NAME: _____ DATE: _____

ALGEBRA 1 SUMMER ASSIGNMENT

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Summer Math Assignment:

The Passaic Public Schools Mathematics Department requests all students to complete the summer assignment. Students must show work on white lined paper and return the assignment to their math teacher upon return to school. The teacher will administer assessment on the summer assignment during the month of September.

Thank you and have a great summer.

NAME: _____ DATE: _____

ALGEBRA 1 SUMMER ASSIGNMENT

DIRECTIONS: This worksheet consists of 9 parts. It is a brief review of concepts that are critical to understanding Algebra 1 next year. It is to be completed during the summer BEFORE the first day of school 2017. Turn this assignment in to your Algebra teacher on the first day of school.

PART 1: VARIABLES AND EXPRESSIONS

You can represent mathematical phrases and real-world relationships using symbols and operations. This is called an algebraic expression.

For example, the phrase *3 plus a number* n can be expressed using symbols and operations as 3 + *n*.

Problem

What is the phrase *5 minus a number* d as an algebraic expression?

$$\underbrace{5}_{5} \quad \underbrace{\textit{minus}}_{-} \quad \underbrace{\textit{a number d}}_{d}$$

The phrase *5 minus a number* d, rewritten as an algebraic expression, is 5 — *d.*

The left side of the table below gives some common phrases used to express mathematical relationships, and the right side of the table gives the related symbol.

Phrase	Symbol
sum	+
difference	−
product	×
quotient	÷
less than	−
more than	+

Exercises: Write an algebraic expression for each word phrase.

1. 5 plus a number *d*

2. the product of 5 and *g*

3. 11 fewer than a number *f*

4. 17 less than *h*

5. the quotient of 20 and *t*

6. the sum of 12 and 4

ALGEBRA 1 SUMMER ASSIGNMENT

Write a word phrase for each algebraic expression.

7. $h + 6$

8. $m - 5$

9. $q \times 10$

10. $\frac{35}{r}$

11. $h + m$

12. $5n$

NAME: _____ DATE: _____

ALGEBRA 1 SUMMER ASSIGNMENT

NOTE: Multiple operations can be combined into a single phrase.

Problem ıraic expression?

11	*minus*	*the product of 3 and a number d*
11	–	$3 \times d$

The phrase *11 minus the product of 3 and a number d,* rewritten as an algebraic expression, is 11 – 3*d*.

Exercises

Write an algebraic expression for each phrase.

13. 12 less than the quotient of 12 and a number *z*

14. 5 greater than the product of 3 and a number *q*

15. the quotient of 5 + *h* and *n* + 3

16. the difference of 17 and $\frac{22}{t}$

Write an algebraic expression or equation to model the relationship expressed in each situation below.

17. Mariela is building a model boat. Every inch on her model is equivalent to 3.5 feet on the real boat her model is based on. What would be the mathematical rule to express the relationship between the length of the model, *m*, and the length of the boat, *b*?

18. Javier is putting away savings for his college education. Every time Javier puts money in his fund, his parents put in $2. What is the expression for the amount going into Lyn's fund if Lyn puts in *L* dollars?

ALGEBRA 1 SUMMER ASSIGNMENT

PART 2: ORDER OF OPERATIONS AND EVALUATING EXPRESSIONS

Exponents are used to represent repeated multiplication of the same number. For example, $4 \times 4 \times 4 \times 4 \times 4 = 4^5$. The number being multiplied by itself is called the base; in this case, the base is 4. The number that shows how many times the base appears in the product is called the exponent; in this case, the exponent is 5. 4^5 is read *four to the fifth power.*

Problem

How is $6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6$ written using an exponent?

The number 6 is multiplied by itself 7 times. This means that the base is 6 and the exponent is 7. $6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6$ written using an exponent is 6^7.

Exercises

Write each repeated multiplication using an exponent.

1. $4 \times 4 \times 4 \times 4 \times 4$

2. $2 \times 2 \times 2$

3. $1.1 \times 1.1 \times 1.1 \times 1.1 \times 1.1$

4. $3.4 \times 3.4 \times 3.4 \times 3.4 \times 3.4 \times 3.4$

5. $(-7) \times (-7) \times (-7) \times (-7)$

6. $11 \times 11 \times 11$

Write each expression as repeated multiplication.

