

Date: _____

Name: _____

PRACTICE 1 Rational Word Problems

1. A chemist's potion boils over and leaves a huge pool of potion in his laboratory. He knows that if he asks his apprentice to clean it up, it would take 20 minutes longer than if he did it himself. So he decides to have the apprentice help him do the job. Together, they clean the mess in 30 minutes. How long would it have taken if the chemist did the job alone?
2. Red Riding Hood drives the 432 miles to Grandmother's house in 1 hour less than it takes the Wolf to drive the same route. Her average speed is 6mph faster than the Wolf's average speed. How fast does each drive?
3. To get to work, Sam jogs 3 km to the train and then rides the remaining 5 km. If the train goes 40 km per hour faster than Sam's constant rate of jogging and the entire trip takes 30 minutes, how fast does Sam jog?
4. A radiator contains 10 quarts of fluid, 30% of which is antifreeze. How much fluid should be drained and replaced with pure antifreeze so that the new mixture is 40% antifreeze?
5. A person traveled 120 miles in one direction. The return trip was accomplished at double the speed and took 3 hours less the time. Find the speed going.
6. A certain company has fixed costs of \$40 000 and variable costs of \$2.50 per unit. Let x be the number of units produced. Find the rule of the average cost function. [The average cost is the cost of the units divided by the number of units]. If the average cost was \$22.50, how many units were produced?
7. The reciprocal of 4 plus the reciprocal of 5 is the reciprocal of what number?
8. One Halloween evening you and your friend counted the number of Snickers Bars you had each received as a result their trick-or-treat expedition. Your friend simply counted that he had received 7 Snicker Bars. You, being a math genius, noticed that if you divided 6 times the number of Snickers Bars that you received by five less than that number, you would have the square of the number of Snickers Bars that you had received. Who had more Snickers Bars?
9. A group of homeowners are to share equally in the \$210 cost of repairing a bus-stop shelter near their homes. At the last moment, two members of the group decide not to participate, and this raises the share of each remaining person by \$28. How many people were in the group at the beginning?

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Name: _____

10. Rowing at 8 km/h, in still water, Rima and Bhanu take 16 h to row the 39 km down a river and back. Find the speed of the current. (The equation is found for you below. Study the chart – as it shows how the set up will look for this type of problem)

	Distance	Speed	Time $T = \frac{D}{S}$
with the current speed, C	$39 \div 2 = 19.5$	$8 + C$	$\frac{19.5}{8 + C}$
against the current	19.5	$8 - C$	$\frac{19.5}{8 - C}$

Since it took 16 hours add the times for the equation to solve:

$$\frac{19.5}{8 + C} + \frac{19.5}{8 - C} = 16$$

11. A river flows at 2km/h, and John takes 6 hours to row 16 km trip up the river and back. How fast did he row? (set up similar to above question)
12. Ero and Jamal set off at the same time on a 30km walk for charity. Ero, who has trained all year for this event, walks 1.4km/h faster than Jamal, but sees a friend on the route and stops to talk for 20 min. Even with this delay, Ero finishes the walk 2 hrs ahead of Jamal. How fast was each person walking?

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ANSWERS Name: _____

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51.6

2. Red Riding Hood drives the 432 miles to Grandmother's house in 1 hour less than it takes the Wolf to drive the same route. Her average speed is 6mph faster than the Wolf's average speed. How fast does each drive?

48 and 54

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4. A radiator contains 10 quarts of fluid, 30% of which is antifreeze. How much fluid should be drained and replaced with pure antifreeze so that the new mixture is 40% antifreeze?

1.43

5. A person traveled 120 miles in one direction. The return trip was accomplished at double the speed and took 3 hours less the time. Find the speed going.

20

6. A certain company has fixed costs of \$40 000 and variable costs of \$2.50 per unit. Let x be the number of units produced. Find the rule of the average cost function. [The average cost is the cost of the units divided by the number of units]. If the average cost was \$22.50, how many units were produced?

2000

7. The reciprocal of 4 plus the reciprocal of 5 is the reciprocal of what number?

$\frac{20}{9}$

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6 \therefore your friend

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5

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11. A river flows at 2km/h, and John takes 6 hours to row 16 km trip up the river and back. How fast did he row? (set up similar to above question)

3.73

12. Ero and Jamal set off at the same time on a 30km walk for charity. Ero, who has trained all year for this event, walks 1.4km/h faster than Jamal, but sees a friend on the route and stops to talk for 20 min. Even with this delay, Ero finishes the walk 2 hrs ahead of Jamal. How fast was each person walking?

