Equivalent Expressions

Equivalent expressions: Applications and decisions

Name _____ **Date** _____ **Score** _____ / 8

QUICK REVIEW

Equivalent expressions have the same value for every allowed input. Distribute $3(x+4)=3x+12$ and combine like terms $2x+5x=7x$. Unlike terms such as $2x+5$ cannot be combined into $7x$. Testing inputs can expose an error; the distributive property explains equality for all inputs.

Worked example

Expand and check at two inputs. Use $3(x+4)$.

1. Distribute: $3(x+4)=3x+3\times 4=3x+12$.
2. At $x=2$, original $3((2)+4)=18$ and rewritten $3(2)+12=18$.
3. At $x=5$, original $3((5)+4)=27$ and rewritten $3(5)+12=27$.
Answer: $3x+12$.

Practice Problems

Show your thinking.

1. An order costs $5(x+3)$ dollars for x upgrades. A sign prints $5x+3$ instead. Use $x=2$ to test the sign, then correct the expanded expression for every x.

2. Two clubs buy supplies costing $(2x+6)+(4x+2)$ dollars altogether. The invoice templates are $6x+8$ and $6(x+8)$. Which always matches? Explain the other template's error.

3. Two plans cost $2(3n+4)$ and $6n+11$ dollars for n notebooks. Does either cost less for every order size? Explain without testing every order.

4. A printer accepts $4(x+3)+qx$ as a model of $7x+12$ labels. Find q so the rule matches for every x, and check at $x=2$.

5. Two parking rules are $3h+6$ and $4h+2$ dollars for h hours. They match for 4 hours. Does that prove they always match? Use a different positive whole-number input to justify your answer.

6. A store models a total as $12x+24$. Give two different product forms using an outside whole-number factor greater than 1. Verify both by distributing.

7. Each of 3 groups earns $2p+5$ points. A bonus of 5 points is added once to the total. Which final rule is correct: $6p+20$ or $6p+30$? Explain how the rules treat the bonus.

8. Four kits each use $2x+6$ pieces, but 8 pieces are reused from stock. A purchase order says $8x+16$ pieces. Is that always right? Use algebra, then find the new pieces needed when $x=3$.

Answer Key

1. Not equivalent; correct sign: $5x + 15$.
2. Only $6x + 8$ always matches.
3. The first always costs 3 dollars less.
4. $q = 3$.
5. No. At $h = 1$ the rules give 9 and 6 dollars.
6. For example, $4(3x + 6)$ and $6(2x + 4)$.
7. $6p + 20$ points.
8. Yes; buy 40 new pieces at $x = 3$.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. At $x = 2$, the real cost is $5(2 + 3) = 25$ dollars, but the sign gives $5(2) + 3 = 13$ dollars.

2. Distribute 5 to both terms: $5(x + 3) = 5x + 5(3) = 5x + 15$. The sign omitted 12 dollars.

Problem 2

1. Combine the variable charges: $2x + 4x = 6x$. Combine fees: $6 + 2 = 8$ dollars.

2. $6(x + 8) = 6x + 48$, so that template charges the 8-dollar fee six times, not once.

Problem 3

1. Distribute: $2(3n + 4) = 6n + 8$. Both plans charge the same $6n$ for notebooks.

2. The second fixed fee is 11 rather than 8, so the difference is always $11 - 8 = 3$ dollars.

Problem 4

1. Distribute and collect the variable part: $4(x + 3) + qx = (4 + q)x + 12$.

2. Match coefficients: $4 + q = 7$, so $q = 7 - 4 = 3$.

3. At $x = 2$, the model gives $4(2 + 3) + 3(2) = 26$ and $7(2) + 12 = 26$.

Problem 5

1. Check the match: $3(4) + 6 = 18$ and $4(4) + 2 = 18$ dollars.

2. Test $h = 1$: $3(1) + 6 = 9$ dollars and $4(1) + 2 = 6$ dollars. This one counterexample disproves a match for every input.

Problem 6

1. Both terms have factor 4: $12x \div 4 = 3x$ and $24 \div 4 = 6$. So $4(3x + 6) = 12x + 24$.

2. Both terms also have factor 6: $12x \div 6 = 2x$ and $24 \div 6 = 4$. So $6(2x + 4) = 12x + 24$.

Problem 7

1. Three groups give $3(2p + 5) = 6p + 15$ points.

2. Add the bonus once: $6p + 15 + 5 = 6p + 20$. The 30-point constant would count the bonus in all 3 groups.

Problem 8

1. Four kits use $4(2x + 6) = 8x + 24$ pieces.

2. Subtract the reused pieces once: $8x + 24 - 8 = 8x + 16$.

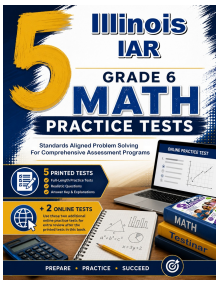
3. At $x = 3$, buy $8(3) + 16 = 40$ pieces.

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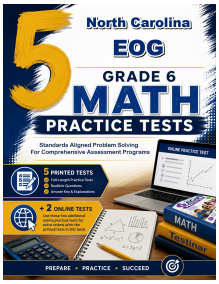
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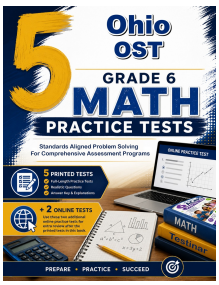
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