Marking guide | Algebra

Algebra applications test

16 questions | 45 marks | 60 minutes

Apply algebra to costs, rates, formulas and the limits of a model.

Equivalent correct methods earn the corresponding marks.

1. A craft set contains $4x + 3$ red tiles and $2x + 5$ blue tiles. Write the total in simplified form. [2 marks]

Add and collect like terms.

Answer: $6x + 8$ tiles.

2. A rectangular display has sides $x + 3$ and $2x + 1$ metres. Write its perimeter in simplified form. [2 marks]

Use $2(x + 3) + 2(2x + 1)$.

Answer: $6x + 8$ m.

3. Five identical boxes each hold $3a - 2$ objects. Expand the total count. [2 marks]

Use $5(3a - 2)$.

Answer: $15a - 10$

4. A club record shows $24n + 18$ points. Factorise it using the greatest numerical common factor. [2 marks]

The greatest common numerical factor is 6.

Answer: $6(4n + 3)$

5. For n booked seats, a model gives price $P = \frac{12n + 36}{n}$. Simplify the formula and state a practical domain. [3 marks]

Divide each numerator term by n; seat counts cannot be zero or fractional.

Answer: $P = 12 + 36/n$; positive whole-number n.

6. A task takes x hours for one worker and $2x$ hours for another. Write their combined rate in tasks/hour. [3 marks]

Add the individual rates $1/x + 1/(2x)$.

Answer: $3/(2x)$, $x > 0$.

7. Two tank capacities are $3p$ and $5p$ litres. Express the fraction of total capacity belonging to the first tank, with a sensible condition on p. [3 marks]

The total is $8p$; the first fraction is $3p/(8p)$.

Answer: $3/8$, $p > 0$.

8. A supplier divides $6(x + 1)$ dollars among $3(x + 1)$ accounts. What is the ratio, and what algebraic value is excluded? [2 marks]

Cancel the common factor while retaining the original nonzero-denominator requirement.

Answer: 2 dollars per account; $x \neq -1$.

9. A printed formula is $T = \frac{5p - (p + 2)}{p - 1}$. Simplify it and state its restriction. [3 marks]

Subtract the entire bracket: $5p - p - 2$.

Answer: $T = (4p - 2)/(p - 1)$, $p \neq 1$.

10. A cost of 84 dollars is shared equally among n students. Each pays 7 dollars. Find n and check the answer in the original model. [3 marks]

Solve $84/n = 7$; $84/12 = 7$ and 12 is a positive whole number.

Answer: $n = 12$ students.

11. A machine gives outputs $y = kt + 3t$. Make t the subject and identify the parameter value that needs separate treatment. [3 marks]

Factor the input: $y = t(k + 3)$.

Answer: $t = y/(k + 3)$ if $k \neq -3$; $k = -3$ is the special case.

12. A car trip is modelled by $d = vt$. Make v the subject, then explain why a zero-duration trip needs separate treatment. [3 marks]

The rearrangement divides by t, so it cannot be used at zero.

Answer: $v = d/t$, $t \neq 0$. At $t = 0$ the original model gives $d = 0$ for every v.

13. A ramp model uses $L = \sqrt{x - 4}$ metres. A student chooses $x = 1$. Explain why this is invalid over the real numbers and state the allowed algebraic inputs. [3 marks]

A real square root needs $x - 4 \geq 0$.

Answer: $x = 1$ makes the radicand negative; require $x \geq 4$.

14. A booking formula is $C = \frac{n+2}{n-3}$. The organiser asks when $C = \frac{5}{n-3}$. Solve and decide whether the result is valid. [3 marks]

The original excludes $n = 3$. Clearing gives $n + 2 = 5$, so the candidate 3 is excluded.

Answer: No valid value.

15. A company quotes two unit-cost models, $A = 4 + 24/n$ and $B = 6 + 12/n$, for positive whole-number n. Find when the quoted unit costs are equal and find that cost. [4 marks]

Multiply $4 + 24/n = 6 + 12/n$ by n: $4n + 24 = 6n + 12$.

Hence $n = 6$, and both models give 8.

Answer: $n = 6$; both cost 8 dollars per unit.

16. Mia simplifies $F = \frac{2x+6}{x+3}$ to 2. [4 marks]

(a) State the excluded value of the original expression. [1 mark]

The denominator is zero at $x = -3$.

Answer: $x \neq -3$.

(b) Evaluate both forms at $x = 5$. [1 mark]

The original gives $(10 + 6)/(5 + 3) = 16/8 = 2$.

Answer: Both give 2.

(c) Can the simplified formula be used to give the original expression a value at $x = -3$? Explain. [2 marks]

Cancellation requires $x + 3 \neq 0$.

Answer: No. The original expression remains undefined.