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MATH241 3.7, 3.8 Practice
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**Problem 1:** *A culture of the bacterium I'dontknow biologium initially contains 75 cells. This bacteria culture grows with constant relative growth rate. After 2 hours, lab workers found the population had increased to 1034.*

- (i) *Find an expression for the number of bacteria after  $t$  hours.*
- (ii) *Find the growth rate and the number of bacteria after 5.5 hours.*
- (iii) *How long will it take for the population to reach 175,000?*

**Solution:**

**Problem 2:** *In a shocking turn of events, a new element was discovered in a laboratory; the new element, called uninspiring-nameium, was added to the periodic table soon after. Scientists found that uninspiring-nameium-17 has a half life of 47 years. Suppose we have a 125 mg sample.*

- (i) *Find the mass that remains after  $t$  years.*
- (ii) *How long will it take before we have no sample left?*
- (iii) *Approximately how long will it take before we have 17.5 mg left?*

**Solution:**

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**Problem 3:** *The gas law for an ideal gas at absolute temperature  $T$  (in kelvins), pressure  $P$  (in atmospheres), and volume  $V$  (in liters) is*

$$PV = nRT,$$

*where  $n$  is the number of moles of gas and  $R = 0.0821$  is the gas constant. Suppose that, at a certain instant,  $P = 12$  atm and is increasing at a rate of 0.08 atm/min, and  $V = 15$  L and is decreasing at a rate of 0.12 L/min. Find the rate of change of  $T$  with respect to time at that instant if  $n = 9$  moles.*

**Solution:**