Study Packet for
Quantitative Reasoning Assessment
Hollins University

This packet includes:

- A set of 26 review problems
- Short solutions to the review problems
- Complete solutions to the review problems with links to an appropriate topic on Purplemath.com. Please note that this additional information may be helpful but it is not inclusive.

The problems are reflective of the general topics covered on the QR Assessment.

The solutions provided show one way to work these problems. In most cases there are many other valid ways to approach the problem.

If you do not know how to work some of the problems in this packet, you can review the provided solutions as well as any notes or books from high school.

1. According to the *Washington Post*, officials estimate that 1.8 million people attended the inauguration of President Obama on January 20, 2009. They also estimate that the attendees left behind 100 tons of garbage on the Mall. Given that a ton equals 2,000 pounds, how many pounds of garbage did the average attendee leave behind?

2. Subway tokens cost 85 ¢. How many can you buy with $20?

3. A student's grade depends on her score on four different exams. Her average on the first three exams is 92. What must she score on her fourth exam in order to guarantee a final average of at least a 90?

4. In 2006, a person places $1,000 in an account that earned 10% interest, compounded annually. Calculate the value of the account for the years 2007, 2008, and 2009.

5. According to *Virginia Department of Environmental Quality*, the Roanoke Valley three-year ozone average has decreased from the 2001-2003 level. However, based on the new 2008 ozone standard, to be in compliance the 3-year average must be 75 ppb (parts per billion) or lower. The 3-year average from 2001-2003 (using an 8 hour standard) was 85 ppb, but during 2005-2007 the average had fallen to 76 ppb. By what percentage did the ozone average decrease from the 2001-2003 reading to the 2005-2007 reading?

6. In 2004, according to census data, one in five Americans over eighteen years of age had never married, as compared to one in six in 1970. What is the ratio of the fraction of never married Americans in 2004 to the fraction of never married Americans in 1970?

7. One year ago, a person invested $6,000 in a certain stock. Today, the value of the investment has risen to $7,200. If, instead, the person had invested $15,000 one year ago instead of $6,000, what would the investment's value be today? (Assume that the $15,000 investment would increase by the same proportion as the $6,000 investment.)

8. Evaluate the following expressions given that $v = -2$ and $w = 3$.
   (a) $3(v - 2w)$ (b) $v^2 + w^2$

9. Figure 1 gives weight charts for baby boys and girls ages birth to 18 months. Each chart gives weights for three different sizes of babies: 5^{th} percentile, or small babies, 50^{th} percentile, or average babies, and 95^{th} percentile, or large babies. For example, according to the chart, the 50^{th} percentile weight for a 6-month old girl is about 15 pounds, while the 95^{th} percentile weight for a 6-month old girl is about 18 pounds.

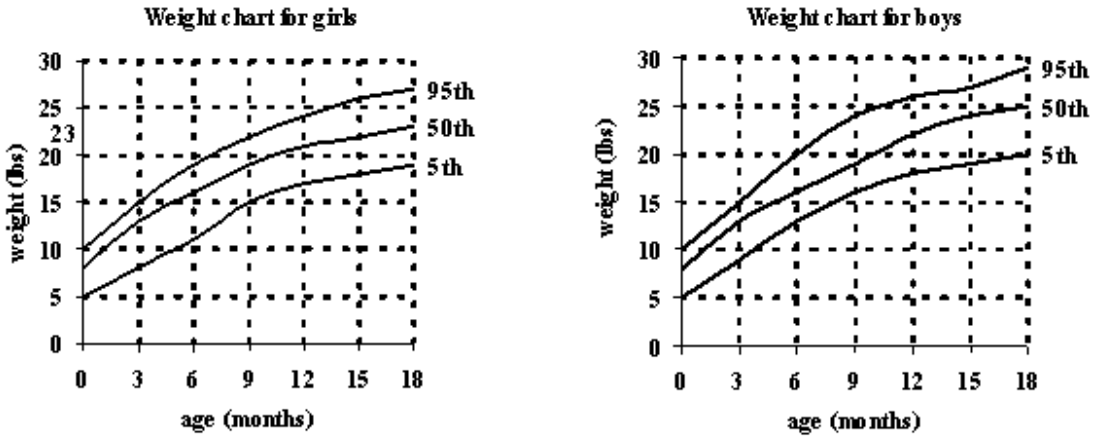

Figure 1: *Weight charts for baby boys and girls, ages birth to 18 months*

(a) About how much more does an average eighteen-month-old boy weigh than an average eighteen-month-old girl?

(b) Consider two 6-month-old boys, one in the 5th percentile and one in the 95th percentile. About how old will the smaller boy be when he weighs as much as the larger boy does now? (You should assume that the smaller boy remains in the 5th percentile as he grows.)

10. In 2008, there were 80 turtles living in a wetland. That year, the population began to grow by 12 turtles/year. Find a formula for P, the number of turtles, in terms of t, the number of years since 2008.

