**Foundations of Mathematics 12**

**Assignment 3: Regression of Exponential and Logarithmic Functions (45 PTS)**

1. Match the following graphs with their equations (4 pts)



1. The population of the world has been growing exponentially for about 150 years. The data table shows the global population in the billions over a 40-year period. (15 pts)

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| **Table 1:** Global population over 40-year period  |
| **Year** | **Population (billions)** |
| 1970 | 3.91 |
| 1988 | 4.52 |
| 1990 | 5.22 |
| 2000 | 6.03 |
| 2010 | 6.97 |

1. Identify x (independent) and y (dependent) variables. (2 pts)
2. Use **exponential regression** to determine the equation for the **curve** of best fit. (1 pt)
3. Briefly describe the data trend (including end behaviour, y-intercept, the number of x-intercepts, and the domain and range). (3 pts)
4. Assuming the same growth rate, estimate the population in the year 2030, to two decimal places. Describe how you did this. Did you extrapolate or interpolate? (4 pts)
5. If the population growth remains the same, when would you expect the population to reach 9.50 billion? Did you extrapolate or interpolate? (3 pts)
6. Do you think this model would be useful for predicting population in the year 3000? Explain. (2)
7. In February 2004, Mark Zuckerberg launched Facebook from his Harvard dorm room. Facebook had 1 000 000 registered users by December of that year and it has been growing rapidly ever since. (12 pts)

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| **Table 2:** Number of registered users of Facebook  |
| **Number of Months since Feb 2004** | **Number of Registered Users (millions)** |
| 10 | 1.0 |
| 22 | 5.5 |
| 34 | 12.0 |
| 38 | 20.0 |
| 44 | 50.0 |
| 54 | 100.0 |
| 59 | 150.0 |
| 60 | 175.0 |
| 62 | 200.0 |
| 65 | 250.0 |
| 67 | 300.0 |
| 70 | 350.0 |
| 72 | 450.0 |
| 77 | 500.0 |
| 79 | 550.0 |

1. Identify x and y variables. (2 pts)
2. Use **logarithmic regression** to determine the equation of the **curve of best fit**. (2 pts)
3. Briefly describe the data trend (including end behaviour, the x-intercept, the number of y- intercepts, and the domain and range). (3 pts)
4. When did Facebook first surpass 275 million registered users? Did you interpolate or extrapolate? (3 pts)
5. Do you think this model can accurately predict the number of registered users 250 months after it was created? Why or why not? (2 pts)
6. Find another “real-world” example of an exponential or logarithmic relationship. Briefly describe. (4 pts)
7. Ms. Wilson buys her coffee from Smile-A-While. She is interested in studying how long it takes for her coffee to cool down after she buys it in the morning. She compiles the following data where *t* stands for time in minutes, and *T* for temperature of the water in degrees Celsius. Room temperature is 20°C. (10 pts)

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| **Table 3:** Temperature of coffee in degrees Celsuis at different points of time, minutes. |
| **Time** | **Temperature** | **Difference between temperature of coffee and room temperature** |
| 0 | 89.0 | 89.0 – 20.0 = 69.0 |
| 2 | 83.2 |  |
| 4 | 78.0 |  |
| 6 | 73.7 |  |
| 8 | 70.4 |  |
| 10 | 67.4 |  |
| 12 | 64.8 |  |
| 14 | 62.6 |  |
| 16 | 60.0 |  |
| 18 | 58.0 |  |
| 20 | 55.8 |  |

1. Graph the data: What do you think will happen to the temperature of the coffee if you wait long enough? (2 pts)
2. Fill out the third column in the table. (2 pts)
3. The first three numbers do not appear to fit the same pattern as the rest. Can you suggest a reason for this? (1 pt)
4. Find a regression model that relates the difference in temperature (y-variable) and the time (x-variable). Write that model here AND briefly explain why you chose this model. (3 pts)
5. According to this model, what temperature would you expect her coffee to be after 30 minutes? (2 pts)