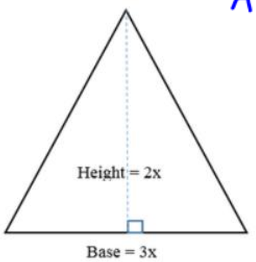
Mathematics 9 **Date:**

Day 5: Rearranging Formulas **Unit 3: Solving Equations**

THINK ABOUT IT: Determine the value of x if the area of the triangle below is 48 m^2.



$$\text{AREA} = \frac{\text{base} \times \text{height}}{2}$$

$\text{Area} = \frac{\text{base} \times \text{height}}{2}$ sub in values or expressions

$48 = \frac{3x \cdot 2x}{2}$

$48 = \frac{6x^2}{2}$ ← simplify

$\frac{48}{3} = \frac{3x^2}{3}$

$\sqrt{16} = \sqrt{x^2}$

$4 = x$

$\therefore x = 4$

REARRANGING FORMULAS – *Teacher directed*

A formula is a mathematical relationship between different quantities that is expressed with algebra. For example, one formula for **s**peed is **d**istance divided by **t**ime, which we express like:

$$t \times s = \frac{d}{t} \times t$$

In this case, we say *s* (speed) is the subject of the formula because *s* is isolated on one side of the equation and does not appear at all on the other. We can **change** the subject of the formula, for example by multiplying both sides by *t*. The equation becomes:

$$s \times t = d$$

Now, d is isolated and becomes the subject. This is called rearranging formulas.

1) Rearrange the following formulas to make b the subject: ⇒ isolate \ solve for b ⇒ Follow SAMDEB

Teacher SAMDEB	Your Turn	SAMDEB
$\frac{a}{2} = \frac{2b}{2}$ ← eliminate 2 by ÷ both sides by 2 $\frac{a}{2} = b$ ← rotate $b = \frac{a}{2}$ or $b = \frac{1}{2}a$	$a = 2b + 2$ $-2 \quad -2$ ← eliminate +2 by subtracting 2 $\frac{a-2}{2} = \frac{2b}{2}$ ← divide both sides by 2 $\frac{a-2}{2} = b$ ← rotate $b = \frac{a-2}{2}$	$a = 2b - 2c$ $+2c \quad +2c$ ← add 2c to both sides $\frac{a+2c}{2} = \frac{2b}{2}$ ← divide both sides by 2 $\frac{a+2c}{2} = b$ ← rotate $b = \frac{a+2c}{2}$

2) Rearrange the following formulas for the indicated variable: fractions, variable in numerator

Teacher SAMDEB	Your Turn	
$t \cdot F = \frac{mv}{\cancel{t}} \cdot \cancel{t}$ isolate m ← get rid of the denominator by multiplying both sides by t $\frac{Ft}{v} = \frac{mv}{v}$ ← divide both sides by v $\frac{Ft}{v} = m$ ← rotate $m = \frac{Ft}{v}$	$R \cdot I = \frac{E}{\cancel{R}} \cdot \cancel{R}$ isolate E ← multiply both sides by R $I \cdot R = E$ ← rotate $E = I \cdot R$	$2\pi \cdot r = \frac{C}{\cancel{2\pi}} \cdot \cancel{2\pi}$ isolate C ← multiply both sides by 2π $2\pi r = C$ ← rotate $C = 2\pi r$

3) Isolate for the indicated variable:

Teacher	Your Turn	
$P = 2(l + w)$ isolate l $P = 2l + 2w$ $-2w \quad -2w$ $\frac{P-2w}{2} = \frac{2l}{2}$ $\frac{P-2w}{2} = l$ $l = \frac{P-2w}{2}$ * distribute 2 * subtract 2w from both sides * ÷ both sides by 2	$A = P(1 + rt)$ isolate t $A = P + Prt$ $-P \quad -P$ $\frac{A-P}{Pr} = \frac{Prt}{Pr}$ $\frac{A-P}{Pr} = t$ $t = \frac{A-P}{Pr}$ * subtract P from both * divide both sides by P * rotate	$2 \cdot A = \frac{(a+b)h}{2} \cdot 2$ isolate a * get rid of the denominator $2A = (a+b)h$ $2A = h(a+b)$ $2A = ah + bh$ $-bh \quad -bh$ $\frac{2A-bh}{a} = \frac{ah}{a} \Rightarrow h = \frac{2A-bh}{a}$