11. Find (a) the perimeter and (b) the area of the shape in Figure 2.

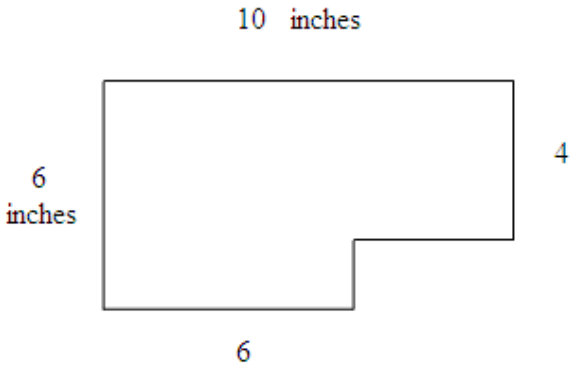

Figure 2

12. Figure 3 shows the number of movies with weekend receipts in different dollar ranges for the weekend of July 24- July 26, 2009. For example, according to the chart, two movies earned less than $5 million. (They were *Bruno* earning $2.7 million and *Public Enemies* earning $4.2 million.) According to Figure 3, how many movies earned more than $20 million?

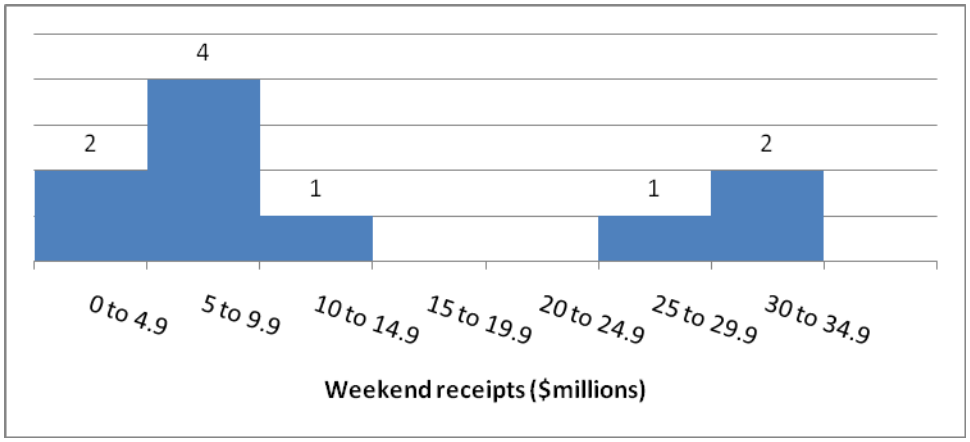

Figure 3: *The number of movies having total receipts in various ranges for the weekend of July 24- July 26, 2009.*

13. Suppose you need to rent a car for one day and that you compare the cost at two different agencies. The cost (in $) at agency *A* is given by $C_A = 30 + 0.22n$, where *n* is the number of miles you drive. Similarly, the cost at agency *B* is given by $C_B = 12 + 0.40n$.

    (a) If you drive only 5 miles, which agency costs less, *A* or *B*?

    (b) How far would you need to drive in order for the other agency to become less expensive?

14. The population of a certain town grew from 60,450 to 195,610 over a ten-year period. This was an increase of 224%. Did the population almost double, almost triple, or more than triple?

15. For a certain flight from Charlotte to Las Vegas, the price of a first-class seat was $1500 and the price of a coach-class seat was $410. There were 26 first-class seats and 120 coach-class seats available on the flight. Assuming that every available seat was sold, find the total amount of revenue (money) generated by the airline for this flight.

16. There are 0.6 grams of powder in a dish. One-fifth of the powder spills out of the dish. How many grams of powder are left in the dish?

17. Find the value of the two pointers, A and B, shown in Figure 4:

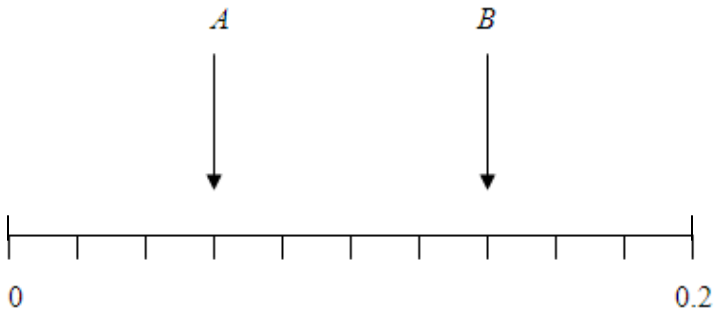

Figure 4

18. Suppose a particular car gets 20 mi/gal. At this rate, how many liters will it take to drive 100 km?
    Note: 1 mile = 1.6039 km, and 1 gallon = 3.79 L.

