

Problem Solving with Creative Math  
Final Exam Spring 2018

Name Key

Break the following problem down into subproblems, solve each subproblem, and then solve the main problem.

**10 points**

5 points for breaking the problem into subproblems with questions written in words, 3 points for detailed numeric solution for each question, 2 points for final answer \*circled\*.

Three years ago Brett bought a music synthesizer that had a list price of \$500. He also paid tax on the purchase at 7.25%. Because of depreciation, the synthesizer is now worth 30% less than its original list price. Brett managed to sell the synthesizer to Becca for \$40 more than it is worth now. (There was no tax on this transaction.) What is the difference between the amount that Brett paid for the synthesizer and the amount Becca paid?

Synthesizer \$500  
tax rate 7.25%

Now worth 30% less than list price.  
\$350

Sold to Becca for  $350 + 40 = \$390$

① What did Brett pay?

$$500 + 500 \cdot 0.0725 \quad \text{or} \quad 500 \cdot 1.0725 \\ = \$536.25$$

② What is the synthesizer worth now?  
— 30% less than list price —

$$500 - (0.3)(500) = 500 - 150 = \$350$$

③ What did Becca pay for the synthesizer?

$$350 + 40 = \$390$$

④ What is the difference between what Brett paid and what Becca paid?

$$536.25 - 390 = \$146.25$$

146.25

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Use unit analysis (dimensional analysis) to solve **one** of the following questions...

**10 points**

Please \*circle\* final answer(s).

$$\frac{8 \text{ gal}}{1 \text{ trip}} \quad \frac{300 \text{ min}}{1 \text{ trip}} \quad \frac{30.5 \text{ mi}}{1 \text{ gal}} \quad \frac{\$33.84}{1 \text{ trip}}$$

- A. Zeke and three friends drove for 300 minutes, using 8 gallons of gas. They got 30.5 miles per gallon with a total fuel cost of \$33.84. Find the following:

a. Miles  $\frac{30.5 \text{ mi}}{1 \text{ gal}} \cdot \frac{8 \text{ gal}}{1 \text{ trip}} = 244 \text{ miles}$

b. dollars per gallon  $\frac{\$33.84}{1 \text{ trip}} \cdot \frac{1 \text{ trip}}{8 \text{ gal}} = \$4.23/\text{gallon}$

c. miles per hour  $\frac{244 \text{ miles}}{300 \text{ min.}} \cdot \frac{60 \text{ min.}}{1 \text{ hr}} = 48.8 \text{ miles per hour}$

d. passenger-miles per gallon  $\frac{4 \text{ passengers}}{1 \text{ trip}} \cdot \frac{244 \text{ miles}}{8 \text{ gallons}} = \frac{976 \text{ passenger miles}}{8 \text{ gallons}} = 122$

e. cents per passenger-mile  $\frac{\$33.84}{1 \text{ trip}} \cdot \frac{1 \text{ trip}}{976 \text{ pass-mi}} = \frac{\$0.0347}{1 \text{ pass-mi}} \cdot \frac{100 \text{ cents}}{1 \text{ dollar}} = 3.47 \text{ cents per pass-mi}$

$$\begin{aligned} &244 \text{ mi} \\ &\$4.23 \text{ p. gal} \\ &48.8 \text{ mi/hr} \\ &122 \text{ pass-mi/gallon} \\ &3.47 \text{ cents p. pass-mi} \end{aligned}$$

