

ME2 Section 10.1: Rates and Ratios

Vocabulary: Ratio: a division comparison of 2 quantities (with or without the same units)

Example: $\frac{7 \text{ students}}{10 \text{ students}}$ or 7 to 10 or 7:10

Equivalent Ratios: ratios which simplify to equivalent fractions

Example: 7 to 10 and 70:100

Rate: a division comparison between two quantities, usually with two different units

Example: 14 dollars per 2 hours, 60 miles per hour

Unit Rate: a rate per 1 unit

Example: 7 $\frac{\text{dollars}}{\text{hour}}$, 60 miles per hour, 1.5 $\frac{\text{gallons}}{\text{minute}}$

3 ways to write/express ratios:

3 to 5, 3:5, $\frac{3}{5}$

Exploration 1: a) 12 boys to 18 girls

$\frac{12}{18}$ 2:3 (answers

b) 18 girls to 30 students

$\frac{18}{30}$ 3:5 may

c) 30 students to 18 girls

$\frac{30}{18}$ 5:3 vary slightly)

d) 12 boys to 30 students

$\frac{12}{30}$ 2:5

e) 30 students to 12 boys $\frac{30}{12}$ 5:2

Exploration 2:

$\frac{150 \text{ miles}}{3 \text{ hours}}$

$\frac{3 \text{ hours}}{150 \text{ miles}}$

$\frac{3 \text{ hours}}{5 \text{ gallons}} \rightarrow \frac{3}{5}$ hours per gallon

50 miles per hour, $\frac{1}{50}$ hours per mile

$\frac{5 \text{ gallons}}{3 \text{ hours}} \rightarrow \frac{5}{3}$ gallons per hour

$\frac{150 \text{ miles}}{5 \text{ gallons}} \rightarrow 30$ miles per gallon

$\frac{5 \text{ gallons}}{150 \text{ miles}} \rightarrow \frac{1}{30}$ gallons per mile

Problem 1: $2\frac{1}{2}$ hours, 20 miles

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

$$\text{speed (rate)} = \frac{\text{distance}}{\text{time}}$$

$$\text{speed} = \frac{20 \text{ miles}}{\frac{5}{2} \text{ hours}} = \frac{20}{1} \cdot \frac{2}{5} \text{ miles per hour} = \boxed{8 \text{ miles per hour}}$$

In 1.5 hours?

$$\downarrow \\ \frac{3}{2}$$

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{distance} = \text{speed} \cdot \text{time}$$

$$\text{distance} = 8 \frac{\text{miles}}{\text{hour}} \cdot \frac{3}{2} \text{ hours}$$

$$= \boxed{12 \text{ miles}}$$

Example 1:

cups of flour	4	8	12	16	20	24	28
# of cakes	1	2	3	4	5	6	7

$$\text{Unit rate: } \frac{12 \text{ cups}}{3 \text{ cakes}} = \frac{4 \text{ cups}}{1 \text{ cake}}$$

becomes 4 cups per cake

We multiply the unit rate by the # of cakes

$$4 \cdot 7 = \boxed{28} \text{ cups of flour}$$

Exploration 3: $\frac{\$612}{36 \text{ hours}} = \17 per hour

# hours	5 hours	10 hours	15 hours
\$	85 dollars	170 dollars	255 dollars
	17.5	17.10	17.15

Problem 2: a) Karen: $\frac{1800 \text{ m}}{40 \text{ min}} = 45 \text{ m per minute}$

Karla: $\frac{1500 \text{ m}}{30 \text{ min}} = 50 \text{ meters per minute}$

b) $\frac{45 \text{ meters}}{1 \text{ minute}} \cdot 12 \text{ minutes} = \boxed{540 \text{ meters}}$

c) $\frac{600 \text{ meters}}{\frac{50 \text{ meters}}{1 \text{ minute}}} = 600 \text{ meters} \cdot \frac{1 \text{ minute}}{50 \text{ meters}} = \boxed{12 \text{ minutes}}$

"Rate" is $\frac{\text{distance}}{\text{time}}$, or distance units per time units.