19. Simplify the following. Express your answers in scientific notation.

(a) $(2\times10^{-4})\times(3\times10^{5})$ (b) $\dfrac{(3\times10^{-4})\times(8\times10^{5})}{4\times10^{-7}}$

20. The equations below describe several different animal populations over a period of time. In the equations, P stands for the size of the population and t stands for the year. Match the appropriate equation or equations to the verbal descriptions that follow.

(i) $P = 1000 - 50t$ (ii) $P = 8000\ (0.95)^t$
(iii) $P = 1000 + 70t$ (iv) $P = 1000\ (1.05)^t$

(a) This population decreases by 5% each year.

(b) This population increases by the same number of animals each year.

(c) This population decreases by the same number of animals each year.

(d) This population increases by 5% each year.

21. The chart below (Table 1) gives the number of Alternative Fueled Vehicles in use in the United States from 2003-2007.

(a) Find the absolute change in the compressed natural gas vehicles from 2003-2007.

(b) Find the relative change in the Total Alternative Fueled Vehicles from 2003-2007.

Fuel type	2003	2004	2005	2006	2007
Compressed natural gas	114,406	118,532	117,699	116,131	114,391
Electric	47,485	49,536	51,398	53,526	55,730
Ethanol 85%	176,090	211,800	246,363	297,099	364,384
Hydrogen	9	43	119	159	223
Liquefied Natural Gas	2,640	2,717	2,748	2,798	2,781
Liquefied petroleum Gas	190,369	182,864	173,795	164,846	158,254
Other Fuels	0	0	3	3	3
Total	533,999	565,492	592,125	634,562	695,766

Table 1: *Estimated Number of Alternative Fueled Vehicles in Use in the United States, by Fuel type, 2003-2007*

22. An IV drip was ordered for a patient. At the start, the IV bag contained 1000 mL of a certain drug. Two hours later, the bag contained 750 mL. Find the rate at which the IV bag was draining. Use these results to predict how many mL will remain in the IV bag after 5 hours.

23. The table below gives the number of hazardous waste sites on the U.S. National Priority List that are in each of 15 centrally located states, as of September 20, 2002. (Source: Environmental Protection Agency, www.epa.gov/superfund/sites/npl/npl.html.)

State	Number of Sites	State	Number of Sites
Colorado	15	Nebraska	10
Idaho	6	North Dakota	0
Illinois	39	Ohio	29
Indiana	28	Oklahoma	10
Iowa	13	South Dakota	2
Kansas	10	Utah	16
Minnesota	24	Wisconsin	39
Missouri	23		

Table 2

(a) Find the mean, median and mode of the number of sites.

(b) Suppose the number of sites in Wisconsin was incorrectly recorded as 239 (rather than 39). Which, if any, of the measures of center (mean, median, and/or mode) would be substantially changed by this error? Explain.

24. Decide whether the following statement makes sense or does not make sense. Explain your reasoning. "I have seen about 10^{50} commercials on TV."

25. Which is larger – the total mail processed by the U.S. Postal Service in 2008 (203 billion pieces) or the number of miles light travels in a year (5.87×10^{12})?

26. Suppose an admission ticket to The Louvre is 14 Euros, where 1 Euro is equivalent to 1.3901 U.S. dollars. What would the admission price be in dollars?

Short Answers to QR Study Packet

1. $\frac{1}{9}$ *lb* per person or $.11\overline{1}$ *lb/person*
2. 23 *tokens*
3. She needs to score an 84 or higher.
4. $1100 in 2007, $1210 in 2008, and $1331 in 2009
5. Approximately an 11% decrease
6. 6/5 or 1.2
7. $18,000
8. (a) –24 (b) 13
9. (a) About 2 *lbs* more (b) About 18 *months* old
10. $P = 80 + 12t$
11. (a) the perimeter is 32 *inches* (b) the area is 52 in^2
12. 3 movies
13. (a) Agency *B* (b) more than 100 miles
14. More than triple
15. R = $88,200
16. 0.48 *grams*
17. Pointer *A* reads 0.06 and pointer *B* reads 0.14.
18. 11.778 *L*
19. (a) 6.0×10^{1} (b) 6.0×10^{8}
20. (a) ii (b) iii (c) i (d) iv
21. (a) -15 vehicles, or 15 fewer vehicles (b) 30.3%
22. 375 *mL*
23. (a) mean =17.6 sites per state, median = 15 sites, and the mode = 10 sites

    (b) The mean would change to 30.93 sites per state since 200 additional sites would be added to the total. Neither the median nor the mode would be significantly affected.
24. This statement does not make sense as it is not possible for a human to watch that many commercials in her or his lifetime.
25. The number of miles light travels in a year is the larger number.
26. $19.46

Solutions to QR Study Packet

1. The attendees left behind 100 tons of garbage, each ton weighing 2000 pounds (lbs).
   This makes $100\ tons \times \frac{2{,}000 lbs}{ton} = 200{,}000\ lbs$.
   We can find the average amount of garbage that each person left behind by dividing the 200,000 pounds of garbage among the 1.8 million attendees:
   $$\frac{200{,}000 lbs}{1{,}800{,}000\ people} = \frac{1}{9} lb\ /\ person$$
   Thus, the average attendee left behind $\frac{1}{9}$ lb of garbage.

