The four numbered problems are worth 25 points each and the extra credit problem is worth 40 points. **Show your work!**

\[(\text{ANSWER}) + (\text{NO WORK}) = (\text{ZERO CREDIT})\].

Work that doesn’t make any sense counts as ‘no work’.

1. The bear population in Jellystone National Park is growing exponentially. In the year 2000 it was 1100 and in 2005 it was 1210. If this growth pattern continues, what will the population be in 2010? Round your final answer to the nearest whole bear.

**Solution.** \(P(t) = 1100e^{kt}\), where \(t = \text{number of years since 2000}\). Since \(P(5) = 1210\), \(k = \ln(1.1)/5 \approx 0.019062\), and \(P(10) \approx 1100e^{-0.19062}\), which rounds to 1331 bears.

2. What is the present value of $6000, to be received 2 years from now, if we assume a 5% annual interest rate, compounded continuously? Round your final answer to the nearest whole dollar.

**Solution.** It’s \(6000e^{-0.05} \approx 5429.02\), which rounds to $5429.

3. What is the effective interest rate of 5% annual interest, compounded continuously? Round your final answer to the nearest tenth of a percent.

**Solution.** The effective rate is \(e^{0.05} - 1 \approx 0.0512711\), or 5.12711 percent, which rounds to 5.1 percent.

4. A certain radioactive substance decays according to the formula

\[A(t) = A_0e^{-0.00693t}\]

where \(t\) is in years. What is the substance’s half-life? Round your final answer to the nearest whole year.

**Solution.** The half-life is \((\ln 2)/0.00693 \approx 100.021\) years, which rounds to 100 years.

**Extra Credit.** The world’s population is growing exponentially. According to the United Nations, the population of the world was 6 billion in 2000 and will be 9 billion in 2050. If these figures are correct, and if this growth pattern continues, what will the world’s population be in 2500? Round your final answer to the nearest billion.

**Solution.** \(P(t) = 6e^{kt}\), where the population is in billions and \(t = \text{years since 2000}\). Since \(P(50) = 9\), \(k = (\ln(9/6))/50 \approx 0.0081093\), and \(P(500) \approx 345.99\) billion, which rounds to 346 billion.