly below it. A three-row pyramid has a, b and c in its bottom row. The expression for the topmost number is:

A. 2a + b + 2c

B. a x b x c

C. a + b + c

D. a + 2b + c

6. On a calendar page, a 2 x 2 grid starts at the number n. The other three numbers are n + 1, n + 7 and n + 8. Their total is:

A. 2n + 8

B. 4n + 8

C. n + 16

D. 4n + 16

7. Which of these numbers is divisible by 3?

A. 1000

B. 2026

C. 1234

D. 5121

8. A number is divisible by 9 exactly when:

A. Its last digit is 9

B. Its digit sum is even

C. It is odd

D. Its digit sum is divisible by 9

9. Split 10 into two positive whole-number parts so that their product is as large as possible. The largest product is:

A. 21

B. 24

C. 25

D. 16

10. The solution of 2 x + 3 = 11 is:

A. x = 14

B. x = 7

C. x = 3

D. x = 4

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Section B · Written responses (12 marks)

Attempt all five. Use a separate sheet if you need more space. The marks for each question are shown.

11. A trick says: think of a number, double it, add 10, divide by 2, then subtract the number you started with. Use algebra to show why the answer is always 5. [2 marks]

12. Use the rule: each upper brick is the sum of the two directly below it. A three-row number pyramid has 4, 7 and 2 in its bottom row. Fill in the rest of the pyramid. [2 marks]

13. In the calendar trick, the four numbers of a 2 x 2 grid add to 64. Find the four numbers. [2 marks]

14. Use the rule: each upper brick is the sum of the two directly below it. Derive the expression for the topmost number of a three-row pyramid whose bottom row is a, b, c. Then use it to find the top when the bottom row is 2, 5, 9, without filling in the whole pyramid. [3 marks]

15. Test whether 73,82,451 (7382451) is divisible by 9, and explain why the digit-sum test works. [3 marks]

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Answers & marking guidance

Use these after attempting the paper. Accept equivalent correct reasoning and sensible units. These are Evater model answers, not an official marking scheme.

Section A · 1 mark each

1. A — For a number x, the steps give (2 x + 6)/2 - x = x + 3 - x = 3, whatever x is.

2. D — Each upper brick is the sum of the two below: 14-9 =5.

3. D — The top is the sum of the two below: 3 + 5 = 8.

4. A — The middle row is 1 + 2 = 3 and 2 + 3 = 5, so the top is 3 + 5 = 8.

5. D — The middle row is a + b and b + c, so the top is (a + b) + (b + c) = a + 2 b + c.

6. D — n + (n + 1) + (n + 7) + (n + 8) = 4 n + 16.

7. D — The digit sum of 5121 is 5 + 1 + 2 + 1 = 9, which is divisible by 3; the others have digit sums of 10, 10 and 1.

8. D — The test for 9 uses the digit sum: the number and its digit sum leave the same remainder on division by 9.

9. C — Equal parts maximise the product: 5 x 5 = 25 beats 4 x 6 = 24, 3 x 7 = 21 and so on.

10. D — 2 x = 11 - 3 = 8, so x = 4. Check: 2 x 4 + 3 = 11.

Section B · Model answers

11. Let the number be x. Doubling gives 2 x; adding 10 gives 2 x + 10; dividing by 2 gives x + 5; subtracting x leaves 5. Since x disappears, the answer is 5 for every starting number.

Marking: 1 mark for writing the steps with x; 1 mark for showing x cancels to leave 5.

12. Middle row: 4 + 7 = 11 and 7 + 2 = 9. Top: 11 + 9 = 20.

Marking: 1 mark for the middle row (11 and 9); 1 mark for the top (20).

13. If the first number is n, the grid holds n, n + 1, n + 7 and n + 8, so 4 n + 16 = 64. Then 4 n = 48 and n = 12. The numbers are 12, 13, 19 and 20.

Marking: 1 mark for setting up 4 n + 16 = 64; 1 mark for the four correct numbers.

14. The middle row is a + b and b + c, so the top is (a + b) + (b + c) = a + 2 b + c. For 2, 5, 9: top = 2 + 2 x 5 + 9 = 21.

Marking: 1 mark for the middle row in terms of a, b, c; 1 mark for the expression a + 2 b + c; 1 mark for 21.

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15. The digit sum is 7 + 3 + 8 + 2 + 4 + 5 + 1 = 30, and 30 is not divisible by 9, so 7382451 is not divisible by 9. Why it works: each power of 10 (10, 100, 1000, ...) is 1 more than a multiple of 9, so every digit contributes only its own value to the remainder; the number and its digit sum therefore leave the same remainder on division by 9.

Marking: 1 mark for the digit sum 30; 1 mark for the correct conclusion; 1 mark for the place-value reason.

Topic references

NCERT Class 8 Mathematics, Ganita Prakash, Chapter 13: Algebra Play.

https://ncert.nic.in/textbook/pdf/hegp206.pdf

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