   Problem solving: http://www.purplemath.com/modules/translat.htm
   Unit conversion: http://www.purplemath.com/modules/units.htm

2. Note that 85¢ is $.85. Now you divide $20 by $.85, and round down to the nearest whole number (since you cannot purchase part of a token). Since $\$20 \div \$.85 \approx 23.53$, you can buy 23 tokens with $20 and expect some change.
   Another way to work this problem is to think of buying tokens in sets of 10. One set of 10 tokens costs 10 × $0.85 = $8.50. This means that two sets of 10 tokens would cost 2 × $8.50 = $17. So if you buy 20 tokens for $17, you still have $3 left. This is only enough to buy 3 more tokens, because 3 × $0.85 = $2.55. In conclusion, $20 will buy 23 tokens and leave you with some change ($0.45, to be exact).
   Problem solving: http://www.purplemath.com/modules/translat.htm

3. Recall that to calculate an average you need to add all the exam scores, and then divide by the number of exams. Since this student's average for her first 3 exams was 92, you know that the total number of points she earned on her first 3 exams was 3 × 92 = 276 points. This is because $92 = Exam\ average = \frac{\text{total number of exam points}}{\text{number of exams (3)}}$
Now, if the student wants her final average for all 4 exams to be at least 90 points, then her point total for all 4 exams must be at least $4 \times 90 = 360$ points. Since she already has 276 points, she only needs $360 - 276 = 84$ points more. Thus, she must score at least 84 points on her last exam.
Finding the average (mean): http://www.purplemath.com/modules/meanmode.htm

4. The Table below shows the bank balance for 2006, 2007, 2008, and 2009.

Year	Balance
2006	$1000

2007	$1100
2008	$1210
2009	$1331

To find the balance for 2007, we begin with the 2006 balance of $1000 and then add 10%:

Balance in 2007 = balance in 2006 + 10% of balance in 2006

$$= \$1000 + 10\% \times \$1000 = \$1000(1 + .10) = \$1000(1.10) = \$1100$$

Similarly, to find the balance for 2008, we begin with the 2007 balance of $1100 and then add 10%. Notice that 10% of $1100 is not the same as 10% of $1000, and so this time the balance goes up by a different amount:

Balance in 2008 = balance in 2007 + 10% of balance in 2007

$$= \$1000 + 10\% \times \$1000 = \$1100(1 + .10) = \$1100(1.10) = \$1210$$

Finally, to find the balance for 2009, we begin with the 2008 balance of $1210 and then add 10%:

Balance in 2009 = balance in 2008 + 10% of balance in 2008

$$= \$1000 + 10\% \times \$1000 = \$1210(1 + .10) = \$1210(1.10) = \$1331$$

Compound interest: http://www.purplemath.com/modules/expofcns4.htm

5. The formula for percent change -a *very* useful formula to know- is

$$percent\ change = \frac{absolute\ change}{original\ amount} \times 100\%$$

Here, the absolute change in ozone average is -9 ppb (parts per billion) because it drops from its original level of 85 ppb to its current level of 76 ppb. Using our formula, we see that $percent\ decrease = \frac{9\ ppb}{85\ ppb} \times 100\% \approx 0.11 \times 100\% \approx 11\%.$

Converting decimals and fractions to percents:
http://www.purplemath.com/modules/percents.htm
Percent Change: http://www.purplemath.com/modules/percntof3.htm

6. The fraction of never married Americans in 2004 is $\frac{1}{5}$, and the fraction of never married Americans in 1970 is $\frac{1}{6}$. The ratio of the first fraction to the second is therefore:

$$ratio = \frac{\frac{1}{5}}{\frac{1}{6}} = \frac{1}{5} \times \frac{6}{1} = \frac{6}{5} = 1.2.$$

Recall that to divide by a fraction like $\frac{1}{6}$, we must multiply by the fraction's reciprocal, which means that we turn the fraction "upside down" and then multiply.
Ratio: http://www.purplemath.com/modules/ratio2.htm

7. Thinking in terms of proportionality, we see that the ratio of the stock's value today to its value one year ago ($15,000) should equal the ratio of $7,200 to $6,000

$$\frac{value\ today}{\$15,000} = \frac{\$7200}{\$6000}.$$

$$value\ today = \frac{\$7200}{\$6000} \times \$15,000 = \frac{6}{5} \times \$15,000 = 6 \times \$3,000 = \$18,000$$