4) Rearrange the following formulas for the indicated variable:

Teacher SAMPLE	Your Turn	
$a = 2b^2 - 4$ solve for b $+4 \quad +4$ $\frac{a+4}{2} = \frac{2b^2}{2}$ $\sqrt{\frac{a+4}{2}} = \sqrt{b^2}$ $\sqrt{\frac{a+4}{2}} = b$ $b = \sqrt{\frac{a+4}{2}}$ * add 4 to both sides * ÷ both sides by 2 * square root	$A = \pi r^2$ solve for r $\frac{A}{\pi} = \frac{\pi r^2}{\pi}$ $\sqrt{\frac{A}{\pi}} = \sqrt{r^2}$ $\sqrt{\frac{A}{\pi}} = r$ $r = \sqrt{\frac{A}{\pi}}$ * divide both sides by π * square root both sides	$V = \pi r^2 h$ solve for r $\frac{V}{\pi h} = \frac{\pi r^2 h}{\pi h}$ $\sqrt{\frac{V}{\pi h}} = \sqrt{r^2}$ $\sqrt{\frac{V}{\pi h}} = r$ $r = \sqrt{\frac{V}{\pi h}}$ * divide both sides by π then h * square root both sides * rotate

5) Rearrange the following formulas for the indicated variable:

Teacher	Your Turn	
$t \cdot s = \frac{d}{t} \cdot t$ solve for t $\frac{st}{s} = \frac{d}{s}$ $\boxed{t = \frac{d}{s}}$ * get rid of the denominator multiply both sides by t * divide both sides by s	$Z \cdot I = \frac{E}{Z} \cdot Z$ solve for Z $\frac{I \cdot Z}{I} = \frac{E}{I}$ $Z = \frac{E}{I}$ * multiply both sides by Z * divide both sides by I	$r^2 \cdot F = \frac{kq}{r^2} \cdot r^2$ solve for r $\frac{F \cdot r^2}{F} = \frac{kq}{F}$ $\sqrt{r^2} = \sqrt{\frac{kq}{F}}$ $r = \sqrt{\frac{kq}{F}}$ • × both sides by r^2 • ÷ both sides by F • sq root both sides

6) $V = \pi r^2 h$ is the formula used to calculate the volume of a cylinder.

Solve for r	Determine the radius when $V = 1000\ cm^3$ and height is $5\ cm$.
$\frac{V}{\pi h} = \frac{\pi r^2 h}{\pi h}$ $\sqrt{\frac{V}{\pi h}} = \sqrt{r^2}$ $\sqrt{\frac{V}{\pi h}} = r$ $r = \sqrt{\frac{V}{\pi h}}$ * ÷ by π, then ÷ by h * square root both sides * rotate	$r = \sqrt{\frac{V}{\pi h}}$ sub 1000 for V and 5 for h crucial $r = \sqrt{\frac{1000}{\pi \cdot 5}}$ evaluate ⇒ $1000 \div (\pi \cdot 5)$ $r = \sqrt{63.66}$ $r \cong 8$ cm

PRACTICE

1. Rearrange the following formulas for the indicated variable

$C = 2\pi r$ solve for r $\frac{C}{2\pi} = \frac{2\pi r}{2\pi}$ * divide by 2π $\frac{C}{2\pi} = r$ $r = \frac{C}{2\pi}$	$y = mx + b$ solve for m $-b \quad -b$ * subtract b $\frac{y-b}{x} = \frac{mx}{x}$ * divide both sides by x $\frac{y-b}{x} = m$ $m = \frac{y-b}{x}$	$\sqrt{A} = \sqrt{s^2}$ solve for s * sq root both sides $\sqrt{A} = s$ $s = \sqrt{A}$
$I = Prt$ solve for t $\frac{I}{Pr} = \frac{Prt}{Pr}$ * divide both sides by P then r $\frac{I}{Pr} = t$ $t = \frac{I}{Pr}$	$x^2 + y^2 = r^2$ solve for x $-y^2 \quad -y^2$ * subtract y^2 from both sides $\sqrt{x^2} = \sqrt{r^2 - y^2}$ * sq root both sides $x = \sqrt{r^2 - y^2}$	$I^2 \cdot R = \frac{P}{I^2} \cdot I^2$ solve for I * multiply both sides by I^2 $\frac{I^2 \cdot R}{R} = \frac{P}{R}$ * divide both sides by R $\sqrt{I^2} = \sqrt{\frac{P}{R}}$ * sq root both sides $I = \sqrt{\frac{P}{R}}$

