

Problem Set 4 Chem 142

1. Write complete balanced nuclear equations for the following processes.
 - a) Radium-226 decays by alpha particle emission.
 - b) Scandium-43 is produced by electron capture.
 - c) Selenium-91 decays into selenium-90.
2. Which of the following nuclides are likely to be radioactive and which are likely to be stable. Explain your choice and in the case of radioactivity predict the most likely mode of radioactive decay.
 - (a) Nitrogen-12
 - (b) Lead-208
 - (c) Thorium-233
3. The half-life of cobalt-60 is 5.26 years.
 - (a) What is the rate constant for the decay of cobalt-60?
 - (b) How much of a 71.8 g sample of cobalt-60 remains after eighteen (18.00) years?

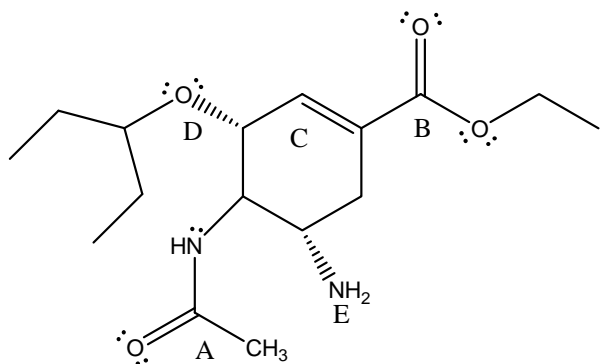
4. ^{131}I (as Na^{131}I) is used to treat hyperthyroid disease. It decays to xenon by first order kinetics. The half-life of ^{131}I is 8.0 days. If you are given 3 ng of Na^{131}I , how many days will it take for 99.99% of it to decay, that is, for there to be only 0.003 ng left?
5. The atomic mass of ^{127}I is 126.9004 g/mol. Calculate the nuclear binding energy of this nucleus (in kJ/mol). The mass of a proton is 1.007825 g/mol and the mass of a neutron is 1.008665 g/mol.

6. Given the information below, answer the following question:

Mass of proton 1.00728 amu Mass of neutron 1.00866 amu Mass of electron 5.485799×10^{-4} amu
 Mass of ${}^9_{19}\text{F} = 18.998403$ amu/atom Velocity of light (c) 2.998×10^8 m s $^{-1}$
 Mass-energy conversion 1 amu = 931.5 MeV

- a) Calculate the mass deficiency of ${}^9_{19}\text{F}$ in amu/atom.
- b) Determine the mass deficiency of ${}^9_{19}\text{F}$ in g mol $^{-1}$.
- c) Calculate the binding energy (BE) of ${}^9_{19}\text{F}$ in kJ mol $^{-1}$.
- d) Calculate the binding energy of ${}^9_{19}\text{F}$ in MeV/atom
- e) Calculate the binding energy of ${}^9_{19}\text{F}$ per nucleon in MeV/nucleon.

7. One component of oseltamivir phosphate, otherwise known as Tamiflu[®], is pictured at right. This is one of the drugs that the World Health Organization has identified as an effective treatment for the H5N1 strain of influenza A, which is more commonly referred to as "bird flu". (10 pts)



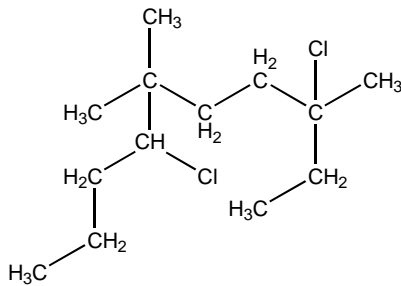
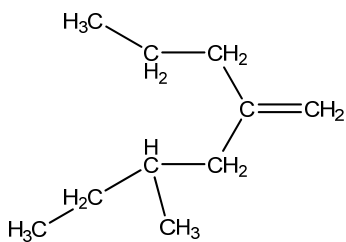
Choices to consider: alkane, alkene, alkyne, aromatic hydrocarbon, alcohol, ether, carboxylic acid, aldehyde, ketone, ester, amine, amide, amino acid.

