Section 1.1

Insulation materials have R-value (how good insulation is).

$U = \frac{1}{R}$

professionals use this number to gauge insulation strength.

Here R is a variable.

a letter, representing some number we may or may not know. R could be 10, 16, ...

And $\frac{1}{R}$ is an algebraic expression

Ex $\frac{1}{R}$ $x^2 + x$ $\frac{9}{5}C + 32$ $2x + 3y$

division squaring & addition

(when you take variable(s), do arithmetic on them)

So $\frac{1}{R}$ is an algebraic expression that gives a materials U-value

And $\frac{9}{5}C + 32$ is an algebraic expression that gives °F temp if C is a °C temp.

It's 20°C out... → $\frac{9}{5}C + 32$ (20 ↓)

so it's 68°F.

$= \frac{9}{5}(20) + 32$

$= 9 \cdot \frac{1}{5}(20) + 32$

$= 9 \cdot 4 + 32$

$= 36 + 32 = 68$

It's 100°C ... → $\frac{9}{5}(100) + 32$

so it's 212°F

$= 9 \cdot \frac{1}{5}(100) + 32$

$= 9 \cdot 20 + 32$

$= 180 + 32$

$= 212$

When you take an alg. expression, sub. in value(s) for variable(s), and calculate:

evaluating the expression.

Ex Evaluate for $x = 4$:

$31 - x$

$\vdots$

$31 - 4$

$\vdots$

27

$31 - x = 31 - 4$

$= 27$

$\frac{16}{x+4} = \frac{16}{4+4}$ (4 ↑)

$= \frac{16}{8}$

$= 2$

Ex Evaluate for $x = 7$ and $y = 5$.

$$4(\overset{7}{x} - \overset{5}{y}) = 4(7-5) = 4(2) = 8$$

$$\frac{40}{\overset{5}{y}} - \frac{7}{\overset{7}{x}} = \frac{40}{5} - \frac{7}{7} = 8 - 1 = 7$$

Maybe I need to know what R-value corresponds to $U = 0.2$.

Maybe I need to know what °C temp corresponds to 75°F.

$$\frac{1}{R} = 0.2$$

$$\frac{9}{5}\underbrace{C}_{\downarrow F} + 32 = 75$$

Equations: an alg. expression = some other alg. expression

Note: $\frac{1}{5} = 0.2$

5 is the solution to $\frac{1}{R} = 0.2$

A solutions to an equation is a number you can "plug in" for variables and the equation becomes true.

Ex $x - 20 = 17$

Is 3 a solution?

Try $3 - 20 \stackrel{?}{=} 17$

$-17 \neq 17$

No!

$7x = 45$

Is 6 a solution?

$7(6) \stackrel{?}{=} 45$

$42 \neq 45$

No!

$2(x+5) = 16$

Is 3 a solution?

$2(3+5) \stackrel{?}{=} 16$

$2(8) \stackrel{?}{=} 16$

$16 = \checkmark 16$

Yes.

Definition A formula is a specific kind of equation: one variable = some expression in some other variable

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

Ex Higher temp ↔ faster chirp rates with crickets.

$T = 0.3n + 40$

↖ number chirps/min.

Say you record 60 chirps/min.

$$T = 0.3\overset{60}{\downarrow}n + 40$$

$$T = 0.3(60) + 40$$

$$= 18 + 40$$

$$= 58$$

→ It's 58°F

A <u>mathematical model</u> is a formula but we're using a <u>simple</u> formula that doesn't exactly capture real world.

1) Evaluate $5(x+3)$ for $x=4$. $\longrightarrow$ $5(4+3) = 5(7) = 35$

2) Evaluate $\frac{5x+52}{3x}$ for $x=4$. $\longrightarrow$ $\frac{5(4)+52}{3(4)} = \frac{20+52}{12} = \frac{72}{12} = 6$

3) Evaluate $5x-4y$ for $x=7$ and $y=5$.

answer: 15

4) write an algebraic expression corresponding to

"the sum of a number and 6" $\longrightarrow$ $x+6$

5) write an algebraic expression corresponding to

"five times a number, decreased by 3" $\longrightarrow$ $5x-3$

6) Is 30 a solution to $50-y=20$? $\rightarrow$ Yes

7) Is 63 a solution to $\frac{r}{9}=7$? $\rightarrow$ Yes

8) Is 10 a solution to $3(w+2) = 4(w-3)$? $\rightarrow$ NO

$3(10+2) \stackrel{?}{=} 4(10-3)$

$3(12) \stackrel{?}{=} 4(7)$

$36 \neq 28$

9) write an equation corresponding to

"Five times a number is 35."