3.6 and 5

Rationals

Word Problems Full Solutions

Day 8:

1.) Let x be the time it takes the chemist to finish the job alone (in minutes).

	Job	Rate	Time	$\frac{J}{R \cdot T}$
apprentice alone	1	$\frac{1}{x+20}$	$x+20$	
together	1	$\frac{1}{x} + \frac{1}{x+20}$	30	
chemist alone	1	$\frac{1}{x}$	x	

cross multiply, collect like terms.

$x^2 + 20x = 60x + 600$ subtract both sides by $60x$ and 600

$x^2 - 40x - 600 = 0$

Quadratic formula:

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $a=1$ $b=-40$ $c=-600$

$x = \frac{40 \pm \sqrt{(-40)^2 - 4(1)(-600)}}{2(1)}$

$x = \frac{40 \pm \sqrt{4000}}{2}$

$x = \frac{40 + \sqrt{4000}}{2}$ $x = \frac{40 - \sqrt{4000}}{2}$

$x \approx 51.6$ $x \approx -11.6$ Time cannot be negative

\therefore It takes the chemist 51.6 minutes.

$J = RT$

$1 = \left(\frac{1}{x} + \frac{1}{x+20}\right) 30$ distribute the 30 into the brackets

$1 = \frac{30}{x} + \frac{30}{x+20}$ LCD

$1 = \frac{30(x+20) + 30x}{x(x+20)}$ expand brackets

$1 = \frac{30x + 600 + 30x}{x^2 + 20x}$

2.) Let v be wolf's speed. Let w be wolf's time.

	Distance (mi)	Velocity	Time	$\frac{D}{V \cdot T}$
Red Riding Hood	432	$v+6$	$w-1$	
Wolf	432	v	w	$D = VT$

① $432 = (v+6)(w-1)$ expand $② 432 = vw$ divide both sides by v

$432 = vw - v + 6w - 6$ sub into ①

$432 = v\left(\frac{432}{v}\right) - v + 6\left(\frac{432}{v}\right) - 6$ simplify

$432 = 432 - v + \frac{2592}{v} - 6$ subtract both sides by 426, add both sides by v

$(6+v) = \frac{2592}{v}$ cross multiply

expand $v(6+v) = 2592$

$6v + v^2 = 2592$ subtract both sides by 2592

$v^2 + 6v - 2592 = 0$

$v^2 + 54v - 48v - 2592 = 0$ Factor by trinomial criss-cross

$(v+54)(v-48) = 0$

By property of zero

$v = -54$ $v = 48$

Time \neq negative

To find red riding hood's speed add 6.

\therefore Speed of red riding hood is 54 mph.

" " wolf is 48 mph.

3) Let v be the speed Sam jogs.



	D (km)	v (km/hr)	T (hr)
Jogs	3	v	$\frac{3}{v}$
Ride	5	$v+46$	$\frac{5}{v+46}$

Total: 36 minutes = 0.5 hours

$$\frac{3}{v} + \frac{5}{v+46} = 0.5$$

LCD $\left\{ \begin{array}{l} \frac{3(v+46) + 5v}{v(v+46)} = 0.5 \end{array} \right.$

expand brackets $\left\{ \begin{array}{l} \frac{3v+120+5v}{v^2+46v} = 0.5 \end{array} \right.$

cross multiply $\left\{ \begin{array}{l} 8v+120 = 0.5v^2+23v \end{array} \right.$

bring all terms to RS $\left\{ \begin{array}{l} 0 = 0.5v^2 + 12v - 120 \end{array} \right.$

factor out 0.5 $\left\{ \begin{array}{l} 0 = 0.5(v^2 + 24v - 240) \end{array} \right.$

Quadratic Formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$$v = \frac{-24 \pm \sqrt{24^2 - 4(1)(-240)}}{2(1)}$$

\therefore Sam jogs 7.6 km/hr.

