**C – Expressions and Equations, Lesson 5, Transforming Formulas (r. 2018)**

EXPRESSIONS AND EQUATIONS

Transforming Formulas

|  |  |
| --- | --- |
| **Common Core Standard**  **A-CED.A.4** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm’s law V=IR to highlight resistance R.* | **Next Generation Standard**  **AI-A.CED.4** Rewrite formulas to highlight a quantity of interest, using the same reasoning as in solving equations.  e.g., Rearrange Ohm’s law *V = IR* to highlight resistance *R*. |

**LEARNING OBJECTIVES**

Students will be able to:

1. rewrite (transform) formulas to isolate specific variables.

**Overview of Lesson**

|  |  |
| --- | --- |
| **Teacher Centered Introduction**  **Overview of Lesson**  **- activate students’ prior knowledge**  **- vocabulary**  **- learning objective(s)**  **- big ideas: direct instruction**  **- modeling** | **Student Centered Activities**  **guided practice Teacher: anticipates, monitors, selects, sequences, and connects student work**  **- developing essential skills**  **- Regents exam questions**  **- formative assessment assignment (exit slip, explain the math, or journal entry)** |

**VOCABULARY**

formula

transform

transformation

isolate

**BIG IDEAS**

Properties and operations can be used to transform **formulas** to isolate different variables in the same ways that equations are manipulated to isolate a variable.

Example: The **formula**  can be used to find the perimeter of a rectangle. In English,  translates as “The ***p****erimeter equals two times the length plus two times the width*.” In the **formula** , the *P* variable is already isolated. You can isolate the *l* variable or the *w* variables, as follows. (*Note that the steps and operations are the same as with regular equations.*)

|  |  |
| --- | --- |
| To isolate the *l* variable:  Start with the formula:    Move the term 2w to the left expression.    Divide both sides of the equation by 2.    You now have a formula for *l* in terms of *P* and *w*. | To isolate the *w* variable:  Start with the formula:    Move the term 2*l* to the left expression.    Divide both sides of the equation by 2.    You now have a formula for *l* in terms of *P* and *w*. |

**DEVELOPING ESSENTIAL SKILLS**

Isolate each variable in the Volume formula for a rectangular prism .



Isolate each variable in the slope intercept formula of a line .



**REGENTS EXAM QUESTIONS**

A.CED.A.4: Transforming Formulas

69) The formula for the volume of a cone is *.* The radius, *r*, of the cone may be expressed as

|  |  |  |  |
| --- | --- | --- | --- |
| 1) |  | 3) |  |
| 2) |  | 4) |  |

70) The formula for the area of a trapezoid is . Express  in terms of *A*, *h*, and . The area of a trapezoid is 60 square feet, its height is 6 ft, and one base is 12 ft. Find the number of feet in the other base.

71) The equation for the volume of a cylinder is . The positive value of *r*, in terms of *h* and *V*, is

|  |  |  |  |
| --- | --- | --- | --- |
| 1) |  | 3) |  |
| 2) |  | 4) |  |

72) The distance a free falling object has traveled can be modeled by the equation , where *a* is acceleration due to gravity and *t* is the amount of time the object has fallen. What is *t* in terms of *a* and *d*?

|  |  |  |  |
| --- | --- | --- | --- |
| 1) |  | 3) |  |
| 2) |  | 4) |  |

73) The volume of a large can of tuna fish can be calculated using the formula . Write an equation to find the radius, *r*, in terms of *V* and *h*. Determine the diameter, to the nearest inch, of a large can of tuna fish that has a volume of 66 cubic inches and a height of 3.3 inches.

74) Michael borrows money from his uncle, who is charging him simple interest using the formula . To figure out what the interest rate, *r*, is, Michael rearranges the formula to find *r*. His new formula is *r* equals

|  |  |  |  |
| --- | --- | --- | --- |
| 1) |  | 3) |  |
| 2) |  | 4) |  |

75) The formula for the sum of the degree measures of the interior angles of a polygon is . Solve for *n*, the number of sides of the polygon, in terms of *S*.

76) Solve the equation below for *x* in terms of *a*.