Thus, the investment would be worth $18,000.
Another way to solve this problem is to think in terms of percentages. Using our formula for percent change (see Question 5), we have

$$percent\ change = \frac{absolute\ change}{original\ amount} \times 100\%$$

$$= \frac{\$7200 - \$6000}{\$6000} \times 100\% = \frac{\$1200}{\$6000} \times 100\% = 0.20 \times 100\% = 20\%$$

Thus, if the person had invested $15,000, it would grow by 20%:
$Value\ of\ \ investment\ now = \$15,000 + \$15,000 \times 20\% = \$15,000(1 + 20\%) = \$15,000(1.20) = \$18,000$
which is the same answer that we got before.
Solving proportions: http://www.purplemath.com/modules/ratio4.htm

8. By substituting the given values for the variables
(a) We have $3(v - 2w) = 3(-2 - 2(3)) = 3(-2 - 6) = 3(-8) = -24$

(b) We have $v^2 + w^2 = (-2)^2 + (3)^2 = 4 + 9 = 13$
Evaluating an expression: http://www.purplemath.com/modules/evaluate.htm

9. (a) From Figure 5 below, we see that the average 18-month-old girl weighs 23 pounds (lbs), and that average 18-month-old boy weighs 25 lbs. Thus, the boy weighs 2 lbs more than the girl.

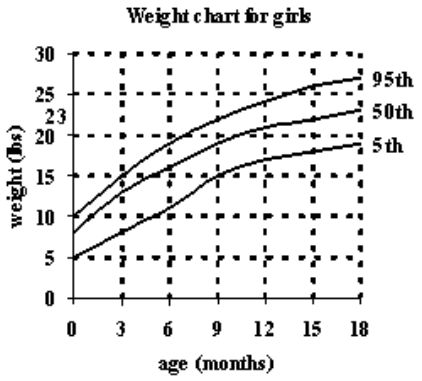

Figure 5: ***The average 18-month-old girl weighs 23 lbs, and the average 18-month-old boy weighs 25 lbs.***

b) From Figure 6 below, we see that the large boy weighs 21 lbs at 6 months of age, and that the small boy won't weigh this much until he is 18 months of age.

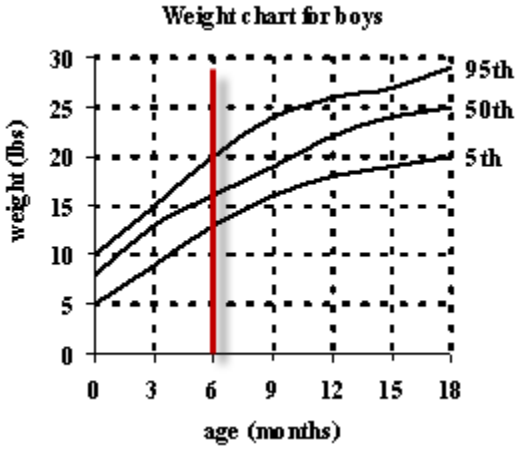

Figure 6: *A 5th percentile, 18-month-old boy weighs the same as a 95th percentile, 6-month-old boy.*

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10. We have # turtles after t years = # turtles in 2008 + additional turtles since 2008

$$= 80 + \underbrace{12 + 12 + \ldots + 12}_{\text{12 more turtles each year}}$$

$$= 80 + 12 \times \#.\text{years since 2008}$$

$$= 80 + 12t$$

Thus, a formula for P is $P = 80 + 12t$.

Another way to work this problem is to notice that the number of turtles is growing at a constant rate over time, which means that the equation for P will be linear, so that $P = b + mt$ where b and m are constants. Here, b is the initial number of turtles at the starting time (2008), or 80, and m is the growth rate, or 12 turtles/year. This gives us $P = 80 + 12t$, the same answer that we got before.

Using a Linear model: http://www.purplemath.com/modules/slopyint.htm

11.

(a) From figure 7 below, the perimeter of a shape is the distance around its border. The given shape has two unlabeled sides. From the figure below, we see that these sides measure 2 *in.* and 4 *in.* Thus, by adding up all the sides, we see that the perimeter of the shape is given by

Perimeter = 6 + 10 + 4 + 4 +2 +6 = **32** *in.*

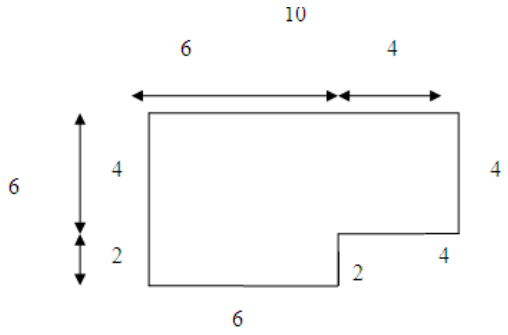

Figure 7

(b) From figure 8 below we see that the shape can be broken into two different squares, one of side 6 inches and one of side 4 i*nches* . The area of a square is given by