7. 4^3

8. 5^4

9. 1.5^2

10. $\left(\frac{2}{7}\right)^4$

11. x^7

12. $(5n)^5$

13. Vanessa wants to determine the volume of a cube with sides of length s. Write an expression that represents the volume of the cube.

NAME: _____ DATE: _____

ALGEBRA 1 SUMMER ASSIGNMENT

NOTE: The order of operations is a set of guidelines that make it possible to be sure that two people will get the same result when evaluating an expression. Without this standard order of operations, two people might evaluate an expression differently and arrive at different values. For example, without the order of operations, someone might evaluate all expressions from left to right, while another person performs all additions and subtractions before all multiplications and divisions.

You can use the acronym P.E.M.A. (**P**arentheses, **E**xponents, **M**ultiplication and Division, and **A**ddition and Subtraction) to help you remember the order of operations.

Problem

How do you evaluate the expression $3 + 4 \times 2 - 10 \div 5$?

$3 + 8 - 10 \div 5$ $= 3 + 8 - 2$	There are no parentheses or exponents, so first, do any multiplication or division from left to right.
$= 11 - 2$	Do any addition or subtraction from left to right.
$= 9$	

Exercises

Simplify each expression.

14. $(5 + 3)^2$

15. $(8 - 5)(14 - 6)$

16. $(15 - 3) \div 4$

17. $\left(\frac{22 + 3}{5}\right)$

18. $40 - 15 \div 3$

19. $20 + 12 \div 2 - 5$

20. $(4^2 + 5^2)^2$

21. $4 \times 5 - 3^2 \times 2 \div 6$

Write and simplify an expression to model the relationship expressed in the situation below.

22. Manuela has two boxes. The larger of the two boxes has dimensions of 15 cm by 25 cm by 20 cm. The smaller of the two boxes is a cube with sides that are 10 cm long. If she were to put the smaller box inside the larger, what would be the remaining volume of the larger box?

ALGEBRA 1 SUMMER ASSIGNMENT

PART 3: REAL NUMBERS AND THE NUMBER LINE

A number that is the product of some other number with itself, or a number to the second power, such as $9 = 3 \times 3 = 3^2$, is called a perfect square. The number that is raised to the second power is called the square root of the product. In this case, 3 is the square root of 9. This is written in symbols as $\sqrt{9} = 3$. Sometimes
square roots are whole numbers, but in other cases, they can be estimated.

Problem

What is an estimate for the square root of 150?

There is no whole number that can be multiplied by itself to give the product of 150.

10× 10 = 100

11× 11 = 121

12× 12 = 144

13× 13 = 169

You cannot find the exact value of $\sqrt{150}$, but you can estimate it by comparing
150 to perfect squares that are close to 150.

150 is between 144 and 169, so $\sqrt{150}$ is between $\sqrt{144}$ and $\sqrt{169}$.

$$\sqrt{144} < \sqrt{150} < \sqrt{169}$$

$$12 < \sqrt{150} < 13$$

The square root of 150 is between 12 and 13. Because 150 is closer to 144 than it is to 169, we can estimate that the square root of 150 is slightly greater than 12.

Exercises

Find the square root of each number. If the number is not a perfect square, estimate the square root to the nearest integer.

1. 100 **2.** 49 **3.** 9

4. 25 **5.** 81 **6.** 169

7. 15 **8.** 24 **9.** 40

10. A square mat has an area of 225 cm^2. What is the length of each side of the mat?

NAME: _____ DATE: _____

ALGEBRA 1 SUMMER ASSIGNMENT

PART 4: PROPERTIES OF REAL NUMBERS

Certain properties of real numbers lead to the creation of EQUAL expressions.

Commutative Properties

The commutative properties of addition and multiplication: changing the order of the numbers in an addition or multiplication problem does not change the answer

Addition: $a + b = b + a$ Multiplication: $a \cdot b = b \cdot a$

Commutative = commute = to MOVE EX: Your teacher COMMUTES to work from Jersey City

Problem

Do the following equations illustrate commutative properties?

a. $3 + 4 = 4 + 3$ **b.** $(5 \times 3) \times 2 = 5 \times (3 \times 2)$ **c.** $1 - 3 = 3 - 1$

A: 3 + 4 and 4 + 3 both simplify to 7, so the two sides of the equation in part (a) are equal. Since both sides have the same two addends but in a different order, this equation illustrates the Commutative Property of Addition.

