Algebra 1 Unit 1 test: Real numbers, expressions and properties

Name _____ Date _____ Period _____

13 questions, 45 points

1. Write as a roster the set of integers n for which $3(n+4)-2n$ is greater than 17 and less than 23. How many elements does it have? (3 points)

2. Let $S = \{5(x+6)-2x,\ \ 3(x+6)+12,\ \ 3x+24\}$. Show that for every real number x the set S has exactly two elements, and write S with each element listed once. (3 points)

3. Simplify $-9(x-9)-(9-12x)$. Show each step. (3 points)

4. Let $S = \{-3, -1, 1, 3, 6\}$. Here a and b are elements of S, and they may be equal. (3 points)

(a) List every ordered pair (a, b) for which $a - b = b - a$.

(b) List every ordered pair (a, b) for which $a \div b = b \div a$.

Explain how you found each list without trying all 25 pairs.

5. Let $S = \{-3, -1, 0, \frac{1}{3}, 1, 3, 4\}$. Write each set as a roster. (3 points)

(a) The elements of S whose additive inverse is also an element of S.

(b) The elements of S whose multiplicative inverse is also an element of S.

(c) The elements of S that are their own multiplicative inverse, and the elements of S that are their own additive inverse.

6. Solve $8(x-6) = -3x + \sqrt{13}$. Give x in simplest form, then decide whether x is rational or irrational, naming the closure facts you use. (3 points)

7. Find every irrational number x for which both $x + \sqrt{5}$ and $x \cdot \sqrt{5}$ are rational. Explain why there are no others. (3 points)

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8. A tank holds 8280 liters of water. It drains at 23 liters per minute, and after t minutes the water left in the tank is $8280 - 23t$ liters. (4 points)

(a) Give the unit of the term $23t$ and say what it measures.

(b) How many liters are left after 1 hour 30 minutes?

(c) How many hours does it take the tank to empty?

9. Isaac looks at $x^2 + 10x + 29$ and says: "When x is a large negative number, the term $10x$ is very negative, so for some x the whole expression must be negative." (4 points)

(a) Use the distributive property and combine like terms to show that $(x + 5)^2 + 4 = x^2 + 10x + 29$ for every real number x.

(b) Use the form $(x + 5)^2 + 4$ to decide whether Isaac is right. What is the smallest value the expression can take?

(c) Find every x for which $x^2 + 10x + 29 = 13$.

10. A new operation $*$ is defined on the real numbers by $a * b = 2ab$. (4 points)

(a) Find the identity for $*$: a number e with $a * e = a$ and $e * a = a$ for every real number a.

(b) For a real number a, find its inverse under $*$: a number b with $a * b = e$, where e is your answer to (a).

(c) Which real number has no inverse under $*$? Explain.

11. A storm drops 18 mm of rain on a flat garage roof 12.5 m long and 8.0 m wide. All of the rain runs into barrels that hold 250 liters each. (5 points)

(a) Find the volume of rain on the roof in liters. Show a chain whose units cancel to liters.

(b) Give the volume to a sensible accuracy, and say which measurement limits it.

(c) How many barrels are needed to catch all of the rain?

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12. Hannah plans a bicycle ride of 5,000 km across a country. The bicycle's wheels are about 50 cm across. Estimate how many times each wheel turns on the ride. Show the conversion factors with the units canceling, and give the answer in scientific notation to two significant figures. (3 points)

13. Hannah caters two identical lunches, one on Saturday and one on Sunday, each for g guests. Each lunch costs 21 dollars a guest plus a setup charge of 90 dollars, and there is one delivery fee of 40 dollars for the weekend. The total charge is

$$2(21g + 90) + 40$$

dollars. (4 points)

(a) Say what the sum in parentheses, $21g + 90$, the factor 2 and the term 40 stand for.

(b) Use the distributive property and combine like terms to write the total with one term in g and one constant. Say what the new coefficient of g and the new constant mean.

(c) Find the total charge when each lunch has 44 guests.

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