Give all answers to at least **4 significant figures**.

1. Some years ago Exercise Physiologists at UCLA published a paper in NATURE wherein they predicted that by the year 2004, the women's world record in the marathon would be faster than the men's record. The mechanism for the improvement in performance is thought to be the improvement of training methods and the expansion of the talent pool. But the data was examined only to describe the trend, not to explain it.

This problem examines the winning Olympic times for the 800 m races for both Men and Women. As the years have gone by, the times have improved for both Men and Women. Below we present a table with the data for the winning times (in minutes:seconds):

Year	Men's 800	time	Women's 800	time
1896	Flack	2:11.0		
1900	Tysoe	2:01.2		
1904	Lightbody	1:56.0		
1906	Pilgrim	2:01.5		
1908	Sheppard	1:52.8		
1912	Meredith	1:51.9		
1920	Hill	1:53.4		
1924	Lowe	1:52.4		
1928	Lowe	1:51.8	Radke	2:16.8
1932	Hampson	1:49.7		
1936	Woodruff	1:52.9		
1948	Whitfield	1:49.2		
1952	Whitfield	1:49.2		
1956	Courtney	1:47.7		
1960	Snell	1:46.3	Shevtsova	2:04.4
1964	Snell	1:45.1	Packer	2:01.1
1968	Doubell	1:44.3	Manning	2:00.9
1972	Wottle	1:45.9	Falck	1:58.5
1976	Juantorena	1:43.5	Kazankina	1:54.9
1980	Ovett	1:45.4	Olizarenko	1:53.4
1984	Cruz	1:43.0	Melinte	1:57.6
1988	Ereng	1:43.5	Wodars	1:56.1
1992	Tanui	1:43.7	van Langen	1:55.5
1996	Rodal	1:42.6	Masterkova	1:57.7
2000	Schumann	1:45.1	Mutola	1:56.2
2004	Borzakovskiy	1:44.45	Holmes	1:56.38

Note: You'll want to convert the time to seconds (conversion available at weblink).
(www-rohan.sdsu.edu/∼jmahaffy/courses/s00a/math121/hwprobs/reviews/praclabe1a.xls)

a. Use EXCEL's trendline feature to find the best straight lines (one for Men and one for Women) through the data, where

$$T = mY + b$$

is the straight line for the best time (T) as a function of the number of years (Y) following the 1896 Olympics with EXCEL determining the slope (m) and intercept (b). Write the equations for the best linear models for both Men and Women.

b. Use the model to determine the predicted year when the best time is 1:50.0 sec for Men and 1:55.0 sec for Women. Which Olympic years are closest to these predictions from the actual data.

c. Use the model to predict the time for the 2004 Olympics for both Men and Women in this event. Give the percent error between the actual and predicted value in 2004.

d. According to the model, which Olympics will first see Women outrunning the Men? Give a short discussion on the validity of this prediction and why you think it is true or false. What fundamental premise do you consider to be critical? Can you formulate another model that might be more valid?

2. In this problem use the power rule to determine the pulse (beats per min) as a function of the weight (kg) of the animal. You are given the following data concerning six animals [1]:

Animal	Weight (kg)	Pulse
Mouse	0.017	450
Hamster	0.103	347
Guinea Pig	0.437	269
Goat	33	81
Man	68	65
Cattle	500	49

a. Let P be the pulse and w be the weight, then the power law expression relating the pulse to the weight is given by

$$P = kw^a.$$

Use the power law under Excel's trendline to best fit the data above. Write the formula giving the best values of k and a.

b. Find the percent error between the pulse given by the model and the actual data for each of the animals in the table above. (Assume that the weight in the table is accurate.) Which animal has the highest percent error and explain why you might expect this? Also, which animal has the lowest percent error and explain why this might be the case?

c. Use the model to find the missing entries in the table below. Discuss which estimates are the best and which are the worst.

Animal	Weight (kg)	Pulse
Rat		352
Opossum		187
Swine	100	
Elephant	2500	

[1]P. L. Altman and D. M. Dittmer, (eds.), Biology Data Book , Federation of American Societies for Experimental Biology, 1964.