B: The expression on each side of the equation in part (b) simplifies to 30. Both sides contain the same 3 factors. However, this equation does not illustrate the Commutative Property because the terms are in the same order on each side of the equation.

C: 1 – 3 and 3 – 1 do not have the same value, so the equation in part (c) is not true. There is **NOT** a commutative property for subtraction OR division.

Associative Properties

The associative properties of addition and multiplication: changing the grouping of numbers in an addition or multiplication problem does not change the answer

Addition: $(a + b) + c = a + (b + c)$ Multiplication: $(a \cdot b) \cdot c = a \cdot (b \cdot c)$

Associative = associate = to talk to EX: You ASSOCIATE with your group of friends

Problem

Do the following equations illustrate associative properties?

a. $(1 + 5) + 4 = 1 + (5 + 4)$

b. $4 \times (2 \times 7) = 4 \times (7 \times 2)$

(1 + 5) + 4 and 1 + (5 + 4) both simplify to 10, so the two sides of the equation in part (a) are equal. Since both sides have the same #s in the same order but grouped differently, this equation illustrates the Associative Property of Addition.

The expression on each side of the equation in part (b) simplifies to 56. Both sides contain the same 3 factors. However, the same factors that were grouped together on the left side have been grouped together on the right side; only the order has changed. This equation does NOT illustrate

the Associative Property of Multiplication.

Other properties of real numbers include:

a. Identity property of addition:	$a + 0 = 0$	$12 + 0 = 12$
b. Identity property of multiplication:	$a \cdot 1 = a$	$32 \cdot 1 = 32$
c. Zero property of multiplication:	$a \cdot 0 = 0$	$6 \cdot 0 = 0$
d. Multiplicative property of negative one:	$-1 \cdot a = -a$	$-1 \cdot 7 = -7$

Exercises

What property is illustrated by each statement?

1. $(m + 7.3) + 4.1 = m + (7.3 + 4.1)$

2. $5p \cdot 1 = 5p$

3. $12x + 4y + 0 = 12x + 4y$

4. $(3r)(2s) = (2s)(3r)$

5. $17 + (-2) = (-2) + 17$

6. $-(-3) = 3$

PART 5: ADDING AND SUBTRACTING REAL NUMBERS

You can add real numbers using a number line or using the following rules.

Rule 1: To add two numbers with the same sign, add their absolute values. The sum has the same sign as the addends.

Problem

What is the sum of –7 and –4?

Use a number line.

Start at zero.
Move 7 spaces to the left to represent -7.
Move another 4 spaces to the left to represent -4.

The sum is -11

Use the rule.

$-7 + (-4)$	The addends are both negative.
$\|-7\| + \|-4\|$	Add the absolute values of the addends.
$7 + 4 = 11$	$\|-7\| = 7$ and $\|-4\| = 4$.

ALGEBRA 1 SUMMER ASSIGNMENT

–7 + (–4) = –11	The sum has the same sign as the addends.

Rule 2: To add two numbers with different signs, subtract their absolute values. The sum has the same sign as the addend with the greater absolute value.

Problem

What is the sum of –6 and 9?

Use the rule.

9 + (–6)	The addends have different signs.
|9| – |–6|	Subtract the absolute values of the addends.
9 – 6 = 3	|9| = 9 and |–6| = 6.
9 + (–6) = 3	The positive addend has the greater absolute value.

Find each sum.

1. –4 + –12	**2.** –3 + 15	**3.** –9 + 1
4. 13 + (–7)	**5.** 8 + (–14)	**6.** –11 + (–5)
7. 4.5 + (–1.1)	**8.** –5.1 + 8.3	**9.** 6.4 + 9.8

NOTE: Addition and subtraction are inverse operations. To subtract a real number, add its opposite.

Problem

What is the difference –5 – (–8)?

–5 – (–8) = –5 + 8	The opposite of –8 is 8.
= 3	Use Rule 2.

The difference –5 – (–8) is 3.

Exercises

Find each difference.

10. 8 – 20	**11.** 6 – (–12)	**12.** –4 – 9
13. –8 – (–14)	**14.** –11 – (–4)	**15.** 17 – 25
16. 3.6 – (–2.4)	**17.** –1.5 – (–1.5)	**18.** –1.7 – 5.4

19. The temperature was 5^0C. Five hours later, the temperature had dropped 10^0C. What is the new temperature?

ALGEBRA 1 SUMMER ASSIGNMENT

PART 6: MULTIPLYING AND DIVIDING REAL NUMBERS

You need to remember two simple rules when multiplying or dividing real numbers.

