Exam 4

# Part 1: Multiple Choice (2 points each)

## Directions: Please circle the *best* answer for each of the following questions.

1. Which name is not correct?
   1. 2,2-dimethylbutane
   2. 2,3-dimethylpentane
   3. 2,3,3-trimethylbutane
   4. 2,3,3-trimethylpentane
   5. none of the above
2. Which is more dangerous in terms of short-lived exposure to radiation? One mole of
   1. 89Sr, β-, t1/2 = 50.5 days
   2. 90Sr, β-, t1/2 = 28.5 years
   3. 91Sr, β-, t1/2 = 9.5 hours
   4. 94Sr, β-, t1/2 = 74 seconds
   5. all of the above
3. The binding energy is defined as the amount of energy
   1. absorbed when electrons are added to an ion.
   2. absorbed when protons and neutrons form a nucleus.
   3. released when electrons are removed from the atom.
   4. required to break apart a nucleus into individual protons and neutrons.
   5. none of the above
4. What is the hybridization of the starred carbon in (CH3)2C=CHC\*N
   1. sp
   2. sp2
   3. sp3
   4. dsp3
   5. d2sp3
5. When ethane, C2H6, reacts with oxygen to produce carbon dioxide and water, 1560 kJ of heat are released per mole of ethane. How many kJ of heat are released per gram of oxygen used?
   1. 6.96 kJ/g
   2. 13.9 kJ/g
   3. 170 kJ/g
   4. 341 kJ/g
   5. none of the above
6. Which of the following compounds is not a possible product of the reaction of methane with chlorine gas?
   1. CH3Cl
   2. CH2Cl3
   3. CHCl3
   4. CCl4
   5. none of the above
7. Which one of the following behaves like an acid?
   1. CH3COCH3
   2. (CH3)2NH
   3. C2H5OH
   4. C2H5COOH
   5. a and c
8. Which process decreases the neutron/proton ratio?
   1. Alpha emission
   2. Beta emission
   3. Electron capture
   4. Positron emission
   5. c and d
9. What is the molecular formula of amphetamine?



* 1. C­9H13N
  2. C8H2N
  3. C8H7NO
  4. C9H10N
  5. C7H14N

1. Which form of protection is commonly used and/or available in chemistry laboratories to protect skin?
   1. Disposable and nondisposable gloves
   2. clothes
   3. laboratory aprons and coats
   4. safety glasses or goggles
   5. all of the above

# Part 2: Short Answer

## Directions: Answer each of the following questions. Be sure to use complete sentences where appropriate. For full credit be sure to show all of your work.

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| Activity (dpm) | Time (days) |
| 7840 | 0 |
| 7570 | 7 |
| 7300 | 14 |
| 5920 | 56 |
| 5470 | 72 |

1. The isotope sample of polonium that was most likely isolated by Marie Curie in her pioneering studies is polonium-210. A sample of this element was prepared in a nuclear reactions. Initially, its activity (α emission) was 7840 dpm. Measuring radioactivity over time produced the data below.
   1. Show that this data represents first order decay (15 points).

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| Activity (dpm) | Time (days) | ln(Activity) |
| 7840 | 0 | 8.9670 |
| 7570 | 7 | 8.9319 |
| 7300 | 14 | 8.8956 |
| 5920 | 56 | 8.6861 |
| 5470 | 72 | 8.6070 |

* 1. What is the equation of the best fit straight line? Be sure to use points off of your line.
  2. Determine the half-life of polonium-210.

or

* 1. Write the nuclear reaction for the decay of polonium-210.

1. What is the difference between a level of radioactivity and a dose of radioactivity (3 points)?

The level of radioactivity is the amount of radioactive particles present in a given instant of time. The dose is the accumulation of exposure over a length of time.

1. When uranium-235 nuclei are bombarded with neutrons (1.0087 amu), they can split apart in a variety of ways, like glass balls that shatter into pieces of different sizes. In one process, uranium-235 (235.04 amu) forms barium-142 (91.92 amu) and krpton-92 (141.92 amu) (12 points).
   1. Write the balanced nuclear fission equation
   2. Calculate the energy (in joules) released when 1.0 g of uranium-235 undergoes this fission reaction (1 amu = 1.6605 x 10-27 kg, c = 2.9987 × 108 m/s).

Δm = mproducts – mreactants

Δm = (141.92 amu + 91.92 amu + 2(1.0087 amu)) – (235.04 amu + 1.0087 amu)

Δm = 235.8674 amu – 236.0487 amu

1. The activity of an iodine-131 source (beta emitter, t1/2 = 8.05 days), which is used to monitor the functioning of the thyroid gland, is 500 Bq (10 points).
   1. Write the balanced decay reaction.
   2. How long will it be before the activity is 10 disintegrations per second (1 Becquerel = 1 disintegrations per second).

1. Three different compounds with the formula C2H2Cl2 are known (8 points).
   1. Two of these compounds are geometric isomers. Draw their structures and name them.

trans-1,2-dichloroethene

cis-1,2-dichloroethene

* 1. The third compound is a structural isomer of the other two. Draw this structure and name it.

1,1-dichloroethene

1. In a combustion experiment, a 3.69 g sample of a hydrocarbon formed 4.50 g of water and 11.7 g of carbon dioxide. Deduce its empirical formula and state whether it is likely to be an alkane, an alkene, or an alkyne. Explain your reasoning (10 points).

Empirical formula CH2

The compound is an alkene; the molecular formula might be C4H8, which matches the formula for alkenes (CnH2n). It is not an alkane or alkyne.

1. Write the condensation reaction for the esterification of propanoic acid and methanol. Name the products (5 points):



1. Warfarin is used to prevent blood clots from forming or growing larger in your blood and blood vessels. Label the functional groups in Warfarin (5 points).



A.\_\_\_\_Ketone \_\_\_\_\_\_\_ B.\_\_\_\_\_aromatic\_\_\_\_\_\_\_\_ C.\_\_\_\_ester\_\_\_\_\_\_\_\_\_\_

D\_\_\_\_alkene\_\_\_\_\_\_\_\_\_ E.\_\_\_\_alcohol \_\_\_\_\_\_\_\_\_\_

1. Answer the following questions about the reaction of 2-pentene and hydrogen gas (12 points).
2. Write the balanced chemical reaction.



1. What is the minimum amount of hydrogen gas, in grams, required to completely hydrogenate 25.8 kg of 2-pentene?
2. If the actual yield of hydrogen gas is 657.8 g of hydrogen, what is the percent yield?