$$\text{Area of square} = (\text{side})^2 = \text{side} \times \text{side}.$$

This means that the area of the square of side 6 is $6 \times 6 = 36$ in^2, and the area of the square of side 4 is $4 \times 4 = 16$ in^2, and so

$$\text{Area of shape} = 36 + 16 = \mathbf{52\ \textit{inches}^2}.$$

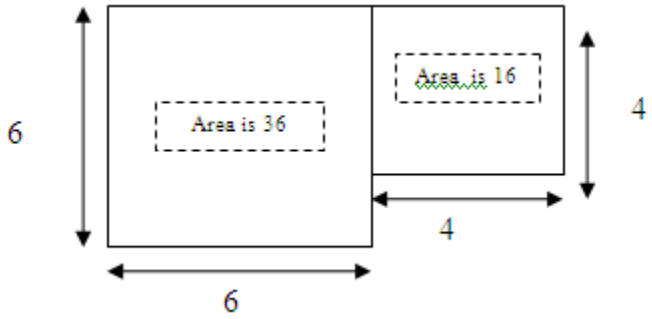

Figure 8

Finding area and perimeter: http://www.purplemath.com/modules/perimetr.htm

12. From figure 9 below, we see that 3 of the top 10 movies made more than $20 million on the weekend of July 24-July 26.

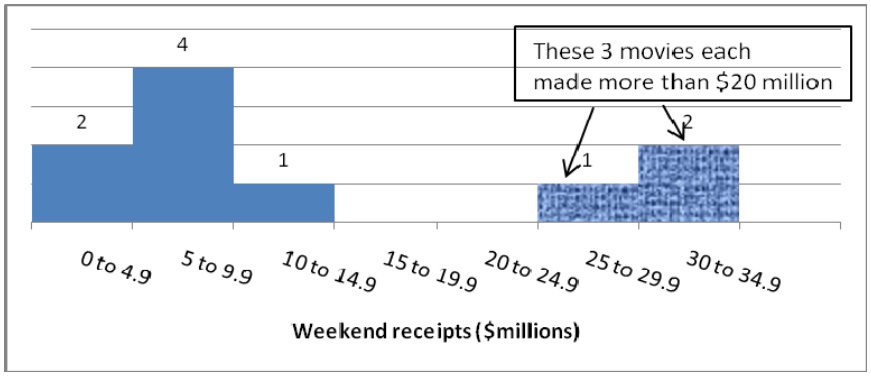

Figure 9

13.
(a) One way to work this problem is to plug in different distances for n to see which agency is less expensive. For example, suppose we imagine driving only 5 miles. In this case, the value of n would be 5, and we would have

$$C_A = 30 + 0.22 \times 5 = \$31.10$$
$$C_B = 12 + 0.40 \times 5 = \$14.00$$

Thus, the cost for driving 5 miles is \$31.10 at agency *A* but only \$14.00 at agency *B*. We conclude that agency *B* would cost less if we are going to drive only a few miles. Notice that on the other hand if we imagine driving 200 miles, the costs work out differently:

$$C_A = 30 + 0.22 \times 200 = \$74$$
$$C_B = 12 + 0.40 \times 100 = \$92.$$

We see that to drive 200 miles would cost \$74 at agency *A* and \$92 at agency *B*. This means that to drive a long distance, it will cost less to rent from *A* than from *B*.

(b) At what distance should we switch agencies? In other words, at what distance does agency *A* cost no more than agency *B*? We can answer this by solving the equation $C_A = C_B$. Setting the formulas for these two costs equal to each other gives:

$$12 + 0.4n = 30 + 0.22n$$
$$.4n - .22n = 30 - 12$$
$$.18n = 18$$
$$n = 100 \ miles$$

Thus, agency *A* will cost the same as agency *B* at n = 100 miles. This means that if we drive farther than 100 miles, we should rent from agency *A* instead of agency *B*.
Solving with linear equations: http://www.purplemath.com/modules/solvelin2.htm

14. If a quantity increases by 100%, it doubles in size. If it goes up by 200%, it triples in size; if it goes up by 300%, it quadruples in size; and so on. So, since the number of people increased by 224%, this means that the population more than tripled- in size.
Meaning of percent: http://www.purplemath.com/modules/percntof.htm

15. The total amount of money the airline earned on this flight would be the sum of the money they earned from First Class and the money they earned from Coach. In order to find the money earned from each type of seat, we need to multiply the price of each seat by the number of seats. So
The amount of money earned from First Class = \$1500 per seat × 26 seats = \$39,000.
The amount of money earned from the Coach seats = \$410 per seat ×120seats = \$49,200.
And the total earned by the airline on this flight is = \$39,000 + \$49,200 = **\$88,200.**
Writing an expression: http://www.purplemath.com/modules/solvelit.htm