1. The product or quotient of two numbers with the same sign is positive.
2. The product or quotient of two numbers with different signs is negative.

Problem

What is the product –6(–30)?

–6(–30) = 180 –6 and –30 have the same sign so the product is positive.

Problem

What is the quotient 72 ÷ (–6)?

72 ÷ (–6) = –12 72 and –6 have different signs so the quotient is negative.

Exercises: Find each product or quotient (refer to the example problems on the previous page!)

1. –5(–6) **2.** 7(–20) **3.** –3 × 22

4. 44 ÷ 2 **5.** 81 ÷ (–9) **6.** –55 ÷ (–11)

7. –62 ÷ 2 **8.** 25 · (–4) **9.** $(-6)^2$

10. –9.9 ÷ 3 **11.** –7.7 ÷ (–11) **12.** –1.4(–2)

13. $-\frac{1}{2} \times \frac{1}{3}$ **14.** $-\frac{2}{3}\left(-\frac{3}{5}\right)$ **15.** $\frac{3}{4} \cdot \left(-\frac{1}{3}\right)$

16. The temperature dropped 2°F each hour for 6 hours. What was the total change in temperature?

17. Reasoning Since $5^2 = 25$ and $(-5)^2 = 25$, what are the two values for the square root of 25?

NAME: _____ DATE: _____

ALGEBRA 1 SUMMER ASSIGNMENT

Dividing Fractions: The product of 7 and $\frac{1}{7}$ is 1. Two numbers whose product is 1 are called reciprocals. To divide a number by a fraction, multiply by its reciprocal.

Problem

What is the quotient $\frac{2}{3} \div \left(-\frac{5}{7}\right)$?

$\frac{2}{3} \div \left(-\frac{5}{7}\right) = \frac{2}{3} \times \left(-\frac{7}{5}\right)$ To divide by a fraction, multiply by its reciprocal.

$= -\frac{14}{15}$ The signs are different so the answer is negative.

Exercises: Find each quotient.

18 $\frac{1}{2} \div \frac{1}{3}$

19. $-6 \div \frac{2}{3}$

20. $-\frac{2}{5} \div \left(-\frac{2}{3}\right)$

21. $\frac{1}{2} \div \left(-\frac{1}{4}\right)$

22. $\left(-\frac{5}{7}\right) \div \left(-\frac{1}{2}\right)$

23. $-\frac{2}{3} \div \frac{1}{4}$

24. Writing Another way of writing $\frac{a}{b}$ is a ÷b Explain how you could evaluate $\frac{\frac{1}{2}}{\frac{1}{6}}$

ALGEBRA 1 SUMMER ASSIGNMENT

PART 7: THE DISTRIBUTIVE PROPERTY

The Distributive Property states that the product of a sum and another factor can be rewritten as the sum of two products, each term in the sum multiplied by the other factor. For example, the Distributive Property can be used to rewrite the product $3(x + y)$ as the sum $3x + 3y$. Each term in the sum $x + y$ is multiplied by 3; then the new products are added.

Problem

What is the simplified form of each expression?

a. $4(x + 5)$
$= 4(x) + 4(5)$ Distributive Property
$= 4x + 20$ Simplify.

b. $(2x – 3)(– 3)$
$= 2x(–3) – 3 (–3)$ Distributive Property
$= –6x + 9$ Simplify.

The Distributive Property can be used whether the factor being multiplied by a sum or difference is on the left or right.

The Distributive Property is sometimes referred to as the Distributive Property of Multiplication over Addition. It may be helpful to think of this longer name for the property, as it may remind you of the way in which the operations of multiplication and addition are related by the property.

Exercises

Use the Distributive Property to simplify each expression.

1. $6(z + 4)$ **2.** $2(–2 – k)$ **3.** $(5x + 1)4$ **4.** $(7 – 11n)10$

5. $(3 – 8w)4.5$ **6.** $(4p + 5)2.6$ **7.** $4(y + 4)$ **8.** $6(q – 2)$

Write each fraction as a sum or difference.

9. $\frac{2m-5}{9}$ **10.** $\frac{8+7z}{11}$ **11.** $\frac{24f+15}{9}$ **12.** $\frac{12d-16}{6}$

Simplify each expression.