$$= \frac{-24 \pm \sqrt{1536}}{2}$$

$$v = \frac{-24 + \sqrt{1536}}{2}$$

$$v \approx 7.6$$

$$v = \frac{-24 - \sqrt{1536}}{2}$$

$$v = -31.6$$

speed cannot be negative

4) Let x be liquid drained and replaced.

$$\frac{0.36(10) - 0.36x + 1.00x}{10 - x + x} = 0.40$$

Simplify and cross multiply

$$3.6 - 0.36x + 1.00x = 4 - 4x$$

$$0.7x = 1$$

$$x \approx 1.43$$

\therefore 1.43 quarts of fluid should be drained and replaced with pure antifreeze.

$$120 = 2v \left(\frac{120}{v} \right) - 6v$$

$$120 = 240 - 6v$$

$$\frac{6v}{6} = \frac{120}{6}$$

$$v = 20$$

\therefore The speed going is 20 miles/hr.

5) Let v be speed in one direction. Let

t be time in 1 direction.



	D (mi)	v (mi/hr)	T (hr)
one direction	120	v	t
return trip	120	$2v$	$t-3$

$$D = vT$$

① $120 = vt$ divide both sides by v
 $\frac{120}{v} = t$

② $120 = 2v(t-3)$ expand
 $120 = 2vt - 6v$

sub ① into ②

6) $x =$ number of units produced.

$$\text{average cost} = \frac{\text{cost of units}}{\text{number of units}}$$

$$21.50 = \frac{40000 + 2.50x}{x} \quad \left. \begin{array}{l} \text{cross} \\ \text{multiply} \end{array} \right\}$$

$$22.50x = 40000 + 2.50x \quad \left. \begin{array}{l} \text{isolate for} \\ x \end{array} \right\}$$

$$\frac{20x}{20} = \frac{40000}{20}$$

$$x = 2000$$

\therefore 2000 units were produced.

7) Let x be the reciprocal of 4 plus the reciprocal of 5.

$$\frac{1}{4} + \frac{1}{5} = x \quad \left. \begin{array}{l} \text{LCD} \end{array} \right\}$$

$$\frac{5+4}{4(5)} = x \quad \left. \begin{array}{l} \text{simplify} \end{array} \right\}$$

$$\frac{9}{20} = x$$

$\therefore 9/20$ is the reciprocal of $20/9$.

8) Let x be your amount of mickers bars.

$$\frac{6x}{x-5} = x^2 \quad \left. \begin{array}{l} \text{cross multiply} \end{array} \right\}$$

$$6x = x^2(x-5) \quad \left. \begin{array}{l} \text{expand} \\ \text{brackets} \end{array} \right\}$$

$$6x = x^3 - 5x^2 \quad \left. \begin{array}{l} \text{divide each} \\ \text{term by } x \end{array} \right\}$$

$$6 = x^2 - 5x \quad \left. \begin{array}{l} \text{subtract each} \\ \text{side by } 6 \end{array} \right\}$$

$$0 = x^2 - 5x - 6 \quad \left. \begin{array}{l} \text{Factor by trinomial} \\ \text{criss cross.} \end{array} \right\}$$

$$0 = (x-6)(x+1)$$

By property of zero

$$x = 6$$

$$x = -1$$

↑ amount of bars cannot be negative.

\therefore Your friend has 1 more than you.

9) Let x be amount of people. Let y be dollars.

$$\textcircled{1} xy = 210 \quad \left. \begin{array}{l} \text{isolate} \\ \text{for } y \end{array} \right\}$$

$$y = 210/x$$

Sub $\textcircled{1}$ into $\textcircled{2}$

$$\cancel{\left(\frac{210}{x}\right)} + 28x - 2\left(\frac{210}{x}\right) - 56 = 210 \quad \left. \begin{array}{l} \text{expand} \\ \text{+56} \end{array} \right\}$$

$$210 + 28x - \frac{420}{x} - 56 = 210 \quad \left. \begin{array}{l} \text{-210} \\ \text{-56} \end{array} \right\}$$

$$28x - \frac{420}{x} = 56 \quad \left. \begin{array}{l} \text{multiply all terms} \\ \text{by } x \end{array} \right\}$$

$$28x^2 - 420 = 56x \quad \left. \begin{array}{l} \text{-56x} \end{array} \right\}$$

