Accelerated Math
Converting Unit Rates Dimensional Analysis Notes (Section 5-4)

Review:

*Identity Property of Multiplication

We can multiply any number by 1 without changing its value.

$250 \times 1 = 250$

$-7 \times 1 = -7$

$4.1 \times \frac{5}{5} = 4.1$

$78 \times \frac{3+4}{8-1} = 78$

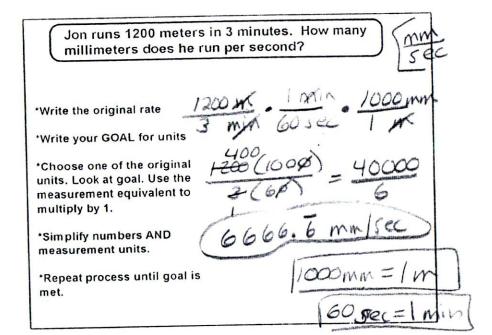$4 \times \frac{1 \text{ foot}}{12 \text{ inches}} = 4$

Names for 1 using measurement equivalents

$$1 = \frac{1 \text{ m}}{100 \text{ cm}} = \frac{100 \text{ cm}}{1 \text{ m}} = \frac{1 \text{ yard}}{36 \text{ in}} = \frac{36 \text{ in}}{1 \text{ yard}} = 1$$

When we multiply 348 cm by 1, we have <u>two</u> choices for 1.

$$\frac{348 \text{ cm}}{1} \cdot \frac{100 \text{ cm}}{1 \text{ m}} \qquad \text{OR} \qquad \frac{348 \text{ cm}}{1} \cdot \frac{1 \text{ m}}{100 \text{ cm}}$$

We choose the name for one that *allow measurements to be crossed out*

<u>Dimensional analysis</u> is the process of including units of measure when computing. We start with the original measurement or rate and multiply by <u>names for one</u> based on measurement equivalents.

Example Change 12.5 kg to **12,500** g

$$\frac{12.5 \text{ kg}}{1} \cdot \frac{1000 \text{ g}}{1 \text{ kg}} = \frac{12.5(1000)}{1}$$

$$1000 \text{ g} = 1 \text{ kg}$$

Example Change 36 in/sec to _____ ft/min

$$\frac{36 \text{ in}}{1 \text{ sec}} \cdot \frac{1 \text{ ft}}{12 \text{ in}} \cdot \frac{60 \text{ sec}}{1 \text{ min}} \qquad \frac{ft}{min}$$

$$\frac{\overset{3}{\cancel{36}}(60)}{\underset{1}{\cancel{12}}} = \boxed{180 \text{ ft/min}} \qquad 12 \text{ in} = 1 \text{ ft}$$

$$1 \text{ min} = 60 \text{ sec}$$

4.5 m = **4.923** yards
(1 yd ≈ 0.914 m)

$$\frac{4.5 \text{ m}}{1} \cdot \frac{1 \text{ yd}}{.914 \text{ m}}$$

$$\frac{4.5}{.914} \approx 4.9234\ldots$$

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500 pounds = **0.25** tons

$$\frac{500 \text{ lb}}{1} \cdot \frac{1 \text{ ton}}{2000 \text{ lb}}$$

$$\frac{500}{2000} = \frac{1}{4} \text{ ton} \qquad 2000 \text{ lb} = 1 \text{ ton}$$

2500 mi = _____ km
(1 km ≈ 0.621 mi)

$$\frac{2500 \text{ mi}}{1} \cdot \frac{1 \text{ km}}{0.621 \text{ mi}} =$$

$$\frac{2500}{.621} \approx 4025.76\ldots$$

4025.8 km

6.8 meters = _____ centimeters

$$\frac{6.8 \text{ m}}{1} \cdot \frac{100 \text{ cm}}{1 \text{ m}}$$

$$\frac{6.8(100)}{1}$$

680 cm ..... 100 cm = 1 m

Problem 1

Jon runs 1200 meters in 3 minutes. How many millimeters does he run per second?

$\frac{mm}{sec}$

*Write the original rate

*Write your GOAL for units

*Choose one of the original units. Look at goal. Use the measurement equivalent to multiply by 1.

*Simplify numbers AND measurement units.

*Repeat process until goal is met.

$$\frac{1200 \, m}{3 \, min} \cdot \frac{1 \, min}{60 \, sec} \cdot \frac{1000 \, mm}{1 \, m}$$

$$\frac{\overset{400}{\cancel{1200}}(1000)}{\cancel{3}(\cancel{60})} = \frac{40000}{6}$$

$$\boxed{6666.\overline{6} \, mm/sec}$$

$$\boxed{1000 \, mm = 1 \, m}$$

$$\boxed{60 \, sec = 1 \, min}$$

Problem 2

Liz is averaging 60 miles per hour on her trip. How many feet per second is this?

$\frac{ft}{sec}$

Write original rate with units

Write GOAL for units

Choose one of original units Write a name for one using measurement equivalents

Multiply by 1 and simplify measurement units

Choose name for one

Multiply by 1 and simplify measurement units

Repeat process until GOAL met

$$\frac{60 \, mi}{1 \, hr} \cdot \frac{5280 \, ft}{1 \, mi} \cdot \frac{1 \, hr}{60 \, min} \cdot \frac{1 \, min}{60 \, sec}$$

$$\frac{60(5280)}{(60)(60)} \left(= 88 \, ft/sec\right)$$

$$hr \rightarrow min \rightarrow sec$$

$$\boxed{1 \, min = 60 \, sec}$$

$$\boxed{1 \, hr = 60 \, min}$$

$$\boxed{5280 \, ft = 1 \, mi}$$

Problem 3

Sara's pool is draining at a rate of 20 quarts per minute. How many gallons per second is this?

$\frac{gal}{sec}$

$$\frac{20 \, qt}{1 \, min} \cdot \frac{1 \, min}{60 \, sec} \cdot \frac{1 \, gal}{4 \, qt}$$

$$\frac{20}{60(4)} = \frac{20}{240} = \frac{1}{12}$$

$$\boxed{\frac{1}{12} \, gal/sec \quad or \quad .08\overline{3} \, gal/sec}$$

$$1 \, min = 60 \, sec$$

Problem 4

Raindrops can fall as fast as 20 miles per hour. How many inches per minute is this?

$\frac{in}{min}$

$$\frac{20 \, mi}{1 \, hr} \cdot \frac{5280 \, ft}{1 \, mi} \cdot \frac{12 \, in}{1 \, ft} \cdot \frac{1 \, hr}{60 \, min}$$

$$\frac{20(5280)\overset{4}{\cancel{(12)}}}{\underset{1}{\cancel{60}}}$$

$$\boxed{21,120 \, in/min}$$

$$mi \rightarrow ft \rightarrow in$$

$$\boxed{1 \, mi = 5280 \, ft}$$

$$\boxed{1 \, ft = 12 \, in}$$

$$\boxed{1 \, hr = 60 \, min}$$