Exam 4

# Part 1: Multiple Choice (2 points each)

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

1. The isotope “belt of stability” is an area in a plot of \_\_\_\_\_\_\_\_
2. nuclear binding energy versus atomic number.
3. isotopic strength versus isotopic weakness.
4. nuclear mass versus mass number.
5. neutron number versus atomic number.
6. mass number versus atomic number.
7. A half-life is \_\_\_\_\_\_\_\_
8. the life that a nuclear chemist leads.
9. half of the lifetime of an unstable nucleus.
10. the time for one-half of the unstable nuclei to decay.
11. constantly changing.
12. independent of the rate constant for decay.
13. Cardiac pacemakers once used plutonium-238 as a power source. Plutonium-238 decays by the emission of gamma rays and alpha particles. This emission is not particularly harmful because \_\_\_\_\_\_\_\_
14. gamma rays are not absorbed very strongly by biological tissue, and alpha particles do not penetrate beyond the container.
15. gamma rays and alpha particles are the least dangerous form of radiation.
16. gamma rays and alpha particles do not penetrate beyond the container.
17. gamma rays are absorbed by the container, and alpha particles do not affect biological tissue.
18. tissue damage caused by gamma rays and alpha particles is rapidly repaired by enzymes.
19. The purpose of control rods in a fission reactor is to \_\_\_\_\_\_\_\_
20. cool down the reactor fuel.
21. absorb neutrons generated in the fission process.
22. prevent oxygen from reaching the fuel.
23. absorb the electrons emitted in the fission process.
24. enhance the neutron capture process.
25. What material is often used for radiation shielding?
26. Tin
27. Gold
28. Lead
29. Plutonium
30. Helium
31. Which statement best describes how these three molecules are related? 
32. They are not related, they are different molecules.
33. They are structural isomers.
34. They are stereoisomers.
35. They illustrate cis-trans isomerization.
36. They are the same compound.
37. Which of the following is an amine functional group?
38. –COOH
39. –OH
40. –SH
41. –NH2
42. –CONH2
43. An alkyne is characterized by a \_\_\_\_\_\_\_\_ bond between carbon atoms that have a \_\_\_\_\_\_\_\_ local molecular geometry and \_\_\_\_\_\_\_\_ hybridization.
44. single; linear; *sp*
45. single; linear; *sp*3
46. double; trigonal planar; *sp*2
47. double; tetrahedral; *sp*3
48. triple; linear; *sp*
49. Which one of the following behaves like an acid?
50. CH3COCH3
51. (CH3)2NH
52. C2H5OH
53. C2H5COOH
54. a and c
55. Which form of protection is commonly used and/or available in chemistry laboratories to protect skin?
56. disposable and nondisposable gloves
57. clothes
58. laboratory aprons and coats
59. safety glasses or goggles
60. 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.

1. How do chemical and nuclear reactions differ in (4 points)
	1. effect on rate of higher reactant concentration?

Both chemical and nuclear reaction rates increase with higher reactant concentrations.

* 1. effect on yield of higher reactant concentration?

If the reactant is limiting in a chemical reaction, then more reactant produces more product and the yield increases. The presence of more radioactive reactant results in more decay products, so a higher reactant concentration increases the yield.

1. Why is ionizing radiation more harmful to children than adults (4 points)?

Ionizing radiation is more dangerous to children because they have rapidly dividing cells, so there is more chance for radiation to cause cell damage or mutation.

1. A person’s body generates about 0.20 µCi of radioactivity! Determine the total radioactivity emitted by 18 students in a lecture hall. (1 Ci = 3.7  1010 Bq and 1 Bq = 1 decay/s) (6 points)

1. Define chain reaction in terms of the fission of uranium nucleus (3 points).

Neutrons, produced by the fission of one uranium nucleus, induce fission in other uranium nuclei.

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).

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 (12 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. Identify all of the functional groups in the following molecule (3 points).



amide, ether, carboxylic acid (alkane could also be included)

1. Answer the following questions about the reaction of 2-pentene and hydrogen gas (10 points).
2. Write the balanced chemical reaction.

 

1. What is the minimum amount of hydrogen gas, in grams, required to completely hydrogenate 13.6 kg of 2-pentene?
2. Write the condensation reaction for the esterification of propanoic acid and methanol. Name the products (5 points):



1. Arrange the following hydrocarbons in order of decreasing melting point (5 points): trans-2-butene, cis-2-butene, butane, ethane, and 2-butyne

 2-butyne > trans-2-butene > cis-2-butene > butane > ethane

1. Name the following compounds (4 points):
	1. 2-methyl-3-hexyne
	2.  4-ethyl-3,3-dimethylheptane
2. Benzaldehyde is responsible for the odor of almonds and cherries (12 points).
3. Draw the structure of benzaldehyde.



1. It has a normal boiling point of 179.0 °C. Calculate the boiling point of benzaldehyde at the summit of Pikes Peak, Colorado, if the atmospheric pressure is 447 torr. ΔHvap for benzaldehyde is 4.88 kJ/mol.