77) Boyle's Law involves the pressure and volume of gas in a container. It can be represented by the formula . When the formula is solved for , the result is

|  |  |  |  |
| --- | --- | --- | --- |
| 1) |  | 3) |  |
| 2) |  | 4) |  |

78) The formula for blood flow rate is given by , where *F* is the flow rate,  the initial pressure,  the final pressure, and *r* the resistance created by blood vessel size. Which formula can *not* be derived from the given formula?

|  |  |  |  |
| --- | --- | --- | --- |
| 1) |  | 3) |  |
| 2) |  | 4) |  |

79) Using the formula for the volume of a cone, express *r* in terms of *V*, *h*, and .

80) The formula  calculates the gravitational force between two objects where *G* is the gravitational constant,  is the mass of one object,  is the mass of the other object, and *r* is the distance between them. Solve for the positive value of *r* in terms of , *G*, , and .

81) Students were asked to write a formula for the length of a rectangle by using the formula for its perimeter, . Three of their responses are shown below.

I. 

II. 

III. 

Which responses are correct?

|  |  |  |  |
| --- | --- | --- | --- |
| 1) | I and II, only | 3) | I and III, only |
| 2) | II and III, only | 4) | I, II, and III |

**SOLUTIONS**

69) ANS: 1

Strategy: Use the four column method.

|  |  |  |  |
| --- | --- | --- | --- |
| Notes | Left Expression | Sign | Right Expression |
| Given |  | = |  |
| Multiply both expressions by 3 |  | = |  |
| Divide both expressions by |  | = |  |
| Simplify |  | = |  |
| Take square root of both sides. |  | = |  |

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70) ANS:

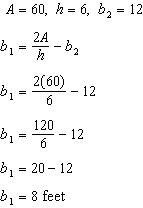
a) 

b) The other base is 8 feet.

Strategy: Use the four column method to isolate ** and create a new formula, then use it to find the length of the other base.

|  |  |  |  |
| --- | --- | --- | --- |
| Notes | Left Expression | Sign | Right Expression |
| Given |  | = |  |
| Multiply both expressions by 2 |  | = |  |
| Divide both expressions by *h* |  | = |  |
| Simplify |  | = |  |
| Subtract  from both expressions |  | = |  |

Substitute the values stated in the problem in the formula.



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71) ANS: 1

Strategy: Use the four column method to isolate *r*.

|  |  |  |  |
| --- | --- | --- | --- |
| Notes | Left Expression | Sign | Right Expression |
| Given |  | = |  |
| Divide both expressions by |  | = |  |
| Simplify |  | = |  |
| Take square root of both expressions. |  | = |  |

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72) ANS: 2

Strategy: Use the four column method. Isolate *t*.

|  |  |  |  |
| --- | --- | --- | --- |
| Notes | Left Expression | Sign | Right Expression |
| Given |  | = |  |
| Multiply both expressions by 2 | 2*d* | = |  |
| Divide both expressions by *a* |  | = |  |
| Simplify |  | = |  |
| Take square root of both expressions |  | = | *t* |

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73) ANS:

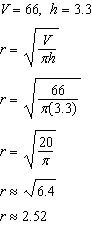
a) 

b) 5 inches

Strategy: Use the four column method to isolate *r* and create a new formula, then use the new formula to answer the problem.

|  |  |  |  |
| --- | --- | --- | --- |
| Notes | Left Expression | Sign | Right Expression |
| Given |  | = |  |
| Divide both expressions by |  | = |  |
| Simplify |  | = |  |
| Take square root of both expressions. |  | = |  |

Substitute the values from the problem into the new equation.



If the radius is approximately 2.5 inches, the diameter is approximately 5 inches.

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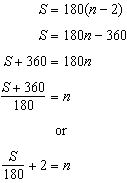
74) ANS: 3

Strategy: Isolate r, as follows:



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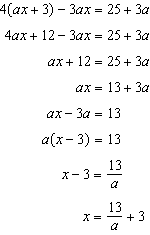
75) ANS:



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76) ANS:





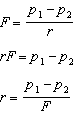
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77) ANS: 3

|  |  |  |  |
| --- | --- | --- | --- |
| Given |  | = |  |
| Divide by |  | = |  |
| Simplify |  | = |  |

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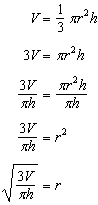
78) ANS: 3



If , then  cannot be true.

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79) ANS:

*.*

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80) ANS:



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81) ANS: 4

Strategy: Transform the formula to isolate the ** variable.



This is solution III.

NOTE that solution III can also be expressed as:



This is solution II.

NOTE also that the distributive property of multiplication can transform solution II into:



This is solution I.

The correct answer choice is I, II, and III.

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