Identify the functional groups indicated by the letters

- A. _____ B. _____ C. _____
 D. _____ E. _____

8. Draw the 4 isomers in line notation of C₄H₈ including geometric isomers and name them

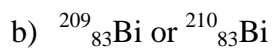
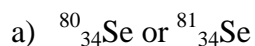
9. Name the following compounds (6 pts)



Name _____

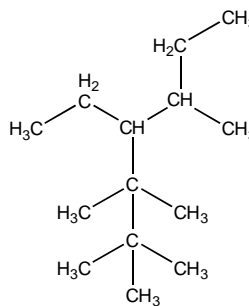
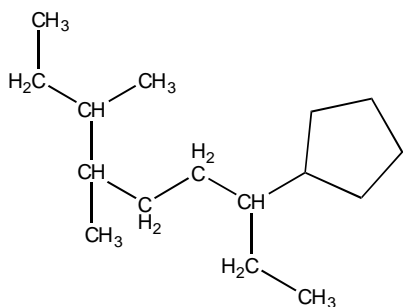
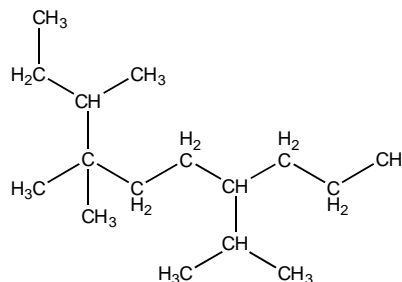
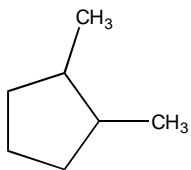
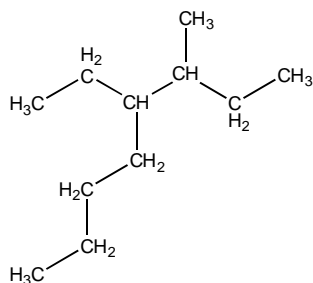
Name _____

10. From each of the following pairs, choose the nuclide that is radioactive. (One is known to be radioactive, the other stable.) explain

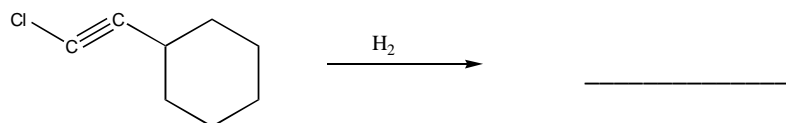
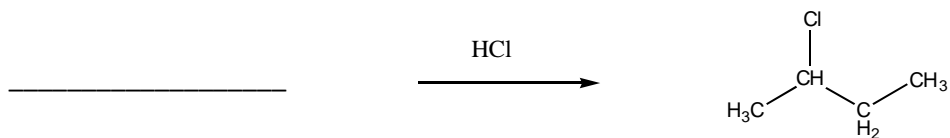
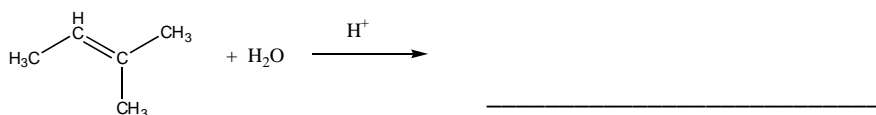


11. Briefly explain why “magic numbers” are important for understanding nuclear structures, i.e., define “magic number”.

12. Write the IUPAC name for each of the following compounds:



13. Complete the following reactions:



14. Write the full and condensed structural formulas for the following substances:

3, 4-dimethyl-4-ethyl octane

4-t-butyl heptane

cis-1, 3-diethyl cyclohexane

3-isopropyl hexane

1, 1-dimethyl cyclopentane

3, 4, 5, 6- tetramethyl nonane

15. Write the IUPAC name for each of the following compounds.

