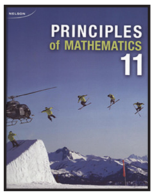
Strengthening and Conditioning

Lesson 5.1 Rates and Unit Rates



Refer to *Principles of Mathematics 11* pages 445-449 and 454-458 for more examples.

- Page 450, #1, 2, 3, 5, 8, and 13
- Page 459, #3, 7, 9, and 13

Question 1a, Page 450

Store A	Store B
$\frac{\$68}{8\text{ kg}} = \$8.50/\text{kg}$	$\frac{\$88.20}{12\text{ kg}} = \$7.35/\text{kg}$ Store B offers the lower rate.

Question 1b, Page 450

Gas Station A	Gas Station B
$\frac{\$41.36}{44\text{ L}} = \$0.94/\text{L}$ Gas Station A offers the lower rate.	$\frac{\$31.36}{32\text{ L}} = 0.98/\text{L}$

Question 2a, Page 450

Convert minutes to hours

Tank A	Tank B
$\frac{x}{15\text{ min}} = \frac{1\text{ hour}}{60\text{ mins}}$ $x = \frac{15\text{ mins} \bullet 1\text{ hour}}{60\text{ mins}}$ $x = 0.25\text{ hours}$ So it takes 4.25 hours to drain tank A. $\frac{300\text{ L}}{4.25\text{ h}} \doteq 70.6\text{ L/h}$ Tank A has the greater rate.	$\frac{x\text{ hours}}{10\text{ min}} = \frac{1\text{ hour}}{60\text{ min}}$ $x = \frac{10\text{ mins} \bullet 1\text{ hour}}{60\text{ mins}}$ $x = \frac{1}{6}\text{ hour}$ So it takes $2\frac{1}{6}$ or $\frac{13}{6}$ hours to drain tank B. $150\text{ L} \div \frac{13}{6}\text{ h} = 150\text{ L} \times \frac{6}{13}\text{ h} \doteq 69.2\text{ L/h}$

Question 2b, Page 450

Convert minutes to seconds and convert kilometres to metres where required.

Runner A	Runner B
$\frac{x}{1\ \text{min}} = \frac{60\ \text{seconds}}{1\ \text{min}}$ $x = \frac{1\ \text{min} \cdot 60\ \text{seconds}}{1\ \text{min}}$ $x = 60\ \text{seconds}$ 60 seconds + 15 seconds = 75 seconds $\frac{400\ \text{metres}}{75\ \text{seconds}} = 5.\bar{3}\ \text{m/s}$ Runner A has the greater rate.	$\frac{x}{5\ \text{min}} = \frac{60\ \text{seconds}}{1\ \text{min}}$ $x = \frac{5\ \text{min} \cdot 60\ \text{seconds}}{1\ \text{min}}$ $x = 300\ \text{seconds}$ 300 seconds + 20 seconds = 320 seconds 1 km = 1000 metres $\frac{1000\ \text{metres}}{320\ \text{seconds}} = 3.125\ \text{m/s}$

Question 3a, Page 450

The time interval in which the ATV is travelling the slowest is the section of the graph with the flattest slope.

From 20 to 28 seconds, the line segment is completely flat (horizontal). During this time, the ATV is not even moving.

The time interval in which the ATV is travelling the fastest is the section of the graph with the steepest slope.

From 28 to 32 seconds, the slope of the graph is the steepest. During this time, the ATV is travelling its fastest.

Question 3b, Page 450

At 28 seconds, the ATV begins to move towards its starting position because the distance from where it initially began decreases from that time until it reaches its starting position at 32 seconds.

Question 3c, Page 450

Between the 20 s and 28 s, the slope of the graph was zero signifying that the ATV was not moving in that time interval. For that 8 s interval, the ATV remained 30 m from where it started.

Question 5, Page 451

Convert millilitres to litres.

$\frac{x}{925 \text{ mL}} = \frac{1 \text{ L}}{1000 \text{ mL}}$ $x = \frac{925 \text{ mL} \cdot 1 \text{ L}}{1000 \text{ mL}}$ $x = 0.925 \text{ L}$	$\frac{\$20.09}{0.925 \text{ L}} = \$21.72/\text{L}$	$\frac{\$52.99}{3.54 \text{ L}} = \$14.97/\text{L}$ The 3.45 L container has a lower unit cost.

Question 8, Page 451

Since 1 kg is about 2.2 lbs, convert the 18 kg to lbs by multiplying 18 kg by 2.2 lbs/kg = 39.6 lbs.