16. Since one-fifth of the 0.6 grams is given by $\frac{1}{5}\times 0.6 = \frac{0.6}{5} = 0.12$, we see that 0.12 grams of powder spill from the dish. Thus, there are $0.6 - 0.12 = .48$ grams left in the dish.
Alternatively, since one-fifth of the 0.6 grams spills out, four-fifths of the 0.6 grams remain. This means that there are $\frac{4}{5}\times 0.6 = \frac{2.4}{5} = .48$ grams left.
Multiplying fractions: http://www.purplemath.com/modules/fraction3.htm

17. The scale is divided into two large pieces of equal size. Together, the two pieces measure 0.20, and so each unit alone must measure 0.10. Each large piece is subdivided into 5 smaller pieces. This means that each small piece measures 0.10 ÷ 5 = 0.02. Thus, the small tick marks on the scale are 0.02 units apart. (See Figure below.) Pointer *A* is at the third tick mark which means is at position 3 × 0.02 = 0.06. Pointer *B* is at the seventh tick mark which it is at position 7 × 0.02 = 0.14.

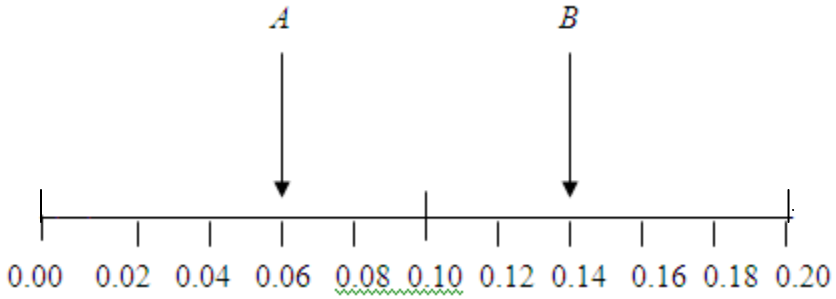

Figure 6

Use of fractions: http://www.purplemath.com/modules/fraction.htm

18. First, convert miles per gallon to kilometers per gallon using the fact that 1 mile = 1.6039 km:

$$\frac{20mi}{gal}\times\left(\frac{1.6093km}{1mi}\right) = 32.186km/gal$$

Next convert the gallons to liters using the fact that 1 gallon = 3.79 L:

$$\frac{32.186km}{gal}\times\left(\frac{1gal}{3.79L}\right) = 8.49km/L$$

Notice how the units are chosen and set up so they reduce in a way that the only units remaining are *km/L*.

This is telling us this car can travel $8.49km$ on a Litre of gasoline. Now we can determine how many liters it takes to drive $100km.$. to answer this, we set up a proportion, cross multiply and solve.

$$\frac{8.49km}{1L} = \frac{100km}{xL}$$

Cross multiplying results in the equation $8.49km \cdot xL = 100km \cdot (1L)$

Dividing by $8.49km$ gives us $x \approx 11.778L$.

Therefore, this car will need $11.778L$ of gasoline to travel $100km$. .

Unit conversions: http://www.purplemath.com/modules/units.htm

Proportionality: http://www.purplemath.com/modules/ratio2.htm

19.

(a) We have $(2\times10^{-4})\times(3\times10^{5}) = 2\times3\times10^{-4}\times10^{5} = 6\times10^{-4+5} = 6\times10^{1}$.

(b) We have $\frac{(3\times10^{-4})\times(8\times10^{5})}{4\times10^{-7}} = \frac{(3\times8)}{4}\times\frac{(10^{-4}\times10^{5})}{10^{-7}} = 6\times\frac{10^{-1}}{10^{-7}} = 6\times10^{-1-(-7)} = 6\times10^{8}$

(or 600,000,000 = 600 million.)

Using Scientific notation: http://www.purplemath.com/modules/exponent3.htm

20. Equations (i) and (iii) are both *linear*. The slope of (i) is –50, and so this population *decreases* by 50 animals per year. The slope of (iii) is +70, and so this population *increases* by 70 animals per year. Both populations start with an initial population of 1000 animals at time $t = 0$.

On the other hand, equations (ii) and (iv) are not liner - they are exponential. If we try several different values for t in equation (ii), such as $t = 0$, 1, 2, and 3, we find that each population is 95% as large as the previous population, which means the populations are decreasing by 5% each year.

t	Population	Population ratios	Percent decrease in population
0	$8000\ (0.95)^0 = 8000$	----	---
1	$8000\ (0.95)^1 = 7600$	$\frac{7600}{8000} = .95$	5%
2	$8000\ (0.95)^2 = 7220$	$\frac{7200}{7600} = .95$	5%
3	$8000\ (0.95)^3 = 6859$	$\frac{6895}{7200} = .95$	5%

By process of elimination, we see that statement (d) must go with equation (iv).
If we try several different values for t in equation (iv), we see that each population is 1.05 times as large as the previous population, so it is growing by 5% each year.

t	Population	Population ratios	Percent increase in population
0	$1000\ (1.05)^0 = 1000$	----	---
1	$1000\ (1.05)^1 = 1050$	$\frac{1050}{1000} = 1.05$	5%
2	$1000\ (1.05)^2 = 1102.5$	$\frac{1102.5}{1050} = 1.05$	5%
3	$1000\ (1.05)^3 = 1157.625$	$\frac{1157.625}{1102.5} = 1.05$	5%

Putting all of this together, we make the following pairings:

(a) -(ii), (b) - (iii), (c) -(i), and (d) - (iv).

