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1.

The US patent office receives numerous patent applications each year in which the innovator claims to have invented a perpetual motion machine. Explain why these inventions are impossible based on the laws of thermodynamics.

2.

An archeologist discovers a wooden item that appears to have been owned by Julius Caesar. The relic was found to have a C-14 to C-12 ratio 0.785 that of a living plant. Based on this information, is it possible that the relic is authentic? Explain your answer with an appropriate calculation.

3.

Dinitrogen pentoxide, N_2O_5 , undergoes first-order decomposition in a particular solvent to yield NO_2 and O_2 . The rate constant at 297.11K was found to be 0.000450/min. Calculate the volume in L of O_2 obtained from the reaction of 1.4715 mol N_2O_5 at this temperature and at 707.6 mmHg after 21.77h. Express your answer to one decimal place.

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