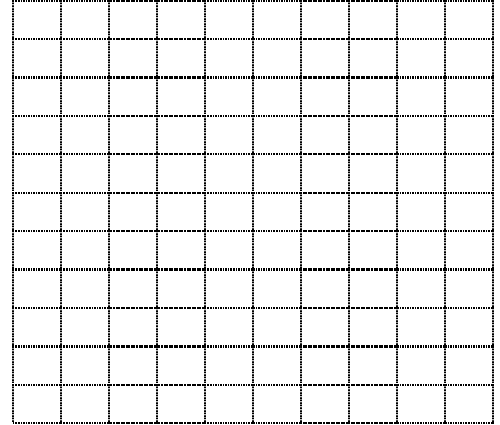


Math 80 – Spring 2009
 Take Home Exam Chapter 4 & 5

Name

1. An arrow is shot vertically into the air. The height (in feet) of the arrow after t seconds is given in the table below.

t	0	1	2	3	4	5	6	7
$h(t)$	0	96	160	192	192	160	96	0



- (a) Are the data modeled by a linear, exponential, or quadratic function? Why?

- (b) Find an algebraic model that expresses the height of the arrow in terms of time in seconds.

- (c) Draw a beautiful graph. Clearly label and scale axes appropriately.

If you solve an equation or inequality to answer a question show that equation or inequality.

- (d) How far above the ground is the arrow after 2.5 seconds? Justify algebraically and graphically. Did you evaluate or solve to answer this question?

- (e) At what time(s) is the arrow on the ground? Justify algebraically and graphically. Did you evaluate or solve to answer this question?

- (f) At what time did the arrow reach maximum height? What is the maximum height? Answer in one complete sentence.

- (g) On what time interval is the arrow more than 180 feet above the ground?

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2. Solve the following equations algebraically. Show work. Circle answers. Use three decimal place accuracy when appropriate. Check with your calculator.

(a) $10a - 4a^2 = 0$

(b) $2 \cdot 10^{0.2x} = 8000$

(c) $7m - m^2 = -18$

(d) $6\text{Log}_{10} 2x - 7 = 12$

(e) $450 = 100 \cdot 4^x + 96$

3. Simplify each of the following expressions.

(a) $2m^{-3} \cdot m^{-4}$

(b) $4w^{-2} \cdot 3w^{-6}$

(c) $4x^4 \cdot 2 + 2x^2 \cdot 2x^2 \cdot 3$

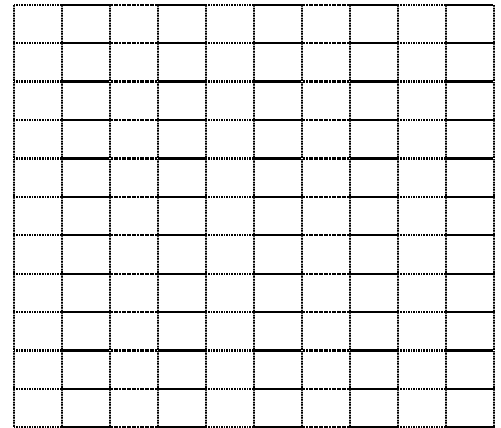
(d) $4ab^3 \cdot 3a^2b^{-3}$

(f) $(4-x)(4+x) - (4-x)^2$

4. Joan is concerned about the amount of energy she uses to heat her house. She keeps a record of the natural gas she consumes each month over one year's heating season. Demand for heating is strongly influenced by the outside temperature. Below is Joan's data and regression model. Temperature is measured in degrees Fahrenheit and gas consumed is measured in average number of cubic feet of gas used per day.

Month	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Temperature ($^{\circ}$ F)	49.4	38.2	27.2	28.6	29.5	46.4	49.7	57.1	65.0
Gas Consumed (Cubic feet per day)	520	610	870	850	880	490	450	250	110

- (a) Sketch the scatterplot of this data in the grid provided. Clearly label your axes.
- (b) Find the regression line that models this data. Clearly define your variables.



- (c) Draw your regression line on the scatterplot by using the ordered pairs below.

(25,) and (60,)

- (d) Interpret the meaning of the slope in the context of this scenario.
- (e) If the temperature increased by 5° , would your bill increase or decrease? By how much?
- (f) Joan adds insulation in her attic during the summer, hoping to reduce her gas consumption. The next February, the average temperature is 25° F and her gas consumption is 870 cubic feet per day. Use the regression equation to estimate how much gas the house would have used before the extra insulation. Did the insulation reduce gas consumption?

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5. The table below gives the number of Starbucks in the U.S.