$$28x^2 - 56x - 420 = 0 \quad \left. \begin{array}{l} \text{factor out} \\ 28 \end{array} \right\}$$

$$28(x^2 - 2x - 15) = 0$$

$$x \times \begin{array}{l} 3 \\ -5 \end{array} \left. \begin{array}{l} \text{Factor by} \\ \text{trinomial criss cross} \end{array} \right\}$$

$$28(x+3)(x-5) = 0$$

$$\text{Property of zero: } x = -3 \quad x = 5$$

↑ can't be negative

\therefore there were 5

10)

with the current speed, c

$$D = \frac{30}{2} = 19.5$$

Speed

$$8+c$$

Time $T = D/S$

$$\frac{19.5}{8+c}$$

against the current

$$19.5$$

$$8-c$$

$$\frac{19.5}{8-c}$$

$$\frac{19.5}{8+c} + \frac{19.5}{8-c} = 16$$

expand numerator, cross multiply

$$156 - 19.5c + 156 + 19.5c = 16(64 - c^2)$$

$$+16c^2 - 312 = 1024 - 16c^2 + 16c^2$$

$$\frac{16c^2}{16} = \frac{712}{16}$$

$$c^2 = \frac{89}{2}$$

$$c = \sqrt{\frac{89}{2}}$$

Speed cannot be negative.

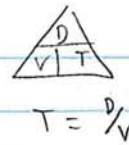
\therefore speed of the current is 6.7 Km/hr.

LCD, expand denominator

$$\frac{19.5(8-c) + 19.5(8+c)}{64 - c^2} = 16$$

Let v be John's speed.

	D (km)	v (km/hr)	T (hr)
11) up the river	$\frac{16}{2} = 8$	$v - 2$	$\frac{8}{v-2}$
down the river	8	$v + 2$	$\frac{8}{v+2}$
total			6 hours



LCM, $\frac{8}{v-2} + \frac{8}{v+2} = 6$

expand denominator

$$\frac{8(v+2) + 8(v-2)}{v^2 - 4} = 6$$

expand numerator, cross multiply

$$8v + 16 + 8v - 16 = 6(v^2 - 4)$$

simplify

$$16v = 6v^2 - 24$$

$$0 = 6v^2 - 16v - 24$$

factor out 2

$$= 2(3v^2 - 8v - 12)$$

Quadratic Formula

$$v = \frac{8 \pm \sqrt{8^2 - 4(3)(-12)}}{2(3)}$$

$$= \frac{8 \pm \sqrt{208}}{6}$$

$$v = \frac{8 + \sqrt{208}}{6} = 3.73$$

$$v = \frac{8 - \sqrt{208}}{6} = -1.07$$

↑ speed can't be negative.

∴ John rows 3.73 km/hr.

12) Let v be Jamal's speed.

	D (km)	v (km/hr)	T (hr)
Ero	30	$v + 1.4$	$\frac{30}{v+1.4}$
Jamal	30	v	$\frac{30}{v}$
total			$2 \frac{20}{60} = 2 \frac{1}{3} = \frac{7}{3}$



$T = \frac{D}{v}$

LCD $\frac{30}{v+1.4} - \frac{30}{v} = \frac{7}{3}$

expand numerator $\frac{30v - 30(v+1.4)}{v^2 + 1.4v} = \frac{7}{3}$

$\frac{30v - 30v + 42}{v^2 + 1.4v} = \frac{7}{3}$

cross multiply

simplify $3(42) = 7(v^2 + 1.4v)$

$$-126 = 7v^2 + 9.8v - 126$$

$$0 = 7v^2 + 9.8v - 126$$

Quadratic Formula:

$$v = \frac{-9.8 \pm \sqrt{9.8^2 - 4(7)(-126)}}{2(7)}$$

$$= \frac{-9.8 \pm \sqrt{3624.04}}{14}$$

$$v = \frac{-9.8 + \sqrt{3624.04}}{14}$$

$$v = 3.6$$

$$v = \frac{-9.8 - \sqrt{3624.04}}{14}$$

$v = -5$ ← speed cannot be negative

Ero's speed = $v + 1.4$

$$= 3.6 + 1.4$$

$$= 5$$

∴ Jamal was walking at 3.6 km/hr. Ero was walking 5 km/hr.