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: $P = 12 + \frac{36}{n}$; 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 $\frac{1}{x}+\frac{1}{2x}$.

Answer: $\frac{3}{2x}$, $x>0$.

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 $\frac{3p}{8p}$.

Answer: $\frac{3}{8}$, $p>0$.

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: $T=\frac{4p-2}{p-1}$, $p\neq 1$.

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 $\frac{84}{n}=7$; $\frac{84}{12}=7$ 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: $t=\frac{y}{k+3}$ 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: $v=\frac{d}{t}$, $t\neq 0$. 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, $A=4+\frac{24}{n}$ and $B=6+\frac{12}{n}$, for positive whole-number n. Find when the quoted unit costs are equal and find that cost. [4 marks]

Multiply $4+\frac{24}{n}=6+\frac{12}{n}$ 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 $\frac{10+6}{5+3}=\frac{16}{8}=2$.

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.