13. $–(6 + j)$ **14.** $–(–9h – 4)$ **15.** $–(–n + 11)$ **16.** $–(6 – 8f)$

ALGEBRA 1 SUMMER ASSIGNMENT

ALGEBRA 1 SUMMER ASSIGNMENT

The previous problems showed how to write a product as a sum using the Distributive Property. The property can also be used to go in the other order, to convert a sum into a product.

Problem

How can the sum of like terms $15x + 6x$ be simplified using the Distributive Property?

Each term of $15x + 6x$ has a factor of x. Rewrite $15x + 6x$ as $15(x) + 6(x)$. Now use the Distributive Property in reverse to write $15(x) + 6(x)$ as $(15 + 6)x$, which simplifies to $21x$.

Exercises

Simplify each expression by combining like terms.

17. $16x + 12x$

18. $25n - 17n$

19. $-4p + 6p$

20. $-15a - 9a$

21. $-9k^2 - 5k^2$

22. $12t^2 - 20t^2$

ALGEBRA 1 SUMMER ASSIGNMENT

By thinking of or rewriting numbers as sums or differences of other numbers that are easier to use in multiplication, the Distributive Property can be used to make calculations easier.

Problem

How can you multiply 78 by 101 using the Distributive Property and mental math?

78 × 101	Write the product.
78 × (100 + 1)	Rewrite 101 as sum of two numbers that are easy to use in
78(100) + 78(1)	Use the Distributive Property to write the product as a sum.
7800 + 78	Multiply.
7878	Simplify.

Exercises

Use mental math to find each product.

23. 5.1 × 7 **24.** 24.9 × 4 **25.** 999 × 11 **26.** 12 × 95

ALGEBRA 1 SUMMER ASSIGNMENT

PART 8: INTRODUCTION TO EQUATIONS

An equation is a mathematical sentence with an equal sign. An equation can be true, false, or open. An equation is true if the expressions on both sides of the equal sign are equal, for example 2 + 5 = 4 + 3. An equation is false if the expressions on both sides of the equal sign are not equal, for example 2 + 5 = 4 + 2.

An equation is considered open if it contains one or more variables, for example $x + 2 = 8$. When a value is substituted for the variable, you can then decide whether the equation is true or false for that particular value. If an open sentence is true for a value of the variable, that value is called a solution of the equation. For $x + 2 = 8$, 6 is a solution because when 6 is substituted in the equation for x, the equation is true: 6 + 2 = 8.

Problem

Is the equation true, false, or open? Explain.

a. 15 + 21 = 30 + 6 — The equation is true, because both expressions equal 36.

b. 24 ÷ 8 = 2 · 2 — The equation is false, because 24 ÷ 8 = 3 and 2 · 2 = 4; 3 ≠ 4.

c. $2n + 4 = 12$ — The equation is open, because there is a variable in the on the left side.

Tell whether each equation is true, false, or open. Explain.

1. 2(12) – 3(6) – 12

2. $3x + 12 = -19$

3. 14 – 19 = –5

4. 2(–8) + 4 = 12

5. $7 - 9 + 3 = x$

6. (28 + 12) ÷ –2 = –20

7. 14 – (–8) – 14 = 8

8. (13 – 16) ÷ 3 = 1

9. 42 ÷ 7 + 3 = 9

Problem

Is $x = -3$ a solution of the equation $4x + 5 = -7$?

$4x + 5 = -7$

$4(-3) + 5 = -7$ — Substitute –3 for x.

$-7 = -7$ — Simplify.

Since –7 = –7, –3 is a solution of the equation $4x + 5 = -7$.

Tell whether the given number is a solution of each equation.

10. $4x - 1 = -27; -7$

11. $18 - 2n = 14; 2$

12. $21 = 3p - 5; 9$

NAME: _____ DATE: _____

ALGEBRA 1 SUMMER ASSIGNMENT

13. $k = (-6)(-8) - 14; -62$ **14.** $20v + 36 = -156; -6$ **15.** $8y + 13 = 21; 1$

16. $-24 - 17t = -58; 2$ **17.** $-26 = \frac{1}{3}m + 5; -7$ **18.** $\frac{1}{4}g - 8 = \frac{3}{2}; 38$

Write an equation for each sentence.