We often use miles per hour (mph), which is a unit rate, or meters per second, etc.

Problem 3: $\frac{12 \text{ miles}}{3 \text{ hours}} = \boxed{4 \text{ miles per hour}}$

In 5 hours: $5 \text{ hours} \cdot \frac{4 \text{ miles}}{1 \text{ hour}} = \boxed{20 \text{ miles}}$

Example 2: a) $4 \text{ miles} \cdot \frac{1760 \text{ yards}}{1 \text{ mile}} = \boxed{7040 \text{ yards}}$

b) $3\frac{1}{2} \text{ hours} = \boxed{\frac{7}{2} \text{ hours}}$

$\frac{7}{2} \text{ hours} \cdot \frac{60 \text{ minutes}}{1 \text{ hour}} = \boxed{210 \text{ minutes}}$

c) $640 \text{ fluid ounces} \cdot \frac{1 \text{ gallon}}{128 \text{ fl. ounces}} = \boxed{5 \text{ gallons}}$

Example 3: Susan has $5\frac{1}{3}$ yards of cloth, or $\frac{16}{3}$ yards

Feet? $\frac{16}{3} \text{ yards} \cdot \frac{3 \text{ ft}}{1 \text{ yard}} = \boxed{16 \text{ ft}}$

Inches? $16 \text{ ft} \cdot \frac{12 \text{ in}}{1 \text{ ft}} = \boxed{192 \text{ inches}}$

or $\frac{16}{3} \text{ yards} \cdot \frac{36 \text{ in}}{1 \text{ yd}} = 192 \text{ inches}$

Practice Exercises: 1) a) 2:3 b) 5:3 c) 3:2

$$2) \frac{18 \text{ blocks}}{3 \text{ hours}} = \boxed{6 \text{ blocks per hour}}$$

$$\left(\frac{6 \text{ blocks}}{\text{hour}}\right) \cdot \left(\frac{9}{4} \text{ hour}\right) = \boxed{\frac{27}{2} \text{ blocks}}$$

or 13.5 blocks or $13\frac{1}{2}$ blocks

$$3) \text{ Cereal 1: } \frac{16 \text{ oz}}{\$3.89} \text{ or } \frac{\$3.89}{16 \text{ oz}} = \boxed{\$0.24 \text{ per oz}}$$

$$\text{Cereal 2: } \frac{12 \text{ oz}}{\$2.79} \text{ or } \frac{\$2.79}{12 \text{ oz}} = \boxed{\$0.23 \text{ per oz}}$$

$$\text{Cereal 3: } \frac{20 \text{ oz}}{\$5.32} \text{ or } \frac{\$5.32}{20 \text{ oz}} = \boxed{\$0.27 \text{ per oz}}$$

→ best deal

unit rates

$$4) a) 5\frac{1}{2} \text{ cups} = \frac{11}{2} \text{ cups} \cdot \frac{1 \text{ gallon}}{16 \text{ cups}} = \boxed{\frac{11}{32} \text{ gallon}}$$

$$b) 3.8 \text{ km} \cdot \frac{0.625 \text{ miles}}{1 \text{ km}} = \boxed{2.375 \text{ miles}}$$

(answers may vary slightly based on conversion)

$$c) 16\frac{3}{4} \text{ yards} = \frac{67}{4} \text{ yards}$$

$$\frac{67}{4} \text{ yards} \cdot \frac{36 \text{ inches}}{1 \text{ yard}} = \boxed{603 \text{ inches}}$$

$$5) a) \frac{45 \text{ miles}}{1 \text{ hour}} \cdot \frac{5280 \text{ ft}}{1 \text{ mile}} = \boxed{237,600 \text{ ft in one hour}}$$

$$b) \frac{237,600 \text{ ft}}{1 \text{ hr}} \cdot \frac{60 \text{ min}}{60 \text{ min}} \cdot \frac{1 \text{ min}}{60 \text{ sec.}} = \boxed{66 \text{ ft per second}}$$

time (min)	15	30	45	60	75	90	105	120
distance (miles)	11.25	22.5	33.75	45	56.25	67.5	78.75	90