Math 9 – Unit 3: Solving Equations

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Lesson 3.3: Rearranging Equations with variables

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Learning Goal: We are learning to rearrange formulas to solve for a given variable.

We live in a world full of formulas (especially in science classes like physics). Quite often, a given formula needs to be rearranged to allow us to solve for something else. In the questions below, solve for the indicated variable using your Solving Equations skills.

a) Given the formula for the area of a rectangle, $A = lw$, rearrange it for the width (w).

$A = lw$

$\Rightarrow \boxed{\frac{A}{l} = w}$

b) Given the formula for the perimeter of a rectangle, $P = 2(l + w)$, rearrange it for the length (l).

$P = 2(l + w)$

$P = 2l + 2w$

$P - 2w = 2l$

$\boxed{\frac{P-2w}{2} = l} \rightarrow l = \frac{P}{2} - w$

c) Given the physics equation, $v_2 = v_1 + a\Delta t$, rearrange to create a formula for acceleration (a)

$V_2 = V_1 + a(\Delta t)$

$V_2 - V_1 = a(\Delta t)$

$\boxed{\frac{V_2 - V_1}{\Delta t} = a}$

d) Given the formula for the circumference of a circle, $C = 2\pi r$, rearrange it for the radius, r.

$C = (2\pi)r$

$\boxed{\frac{C}{2\pi} = r}$

e) Given the formula for the volume of a rectangular prism (a box), $V = lwh$, rearrange it for the width, w

$V = (lh)w$

$\boxed{\frac{V}{lh} = w}$

f) Given the formula for simple interest, $I = Prt$, rearrange it for time, t.

$I = (Pr)t$

$\boxed{\frac{I}{Pr} = t}$

g) Given the formula for the Pythagorean Theorem, $a^2 + b^2 = c^2$, rearrange it for b.

$a^2 + b^2 = c^2$

$b^2 = c^2 - a^2$

$\boxed{b = \sqrt{c^2 - a^2}}$

h) Given the formula for the area of a trapezoid, $A = \frac{h(a+b)}{2}$, rearrange it for the base (b).

$$A = \frac{h(a+b)}{2}$$

$$2A = h(a+b)$$

$$2A = ah + bh$$

$$2A - ah = bh$$

$$\boxed{\frac{2A-ah}{h} = b}$$

i) Given the volume of a cone (yum, ice cream), $V = \frac{\pi r^2 h}{3}$, solve for the radius of the cone, r.

$$V = \frac{(\pi h) r^2}{3}$$

$$3V = (\pi h) r^2$$

$$\frac{3V}{\pi h} = r^2$$

$$\boxed{\sqrt{\frac{3V}{\pi h}} = r}$$

j) Given the physics equation to find the gravitational force between two bodies, $F_g = G\frac{m_1 m_2}{d^2}$, rearrange to solve for the distance, d.

$$F_g = \frac{G m_1 m_2}{d^2}$$

$$F_g \cdot d^2 = G m_1 m_2$$

$$d^2 = \frac{G m_1 m_2}{F_g}$$

$$\boxed{d = \sqrt{\frac{G m_1 m_2}{F_g}}}$$

k) Given the formula for the converting Celsius to Farenheit, $F = \frac{9}{5}C + 32$, solve it for Celsius, C.

$$F = \frac{9}{5}C + 32$$

$$F - 32 = \frac{9}{5}C$$

$$\boxed{\frac{5(F-32)}{9} = C}$$

l) Given $(v_2)^2 = (v_1)^2 + 2a(d_2 - d_1)$

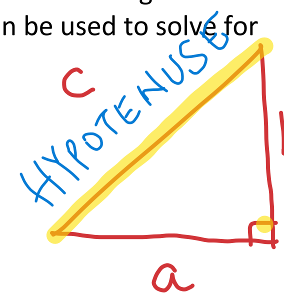
Rearrange the equation for the initial velocity, v_1

$$(v_2)^2 - 2a(d_2 - d_1) = (v_1)^2$$

$$\boxed{\sqrt{(v_2)^2 - 2a(d_2 - d_1)} = v_1}$$

ONLY USED FOR 90° TRIANGLES

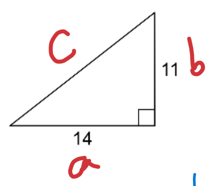
Application: The infamous Pythagorean Theorem is essentially an equation. As long as we have enough information, we can use it to solve. This section is to figure how Pythagorean Theorem can be used to solve for missing sides in right-angled triangle.



Part One: ***Pythagorean Theorem***

Given the following triangles, label the sides a, b, and c, then solve for the missing side.

1.



$c^2 = a^2 + b^2$

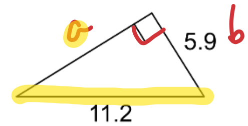
$\boxed{c = \sqrt{a^2+b^2}}$

$c = \sqrt{14^2 + 11^2}$

$c = \sqrt{196+121}$

$c = \sqrt{317} \approx 17.8$

2.



$c^2 = a^2 + b^2$ c

$c^2 - b^2 = a^2$

$\boxed{\sqrt{c^2-b^2} = a}$

$a = \sqrt{(11.2)^2 - (5.9)^2}$

$a = \sqrt{125.44 - 34.81}$

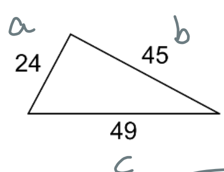
$a = \sqrt{90.63} \approx 9.5$

$\boxed{c^2 = a^2 + b^2}$

Part Two: ***Converse of Pythagorean Theorem***

Given the following triangles, use the Pythagorean Theorem to prove whether or not the triangle is a right-angled triangle. First, label the sides.

1.



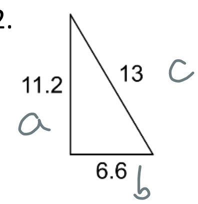
$c^2 = 49^2 = 2401$

$a^2 + b^2 = 24^2 + 45^2 = 576 + 2025 = 2601$

$\therefore c^2 \neq a^2 + b^2$

∴ It is NOT a RIGHT △

2.



$c^2 = 13^2 = 169$

$a^2 + b^2 = (11.2)^2 + (6.6)^2$

$= 125.44 + 43.56$

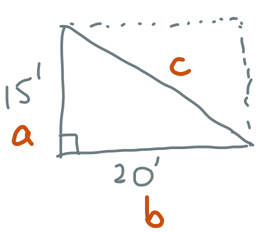
$= 169$

$\therefore c^2 = a^2 + b^2$

∴ It is a RIGHT △.

Part Three: Read the question twice. Draw the situation (probably utilizing a right-angled triangle). Label the information that you know. Solve for the missing side. Write the answer to the question in the sentence.

1. A television screen is described in terms of the diagonal measure of its screen. If a TV screen is 20 inches wide and 15 inches high, what is the length of its diagonal (and hence, the size of the TV)?



$c^2 = a^2 + b^2$

$c = \sqrt{a^2+b^2} = \sqrt{15^2 + 20^2} = \sqrt{225 + 400}$

$c = \sqrt{625} = 25'$

∴ The size of the TV is 25 inches.

Success Criteria:

- I can rearrange a formula by using inverse operations.
- I can use the Pythagorean Theorem to solve for a missing side in a triangle.