19. 13 times the sum of a number and 5 is 91.

20. Negative 8 times a number minus 15 is equal to 30.

21. Jared receives $23 for each lawn he mows. What is an equation that relates the number of lawns *w* that Jared mows and his pay *p*?

22. Shariff has been working for a company 2 years longer than Patsy. What is an equation that relates the years of employment of Shariff *S* and the years of employment of Patsy *P*?

Use mental math to find the solution of each equation.

23. $h + 6 = 13$ **24.** $-11 = n + 2$ **25.** $6 - k = 14$ **26.** $5 = -8 + t$

27. $\frac{z}{5} = -2$ **28** $\frac{j}{-6} = 12$ **29.** $8c = -48$ **30.** $-15a = -45$

ALGEBRA 1 SUMMER ASSIGNMENT

ALGEBRA 1 SUMMER ASSIGNMENT

PART 9: PATTERNS, EQUATIONS AND GRAPHS

Tables, equations, and graphs are some of the ways that a relationship between two quantities can be represented. You can use the information provided by one representation to produce one of the other representations; for example, you can use data from a table to produce a graph. You can also use any of the representations to draw conclusions about the relationship.

Problem

Are (2, 11) and (5, 3) solutions of the equation $y = 3x + 5$?

For each ordered pair, you can substitute the *x*- and *y*- coordinates into the equation for *x* and *y* and then simplify to see if the values satisfy the equation.

For (2, 11):		For (5, 3):
$11 = 3(2) + 5$	Substitute for *x* and	$3 = 3(5) + 5$
$11 = 11$	Multiply and then	$3 \neq 20$

Since both sides of the equation have the same value, the ordered pair (2, 11) is a solution of the equation $y = 3x + 5$. Since the two sides of the equation have different values, the ordered pair (5, 3) is not a solution of the equation $y = 3x + 5$.

Problem

The table shows the relationship between the number of hours Kaya works at her job and the amount of pay she receives. Extend the pattern. How much money would Kaya earn if she worked 40 hours?

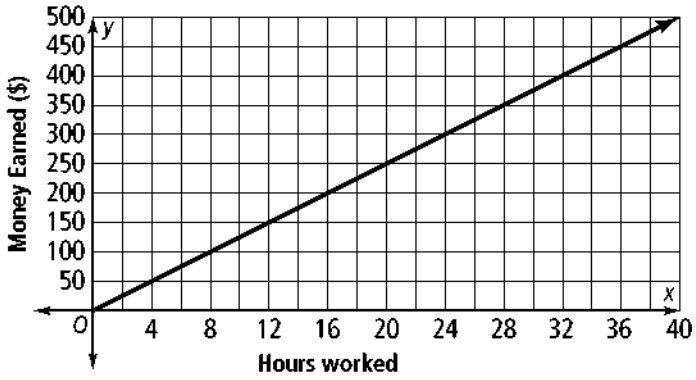
Hours Worked	Money Earned ($)
3	37.50
6	75
9	112.50
12	150

Method 1: Write an equation.

$y = 12.50x$	Kaya earns $12.50 per hour.
$= 12.50(40)$	Substitute 40 for *x*.
$= 500$	Simplify.

She would earn $500 in 40 hours.

Method 2: Draw a graph.



ALGEBRA 1 SUMMER ASSIGNMENT

She would earn $500 in 40 hours.

Exercises

Tell whether the equation has the given ordered pair as a solution.

1. $y = x - 7$; (2, –5)

2. $y = x + 6$; (–5, 11)

3. $y = -x + 1$; (–1, 0)

4. $y = -5x$; (–3, –15)

5. $y = x - 8$; (7, –1)

6. $y = x + \frac{3}{4}; (-1, -\frac{1}{4})$

Use a table, an equation, and a graph to represent each relationship.

7. Tickets to the fair cost $17.

8. Brian is 5 years older than Sam.

Use the table to draw a graph and answer the question.

9. The table shows Jake's earnings for the number of cakes he baked. What are his earnings for baking 75 cakes?

Cakes	Earnings ($)
5	120
10	240
15	360

Use the table to write an equation and answer the question.

10. The table shows the number of miles that Kate runs on a weekly basis while training for a race. How many total miles will she have run after 15 weeks?

ALGEBRA 1 SUMMER ASSIGNMENT

Training Weeks	Miles Run
1	40
2	80
3	120