AP Calculus BC
Lesson 10.4 Exponential Growth

10.4(1) The rate of decay of radium is proportional to the amount present at any time. If 60 mg
of radium are present now and its half-life is 1690 years, how much radium will be present
100 years from now?

(a) Write the differential equation that describes this problem.

(b) Solve the differential equation.

(c) Answer the question asked.

10.4(2) The rate at which barometric pressure decreases with altitude is proportional to the
pressure at that altitude. If the barometric pressure is measured in inches of mercury, and
the altitude, in feet, then the constant of proportionality is 3.7×10^{-5}. Suppose the
barometric pressure at sea level is 29.92 inches of mercury.

(a) Calculate the barometric pressure at the top of Mt. Whitney, 14,500 feet (the highest
mountain in the lower 48 states), and at the top of Mt. Everest, 29000 feet (the highest
mountain in the world).

(b) People cannot easily survive at a pressure below 15 inches of mercury. What is the
highest altitude to which people can safely go?

10.4(3) The population of the United States, in millions, for the years 1900-2000 are given in the table below:

year	1990	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
Pop.	76	92	106	123	131	150	179	203	227	250	275

(a) Use the exponential model and the census figures for 1900 and 1910 to predict the population in 2000. Compare with the actual figure and explain.

(b) Use the exponential model and the census figures for 1980 and 1990 to predict the population in 2000, 2010 and 2020. Compare your model to the model given in part (a) and explain the differences.

10.4(4) A freshly brewed cup of coffee has temperature 95°C in a 20°C room. When the coffee is 70°C, it is cooling at a rate of 1°C per minute. How many minutes does it take for the coffee to cool from 95°C to 70°C? *Hint: use Newton's law of cooling*

10.4(5) A radioactive substance decays such that after 16 hours only 14% of the original amount remains. What is the half life of the substance?