- B. If the horse Seabiscuit travels at a constant speed of 40 miles per hour, how many seconds will it take Seabiscuit to run a race of 6 furlongs? (Note: 1 furlong = 1/8 mile)

$$\frac{40 \text{ mi}}{1 \text{ hr}} \cdot \frac{8 \text{ furlongs}}{1 \text{ mi}} = \frac{320 \text{ furlongs}}{1 \text{ hour}} \quad \begin{aligned} \frac{1}{8} \text{ mi} &= 1 \text{ furlong} \\ 1 \text{ mi} &= 8 \text{ furlongs} \end{aligned}$$

$$\times \frac{320 \text{ furlongs}}{1 \text{ hour}} \cdot \frac{1 \text{ hour}}{60 \text{ min}} \cdot \frac{1 \text{ min}}{60 \text{ sec}} = 0.0889 \text{ furlongs per second}$$

$$\frac{1 \text{ hour}}{320 \text{ furlongs}} \cdot \frac{60 \text{ min}}{1 \text{ hr}} \cdot \frac{60 \text{ sec}}{1 \text{ min}} = 11.25 \text{ seconds/furlong}$$

$$11.25 \text{ seconds} \cdot 6 \text{ furlongs} = \boxed{67.5 \text{ seconds}}$$

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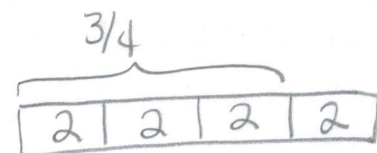
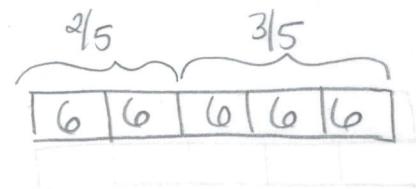
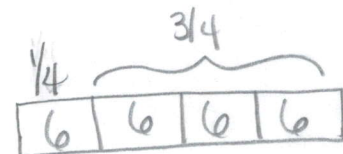
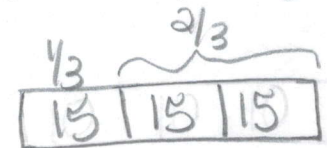
Work backwards to solve the following problem...

**10 points**

5 points for detailed solution (break the problem into steps), 3 points for a summary or outline of your approach, 2 points for final answer \*please circle\*

My mother told us kids that if we wanted to go on this camping trip, we had to plan the meals. No problem. We planned to have hot dogs. That's not all, of course. We also took along mustard, relish, catsup, and buns. We figured we had it made. However, after setting up the tent, we didn't make sure that the food was safe. Raccoons got into it and ate  $\frac{1}{3}$  of the hot dogs. After discovering the loss, our family had 6 hot dogs with our eggs for breakfast. When we went out sightseeing, we just left the hot dogs on the table and returned to find that jays had eaten another  $\frac{1}{4}$  of our remaining supply. Despite our bad luck with the food, we continued to enjoy the camping trip. We went to the store and bought 12 hot dogs and added them to our supply. Then some of our campsite neighbors had a hankering for normal food and "borrowed"  $\frac{2}{5}$  of the remaining hot dogs. At our dinner that evening, we ate 10 hot dogs. That night, bears got  $\frac{3}{4}$  of the last part of our supply, and in the morning we all shared the remaining 2 hot dogs. How many hot dogs did we start with?

Start	_____	45
raccoons ate $\frac{1}{3}$	_____	30
ate 6 hot dogs	_____	24
jays ate $\frac{1}{4}$	_____	18
bought 12	_____	30
neighbors took $\frac{2}{5}$	_____	18
ate 10 hot dogs	_____	8
bears ate $\frac{3}{4}$	_____	2
2 hot dogs left	_____	2