$\frac{\$21.30}{25 \text{ lb}} \doteq \$0.85/\text{lb}$	$\frac{\$24.69}{39.6 \text{ lb}} \doteq \$0.62/\text{lb}$ The pet store in town has a lower unit cost.

Question 13, Page 452

a. The graph in a. best matches the constant flow of tap water into the graduated cylinder. The graduated cylinder has a constant diameter and will fill at a constant rate. The rate at which the graduated cylinder will fill (depth will increase) is faster than the beaker (the other cylindrical container with a constant diameter) because its diameter is smaller. As such, the filling of the beaker is best represented by the graph in c., which also shows a constant rate of filling, but at a less rapid rate.
b. The graph in b. best matches the constant flow of tap water into the flask. The bottom of the flask is wider than the top. As the depth of the water increases, the diameter of the flask narrows, resulting in a more rapid filling of the flask near the top. The curve of the graph in b. shows that the depth of the water increases more rapidly as the flask fills.
c. The graph in c. best matches the beaker because the beaker is wider and shorter than the graduated cylinder. It will fill at a constant rate because the sides are vertical just as the graduated cylinder, but the beaker is wider so it will fill at a slower rate.
d. The graph in d. best matches the constant flow of tap water into the drinking glass. The bottom of the glass is narrower than the top. As the depth of water increases, the diameter of the glass increases, resulting in a slowing down of the rate of filling near the top of the glass. The curve of the graph in d. shows that the depth of the water increases less rapidly as the glass fills.

Question 3, Page 459

$$\frac{32 \text{ turns}}{24 \text{ mm}} = \frac{t}{42 \text{ mm}}$$
$$\frac{32 \text{ turns} \cdot 42 \text{ mm}}{24 \text{ mm}} = t$$
$$56 \text{ turns} = t$$

Question 7, Page 459

$$\frac{m}{1.5 \text{ GB}} = \frac{1024 \text{ MB}}{1 \text{ GB}}$$
$$m = \frac{1024 \text{ MB} \bullet 1.5 \text{ GB}}{1 \text{ GB}}$$
$$m = 1536 \text{ MB}$$

$$\frac{t}{1536 \text{ MB}} = \frac{2 \text{ s}}{12 \text{ MB}}$$
$$t = \frac{2 \text{ s} \bullet 1536 \text{ MB}}{12 \text{ MB}}$$
$$t = 256 \text{ s}$$

Question 9, Page 459

$$\frac{1 \text{ dose}}{0.5 \text{ mL}} = \frac{d}{10 \text{ mL}}$$
$$\frac{10 \text{ mL} \bullet 1 \text{ dose}}{0.5 \text{ mL}} = d$$
$$20 \text{ doses} = d$$

Question 13, Page 460

a. Let C = Canadian dollars (CAD)

$$\frac{C}{38.95 \text{ USD}} = \frac{1.05 \text{ CAD}}{1 \text{ USD}}$$
$$C = \frac{1.05 \text{ CAD} \bullet 38.95 \text{ USD}}{1 \text{ USD}}$$
$$C = 40.8975 \text{ CAD}$$

$$40.8975 \times 20 = 817.95 \text{ CAD}$$

b. $20 \text{ bags} \times \frac{40 \text{ lbs}}{1 \text{ bag}} = 800 \text{ lbs}$

Emma has 800 lbs of dog food.

$$\frac{w}{4 \text{ kg}} = \frac{2.2 \text{ lbs}}{1 \text{ kg}}$$
$$w = \frac{2.2 \text{ lbs} \cdot 4 \text{ kg}}{1 \text{ kg}}$$
$$w = 8.8 \text{ lbs}$$

Each dog eats 8.8 pounds of food per week.

$$\frac{d}{1 \text{ day}} = \frac{8.8 \text{ lbs}}{7 \text{ days}}$$
$$d = \frac{8.8 \text{ lbs} \cdot 1 \text{ day}}{7 \text{ days}}$$
$$d \doteq 1.26 \text{ lbs}$$

Each dog eats about 1.26 pounds of food per day.

$$\frac{1.26 \text{ lbs}}{1 \text{ dog}} = \frac{p}{12 \text{ dogs}}$$
$$\frac{1.26 \text{ lbs} \cdot 12 \text{ dogs}}{1 \text{ dog}} = p$$
$$15.1 \text{ lbs} \doteq p$$

The 12 dogs will eat about 15.2 pounds per day.
Most two month periods will have 61 days.
$15.2 \text{ lbs/day} \times 61 \text{ days} = 920 \text{ lbs}$
Emmma's dog food will not last the two months.

c. Shipping charges, shelf life, applicable taxes in the two countries.