Year	1987	1989	1991	1993	1995	1997	1999	2001
Starbucks	17	55	116	272	676	1412	2135	4709

- (a) Use the table to give an estimate of when the number of Starbucks reached 1000.
- (b) Use the regression capabilities of your calculator to find a reasonable model for this data. Define your variables.
- (c) Interpret the meaning of the constants (parameters) in your model in the context of this data.
- (d) ALGEBRAICALLY determine when the number of Starbucks reached 1000. Show your work in a neat and organized manner.
- (e) Show or explain how to check your answer.

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6. A molecule of hexane, C_6H_{14} , has six carbon atoms and fourteen hydrogen atoms. Its molecular weight in grams per mole, the sum of the atomic weights of carbon and hydrogen, is 86.178. The molecular weight of octane C_8H_{18} is 114.232 grams per mole. Octane has eight carbon atoms and eighteen hydrogen atoms. Find the atomic weights of carbon and hydrogen.

(a) Set up a system of equations to model this problem. Clearly define your variables.

(b) Solve your system of equations algebraically.

(c) Write a conclusion using a complete and comprehensive sentence.

7. Solve the following system of equations algebraically.
$$\begin{cases} 2x + y - 3z = 10 \\ x - 2y + z = 8 \\ -4x + 2y + z = -6 \end{cases}$$

8. The most famous attempt to predict growth mathematically was made by a British economist and clergyman, Thomas Malthus, in an essay published in 1798. Malthus argued that the growth of the human population would overtake the growth of food supplies, because the populations *multiplied* by a fixed amount each year but the food supplies grew by *adding* a fixed amount each year. He concluded that humans were doomed to breed to the point of starvation unless the population was reduced by other means, such as war or disease. The table below is based on Malthus' calculations with years from 1800. A food unit is defined to be enough food for one person for one year.

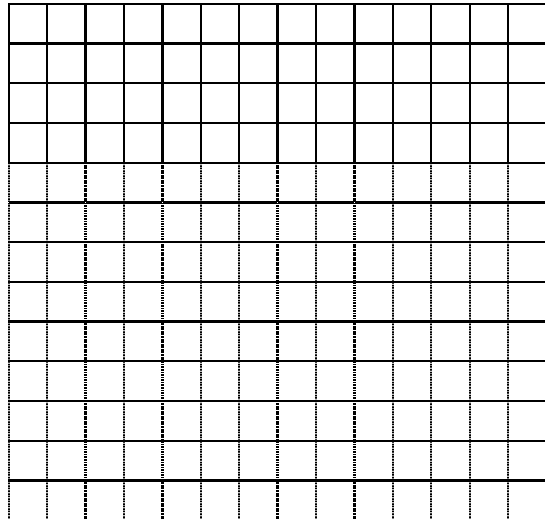
Year	0	5	10	15	20	25	30	35
Population of England in millions	7	8.04	9.23	10.59	12.16	13.96	16.03	18.4
Food units in millions	7	8.4	9.8	11.2	12.6	14	15.4	16.8

- (a) Use the table to estimate when Malthus calculated that the British population would start to exceed the food supply, signaling the start of starvation. Briefly explain your reasoning.
- (b) Find an algebraic model for the population of England. Did you choose a linear model or an exponential model? Explain how you made your decision. (Did you remember to define your variables?)
- (c) What assumptions was Malthus making about population growth in England? Be as specific as possible.
- (d) Find an algebraic model for food production in England. Did you choose a linear or an exponential model? Explain how you made your decision. (Did you remember to define your variables?)
- (e) Use your models to find an estimate for the last year that the food supply will adequately feed the population. Document your process.

9. Show how to solve the following system of equations $\begin{cases} y = 6x - x^2 \\ x + y = 10 \end{cases}$

(a) Numerically

(b) Graphically



(c) Algebraically

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10. You have just won \$100,000 (tax-free) from the lottery. You plan to invest the money in three accounts, one paying 4% interest, one paying 7% interest and the last one paying 10% interest. Your only criterion is that you receive \$8200 every year in interest to pay for your exotic travels.

(a) Set up a system of equations to model this problem situation. Clearly define your variables.

(b) Complete the table below. Show work / Explain what you did. Identify any patterns.

Amount @ 4%	Amount @ 7%	Amount @ 10%
0		
\$1000		
\$2000		
\$3000		
\$4000		
\$5000		

(c) Based on your table,

- express the amount you invest at 7% in terms of the amount you invest at 4%

- express the amount you invest at 10% in terms of the amount you invest at 4%