$5x = 35$

10) write an equation corresponding to

"The product of 6 and a number, increased by 3 is 33"

$6x+3 = 33$

and also

"The product of 6 and a number increased by 3 is 33."

$x+3$

$6(x+3) = 33$

1.2 Fractions

Ex Convert mixed numbers to improper fractions

$1\frac{2}{3}$

$= 1 \text{ and } \frac{2}{3}$

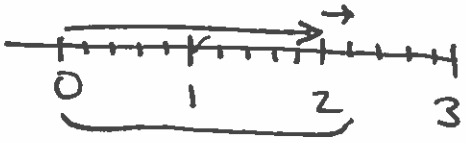
$= 1 + \frac{2}{3}$

$= \frac{3}{3} + \frac{2}{3}$

$= \frac{5}{3}$

$2\frac{1}{5}$

$= 2 + \frac{1}{5}$



11 steps at $\frac{1}{5}$...

$= \frac{11}{5}$

$4\frac{5}{9}$ (+, ×)

shortcut

$= \frac{41}{9}$

Ex Convert improper fractions to mixed numbers. (biggest thing < 11, div. by 2)

$\frac{11}{2} = \frac{10+1}{2}$

$= \frac{10}{2} + \frac{1}{2}$

$= 5 + \frac{1}{2}$

$= 5\frac{1}{2}$

$\frac{7}{3} = \frac{6+1}{3}$

$= \frac{6}{3} + \frac{1}{3}$

$= 2 + \frac{1}{3}$

$= 2\frac{1}{3}$

$\frac{15}{4} = \frac{12+3}{4}$

$= \frac{12}{4} + \frac{3}{4}$

$= 3 + \frac{3}{4}$

$= 3\frac{3}{4}$

Ex Reduce

$\frac{20}{5} = 4$

$\frac{16}{6} = \frac{2 \cdot 8}{2 \cdot 3}$ (2 divides both)

$= \frac{2}{2} \cdot \frac{8}{3}$

$= \frac{8}{3}$

$\frac{49}{14} = \frac{49 \div 7}{14 \div 7}$

$= \frac{7}{2}$

Ex $\frac{2}{3} \cdot \frac{6}{7} = \frac{12}{21} = \frac{12 \div 3}{21 \div 3} = \frac{4}{7}$

Multiply Fraction, just multiply numerators, multiply denominators

$\frac{2}{\cancel{3}_1} \cdot \frac{\cancel{6}^2}{7} = \frac{4}{7}$

Ex $\frac{10}{3} \div \frac{2}{3} = \frac{10}{\cancel{3}_1} \cdot \frac{\cancel{3}^1}{2}$

awkward! same as mult by reciprocal

$= \frac{10}{2}$

$= 5$

$\frac{5}{8} \div \frac{2}{3}$

$= \frac{5}{8} \cdot \frac{3}{2}$

$= \frac{15}{16}$

$\frac{1}{2} + \frac{3}{4}$

$= 1\frac{1}{4}$ or $\frac{5}{4}$

$\frac{1}{2} + \frac{3}{4} = \frac{2}{4} + \frac{3}{4}$

$= \frac{5}{4}$

make common denominator

$\times \frac{2}{2}$ no change

(only for add/sub, not mult/div)

$\frac{5}{6} - \frac{3}{4} = \frac{10}{12} - \frac{9}{12} = \frac{1}{12}$

$\times \frac{2}{2}$ $\times \frac{3}{3}$

common denom? 12, 24, ...

1) Simplify $\frac{8}{14} \longrightarrow \frac{4}{7}$

2) Simplify $\frac{75}{80} \longrightarrow \frac{15}{16}$

3) Multiply (and simplify, if possible) $8 \cdot \frac{3}{7} \longrightarrow 3\frac{3}{7}$ or $\frac{24}{7}$

4) Multiply (and simplify, if possible) $\frac{7}{4} \cdot \frac{6}{11} \longrightarrow \frac{21}{22}$

5) Divide (and simplify, if possible) $\frac{7}{4} \div \frac{3}{8} \longrightarrow \frac{14}{3}$ or $4\frac{2}{3}$

6) Add (and simplify, if possible) $\frac{5}{16} + \frac{1}{16} \longrightarrow 3/8$

7) Subtract (and simplify, if possible) $\frac{3}{2} - \frac{2}{3} = \frac{9}{6} - \frac{4}{6} = \frac{5}{6}$ ($\cdot 3/3$, $\cdot 2/2$)

8) Is 4 a solution to $\frac{1}{2}(x-2) + 3 = \frac{3}{8}(3x-4)$

No