2. **Rearrange** the following formulas for the indicated variables, then **evaluate** for the given values for each variable.

$I = Prt$ solve for r *Evaluate when I = \$30, P=\$1000, t=3 years* $\frac{I}{Pt} = \frac{Prt}{Pt}$ * divide both sides by P then t * rotate $\frac{I}{Pt} = r$ $r = \frac{I}{Pt}$ * sub in the values $r = \frac{30}{1000(3)}$ $= \frac{30}{3000}$ $\therefore r = 0.01$	$P = 2(l + w)$ solve for w *Evaluate when P=100m, l=30m* $P = 2l + 2w$ $-2l \quad -2l$ $\frac{P-2l}{2} = \frac{2w}{2}$ $\frac{P-2l}{2} = w$ $w = \frac{P-2l}{2}$ $w = \frac{100 - 2 \cdot 30}{2}$ $= \frac{100-60}{2}$ $= \frac{40}{2}$ $= 20$ $\therefore$ w is 20m

3. Rearrange then evaluate.

a) It is not safe for an adult to surpass her or his maximum heart rate. This maximum heart rate, M, in beats per minute (bpm), is modeled by the equation M=230 – 1.2A, where A is the age of the adult in years.

Rearrange to solve for A.

$M = 230 - 1.2A$
$-230 \quad -230$

$\frac{M-230}{-1.2} = \frac{-1.2A}{-1.2}$

$\frac{M-230}{-1.2} = A$

$\boxed{A = \frac{M-230}{-1.2}}$

At what age should a person's maximum exercising heart rate be 194 bpm?

$A = \frac{M-230}{-1.2}$ sub 194 for M

$= \frac{194-230}{-1.2}$

$= \frac{-36}{-1.2}$

$= 30$

∴ At age of 30.

b) The cost, C, in dollars, of producing a school yearbook is given by the formula C=S+4n, where S is the setup cost, and n is the number of yearbooks printed.

Solve the formula for n.

$C = S + 4n$
$-S \quad -S$

$\frac{C-S}{4} = \frac{4n}{4}$

$\frac{C-S}{4} = n$

$n = \frac{C-S}{4}$

If the set-up cost is $925, how many yearbooks can be printed? If S=$1500?

$n = \frac{C-S}{4}$

$= \frac{1500-925}{4}$

$= 143.75$

∴ 143 books can be printed.

c) The area, A, of a circle with radius r is given by $A = \pi r^2$.

Solve the formula for r.

$\frac{A}{\pi} = \frac{\pi \cdot r^2}{\pi}$

$\sqrt{\frac{A}{\pi}} = \sqrt{r^2}$

$\sqrt{\frac{A}{\pi}} = r$

Determine the radius of a circular oil spill that covers an area of 5.0 km^2

$r = \sqrt{\frac{A}{\pi}}$ sub 5 for A

$r = \sqrt{\frac{5}{\pi}}$

$r \cong 1.26$

∴ The radius is approximately 1.26 km.

d) You can convert Fahrenheit to Celsius using the following formula

Solve the formula for F.

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

$9C = 5(F-32)$

$9C = 5F - 32$
$+32 \quad +32$

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

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

What is 35°*C* converted to °*F* ?

$F = \frac{9C+32}{5}$ sub 35 for C

$= \frac{9(35)+32}{5}$

$= \frac{347}{5}$

$F = 69.4$

∴ It's 69.4°F degrees.