NAME_____

MA 111 Exam 1

1. 5 points. A report from the World's Fastest Bicycle Competition 2000 reports that "Sam Whittingham cruises in the Varna Mephisto, a bike designed and built by George Georgiev set a 200M Flying start record for single rider human powered vehicles at high altitude. His time was 6.15 seconds which equates to 72.74 MPH!"
(www.recumbents.com/WISIL/speedruns2000/worlds-fastest-bicycle-2000.htm.)
Noting that "200M" means "200 meters", and that 1 mile equals 1.609344 kilometers, check the above calculation to two decimal places. Show your work.

$$\frac{200 \text{ m}}{6.15 \text{ sec}} \times \frac{1 \text{ mile}}{1.609344 \text{ km}} \times \frac{1 \text{ km}}{1000 \text{ m}} \times \frac{3600 \text{ sec}}{1 \text{ hr}} = \frac{72.75 \text{ mi}}{1 \text{ hr}}.$$

2. (a) 5 points. Compare the population of China (1.31 billion) to the population of the U.S. (312 million) with a ratio. Show your work and express your answer in the form of a sentence.

   1.31 billion divided by 312 million is approximately equal to 4.2, so China's population is about 4.2 times the population of the U.S, or the population of the U.S. is about $\frac{1}{4.2}$ of the population of China.

   (b) 5 points. Compare the population the U.S. to the population of China as a percent. Show your work and express your answer in the form of a sentence.

$$\frac{312 \text{ million}}{1.31 \text{ billion}} \times 100 = 23.8\%.$$

So the population of the U.S. is about 23.8% of China's population, or, from the previous calculation, China's population is about 420% of the population of the U.S.

3. 5 points. The New York Times reports, "For wireless network users with a lot of data to save and share, Iomega's StorCenter Wireless Network Storage 1TB drive offers plenty of room to move. With a full terabyte – 1,000 gigabytes – of storage space, the StorCenter can easily handle the typical backup and file-sharing needs of computers on a home or a small-business network."
(www.nytimes.com/2006/09/27/technology/circuits/27drive.html.)
Make better sense of a terabyte, using that a gigabyte is one thousand megabytes, and one digital photo taken with my digital camera has a size of about 2.5 megabytes. Show your work.

1 terabyte is 1000 gigabytes, which is $1000 \times 1000 = 1,000,000$ megabytes. With that much memory, you can store

$$\frac{1,000,000 \text{ megabytes}}{2.5 \text{ megabytes}} = 400,000$$

photos.

4. (a) 5 points. What is 1.5% of 72? Show your work and give an exact answer.

$\frac{A}{72} = \frac{1.5}{100}$, so $A = \frac{1.5}{100} \times 72 = 1.08$.

(b) 5 points. 400 is what percent of 250? Show your work and give an exact answer.

$\frac{400}{250} = \frac{P}{100}$, so $P = \frac{400}{250} \times 100 = 160\%$.

5. A New York Times blog reports, "Despite a crippling recession and tight credit markets, the American wind power industry grew at a rapid pace in 2009, adding 39 percent more capacity. The country is close to the point where 2 percent of its electricity will come from wind turbines.... The American Wind Energy Association, in its annual report to be released on Tuesday, said the amount of capacity added last year, 9,900 megawatts, was the largest on record, and was 18 percent above the capacity added in 2008, also a banner year."
(dealbook.blogs.nytimes.com/2010/01/26/wind-power-grows-39-for-the-year.)

(a) 5 points. What was the wind power capacity in 2008? Show your work and round your answer to the nearest megawatt.

Starting with the capacity in 2008, 39% more capacity was added, which equaled 9900 megawatts. So if the 2008 capacity was C, we have that 9900 megawatts is 39% of C. Thus $\frac{9900}{C} = \frac{39}{100}$, so $C = \frac{9900 \times 100}{39} = 25385$ megawatts.

(b) 5 points. What was the amount of capacity added in 2008? Show your work and round your answer to the nearest megawatt.

Since 9900 megawatts was 18% higher than the capacity A added in 2008, we have $9900 = A(1 + \frac{18}{100})$, so $A = \frac{9900}{1.18} = 8390$ megawatts.

6. (a) 5 points. If the price of a math textbook originally is \$95, and the price is reduced by 13%, what is the new price? Show your work and round your answer to the nearest cent.

$B = A(1 - \frac{P}{100})$. Here, $B = 95(1 - \frac{13}{100}) = \$82.65$.

(b) 5 points. If your annual salary of \$70,000 is reduced by 10% and then later increased by 10%, what is your new salary? Show your work and give an exact answer.

To reduce the salary by 10%, multiply by $(1 - \frac{10}{100})$. To increase the result by 10%, multiply by $(1 + \frac{10}{100})$. So the new salary is $70000(1 - 0.10)(1 + 0.1) = \$69300$.

7. The U.S. Bureau of Labor Statistics reported on January 22, 2010: "The national unemployment rate was unchanged in December at 10.0 percent but was 2.6 percentage points higher than a year earlier."
(www.bls.gov/news.release/laus.nr0.htm.)

(a) 5 points. What was the national unemployment rate a year earlier? Show your work and round your answer to one decimal place.

$10.0 - 2.6 = 7.4\%$.

(b) 5 points. What was the percent change in the percent of unemployment from last year to this year? Show your work and round your answer to one decimal place

$\frac{10.0 - 7.4}{7.4} \times 100 = 35.1\%$.

8. Suppose last year 42% of the 1500 graduates of Mytown High School go to college, but this year 44% of the 1400 graduates go to college.

   (a) 5 points. What is the percent change in the number of graduates who go to college? Show your work and round your answer to one decimal place.

   Last year the number of graduates to go to college was 42% of 1500, which equals $0.42 \times 1500 = 630$. This year the number of graduates to go to college was 44% of 1400, which equals $0.44 \times 1400 = 616$. So the percent change in the number of graduates going to college is $\frac{616-630}{630} \times 100 = -2.2\%$; i.e., a 2.2% decrease.

   (b) 5 points. What is the percent change in the percent of graduates who go to college? Show your work and round your answer to one decimal place.

   $\frac{44-42}{42} \times 100 = 4.8\%$.

   (c) 5 points. In one or two sentences, explain how each of the above two answers can be meaningful to you, if you were the principal.

   If you are just interested in how many graduates go to college, the first number may be more important, but still, according to the second number, there was a larger fraction of graduates going to college this year, which may be regarded as positive.

9. 5 points. Briefly explain why it is possible that 90% of individuals who have disease X are smokers, but only 5% of smokers have disease X.

   The percents are being calculated on different bases. For example, if there are 1800 smokers, and there are 100 individuals who have disease X, and the intersection of these two populations contains 90 individuals (i.e., there are 90 individuals that are both smokers and also have disease X), then the percent of individuals who have disease X that are smokers is $\frac{90}{100} \times 100 = 90\%$, while the percent of smokers that have disease X is $\frac{90}{1800} \times 100 = 5\%$.

10. 5 points. Extra Credit. Thinking about how you can calculate percent increase and percent increase via multiplication, explain why a 4% increase followed by a 7% decrease yields exactly the same result as a 7% decrease followed by a 4% increase.

   If you first increase by 4% and then decrease by 7%, you take your starting number A and first multiply it by $(1 + \frac{4}{100})$ and then multiply it by $(1 - \frac{7}{100})$. But if you first decrease by 7% and then increase by 4% you take your starting number A and first multiply it by $(1 - \frac{7}{100})$ and then multiply it by $(1 + \frac{4}{100})$. Since $A(1.04)(0.93) = A(0.93)(1.04)$, you will get the same answer either way.