Linear equation: http://www.purplemath.com/modules/slope.htm
Exponential equations: http://www.purplemath.com/modules/expofcns.htm

21.

(a) The **absolute change** is the amount of change over time in the number of compressed gas vehicles from 2003 to 2007. As we see from the chart, there were 114,406 in 2003 and 114,391 in 2007. Therefore, we subtract the old amount from the new amount to find $114,391 - 114,406 = -15$ *vehicles* or **15 fewer vehicles** in 2007.

(b) The formula for relative change or **percent change** -a *very* useful formula to know- is

$$percent\ change = \frac{absolute\ change}{original\ amount} \times 100\%$$

The original total number of vehicles (in 2003) was 533, 999. The total number of vehicles in 2007 was 634,552. So the absolute change was 634,552 – 533,999 = 161,767.

Thus the percentage change was: $= \frac{161,767}{533,999} \times 100\% \approx .3029 \times 100 = 30.29\%$

Since the percent change is positive, this tells us that the total number of vehicles increased by *30.29%* from 2003 to 2007.

Percent Change: http://www.purplemath.com/modules/percntof3.htm

22. At the beginning of any procedure the time is zero. Therefore, the first data point is (0, 1000). We are given that 2 hours later the bag contained 750 *mL* of the medication. Thus, our second point is (2, 750).

To find the slope, find the change in the medication, and divide by the change in time. This will give us the *rate* at which the fluid is draining from the bag.

$$rate\ of\ change = slope = m = \frac{750 - 1000}{2 - 0} = \frac{-250}{2} = -125 mL / hr$$

So the volume in the bag is decreasing by 125 *mL* every hour. Since initial volume is 1,000 *mL*, if we let *t* represent the number of hours that have passed, the volume, *V*, after *t* hours would be ***V*=1000-125*t*.**

Thus, assuming everything continues to run as intended, after 5 hours, the volume will be

$$V = 1000 - 125(5) = 100 - 625$$
$$= 375\, mL$$

Linear equation: http://www.purplemath.com/modules/slope.htm or
http://www.purplemath.com/modules/slopgrph.htm

23.

(a) Another word for ***mean*** is average. The formula for an average is:

$$\frac{sum\ of\ the\ values}{total\ number\ of\ the\ values}$$

So, for this question the ***mean*** or average is:

$$\frac{264\ sites}{15\ states} = 17.6\ sites\ \ per\ \ state$$

The **median** number of sites would be the "middle" value of the sample. In other words, in order to calculate the median, we need to start by places the values in order from smallest to largest (or vice versa). This list is: 0 2 6 10 10 10 13 15 16 23 24 28 29 39 39. Since there are 15 numbers in this list, the middle number would be the 8th number from either end or 15. Thus the **median** is **15** sites.

The **mode** is that value that occurs most frequently in our sample. In this sample, 3 of the states had 10 sites, and no state had more than 10 sites, so the mode is 10 sites..

(b) If the number of sites in Wisconsin was recorded as 239 rather than 39, neither the median nor mode would be significantly affected because the middle number would still be 15, and the most frequently number would still be 10. However, the mean would become

$$\frac{464\ sites}{15\ states} = 30.93\ sites\ \ per\ \ state$$

Mean, median & mode: http://www.purplemath.com/modules/meanmode.htm

24. This statement does not make sense. A human lifetime is only a few billion, 10^9, seconds. If you do the unit conversion, you will find that 1 billion seconds is about 30 years. Thus, if you saw even a billion commercials you'd have to see one almost every second of your entire life. Remember that 10^{50} is much, much, much larger than 10^9.

Meaning of exponents: http://www.purplemath.com/modules/exponent.htm

25. In order to compare both numbers, we need to write them both in scientific notation. The total mail delivered in 2008 is 203 billion or 2.0×10^{11} while the number of miles that light travels in a year is 5.87×10^{12}. Clearly the number of miles that light travels in a year is the larger number because the exponent is larger.

Using Scientific notation: http://www.purplemath.com/modules/exponent3.htm

26. We convert the admission fee of 14 Euros to dollars using the fact that
1Euro = 1.3901 US dollars in the following manner:

$$14\ Euros \times \frac{\$1.3901}{1\ Euro} = \$19.4614$$

In this case, we round our answer to \$19.46 since we are using US currency.
Unit conversions: http://www.purplemath.com/modules/units.htm