45 hot dogs



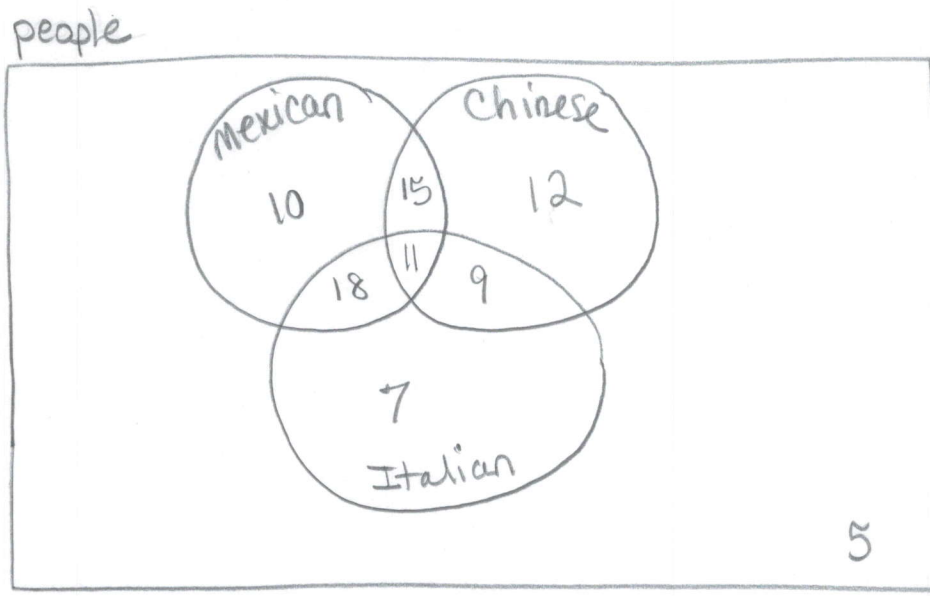
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Use a venn diagram to solve the following problem...

**10 points**

4 points for detailed solution (draw the venn diagram), 4 points for an outline of your approach (list the clues in the order that you use them and show any mathematical calculations), 2 points for final answer \*please circle\*.

A group of people was surveyed about the kind of food they like. Fifty-four people like Mexican food. Forty-five people like Italian food. Forty-seven people like Chinese food. There are 29 people that like Mexican food and Italian food. There are 26 people that like Mexican food and Chinese food. There are 20 people that like Italian food and Chinese food. There are 11 people that like Mexican food, Italian food, and Chinese food. And there are 5 people that don't like Mexican food, Italian food, or Chinese food.



- 11 like all three
- 5 like none
- 20 Italian + Chinese  
 $20 - 11 = 9$
- 26 like Mexican + Chinese  
 $26 - 11 = 15$
- 29 like Mexican + Italian  
 $29 - 11 = 18$
- 47 like Chinese  
 $47 - 35 = 12$

- How many people were surveyed? 87
- How many people don't like Mexican food? 33
- How many people like Italian food but don't like Chinese food? 25
- How many people like Mexican food and Chinese food, but don't like Italian food? 15
- How many people like Mexican food but don't like Chinese food and Italian food? 10

- 45 like Italian  
 $45 - 38 = 7$
- 54 like Mexican  
 $54 - 44 = 10$

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Start with guess-and-check and move to algebra to solve the following problem...

**10 point**

4 points for guess-and-check table (at least 3 guesses/checks), 4 points for algebra formula derived from the guess-and-check table (show your work to solve the equation), 2 points for final answer \*please circle\*.

Rachael is mixing some fruit juice for tomorrow's party. She has 46 quarts of 29% juice and a whole bunch of 17% juice. She thinks that 29% juice is too strong and 17% juice is too weak. She wants to make 25% juice. So she plans on mixing all 46 quarts of 29% juice with some amount of 17% juice in order to make 25% juice. How much 17% juice should she use?

<u>Amt 29% juice</u>	<u>Amt juice</u>	<u>Amt 17% juice</u>	<u>Amt juice</u>	<u>Total</u>	<u>Total juice</u>	<u>% juice</u>
46 grts	13.34 grts	10 grts	1.7	56	15.04	0.2686 ↑
		15	2.55	61	15.89	0.2605 ↑
		25	4.25	71	17.59	0.2477 ↓

want 25% juice

$$X \quad (0.17)(x)$$

$$\% \text{ juice} = \frac{13.34 + (0.17)(x)}{46 + x} = 0.25$$

$$= 13.34 + 0.17x = 0.25(46 + x)$$

$$= 13.34 + 0.17x = 11.5 + 0.25x$$

$$= 13.34 - 11.5 = 0.25x - 0.17x$$

$$\frac{1.84}{0.08} = \frac{0.08x}{0.08}$$

$$x = 23 \text{ quarts of } 17\% \text{ juice}$$

$$\frac{13.34 + \text{Amt juice in } 17\% \text{ mixture}}{\text{Total juice}} = \frac{\text{Total juice}}{\text{Total}}$$

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Draw a picture and move to algebra to solve **one** of the following problems...

**10 point**

4 points for the diagram, 4 points for algebra formula derived from the diagram (show your work to solve the equation), 2 points for final answer \*please circle\*.

- A. A rectangle with perimeter 104 centimeters has a width 18 centimeters less than its length. What is its area?
- B. The larger of two complementary angles is 3 degrees more than twice the smaller of the two angles. What is the measure of each angle?

A.  $p = 104 \text{ cm}$        $w = l - 18$

$$104 = 2l + 2(l - 18) = 2l + 2l - 36$$

Area =  $35 \cdot 17$   
 $= 595 \text{ cm}^2$

$$104 = 4l - 36$$

$$\frac{140}{4} = \frac{4l}{4} \quad l = 35$$

$$w = 35 - 18 = 17$$

B. complementary angles sum to  $90^\circ$

smaller =  $x$

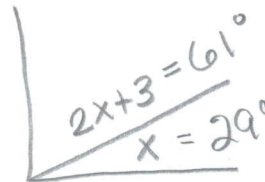
larger =  $2x + 3$

$$x + 2x + 3 = 90$$

$$3x + 3 = 90$$

$$3x = 87$$

$$x = 29^\circ$$



$$2 \cdot 29 + 3 = 61^\circ$$

$$90 - 29 = 61^\circ$$

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**Vocabulary** (12 points)

1. (1 pt) Other than engineers and architects, list one profession that uses diagrams as a way to visualize and/or convey information.

Technical Writer, Teacher, Interior Designer

2. (5 pts) Write the letter of the word that completes each sentence. There are extra words you will not use.

Diagrams help you vis D a problem and set up a(n) G.

Algebra is a language that can help you org A and K information.

A guess-and-check chart shows L and C that often lead to an equation.  
or H

When using the subproblems strategy, you first move your I away from the main problem you are working with and instead concentrate on achieving one or more B.

A Venn diagram is a diagram with J regions where each region contains elements that share a E.

- ~~A.~~ organize
- ~~B.~~ subgoals
- ~~C.~~ operations
- ~~D.~~ visualize
- ~~E.~~ characteristic
- F. system
- ~~G.~~ equation
- H. pattern
- ~~I.~~ focus
- ~~J.~~ bounded
- ~~K.~~ communicate
- ~~L.~~ relationships
- M. eliminate

3. (3 pts) List three methods for making a problem easier...

- a. use a number instead of a variable
- b. solve an easier related problem, look for a pattern
- c. eliminate unnecessary information
- d. use easier numbers



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4. (1 pt) Cross-correlations, adjunct lists, and combining clues are techniques found in which type of problem-solving?
- ☐ Draw a Diagram
  - ☐ Systematic Lists
  - ☐ Find a Pattern
  - ☒ Matrix Logic
5. (1 pt) One way to organize information into a systematic list is to use a technique called...
- ☐ Fudging an entry
  - ☐ Factoring an entry
  - ☒ Freezing an entry
  - ☐ Forcing an entry
6. (1 pt) A critical component of the Guess and Check strategy is to be able to...
- ☐ "Freeze" your guesses as you work
  - ☐ Evaluate your answers using truth tables
  - ☒ Record your guesses and rate their effectiveness
  - ☐ Compare your guesses to an adjunct list