Exam 4

# Part 1: Multiple Choice (2 points each)

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

1. Identify the instrument(s) used to detect radiation.
	1. Film-badge dosimeter
	2. Geiger-Müller counter
	3. Scintillation counter
	4. a and b
	5. all of the above
2. Define mass defect.
	1. The difference in mass between an atom and the sum of its separate components.
	2. An atom with too many neutrons.
	3. The difference in mass between a radioactive atom and a nonradactive atom.
	4. The energy released in a radioactive reaction.
	5. The energy absorbed in a radioactive reaction.
3. The following reaction represents what nuclear process? $+\rightarrow +$
	1. Nuclear fusion
	2. Alpha emission
	3. Beta emission
	4. Neutron emission
	5. Neutron capture
4. How many moles of aqueous ions will be produced from the dissolution of 1.0 moles of Na3[FeCl6] in water?
	1. 9.0 moles
	2. 4.0 moles
	3. 10.0 moles
	4. 2.0 moles
	5. 1.0 moles
5. Identify the structure that cis-trans isomerism can occur in.
	1. MA5B
	2. MAB
	3. MA3B3
	4. MA4B2
	5. MAB2
6. For an octahedral complex what metal d orbitals are directly towards the ligand?
	1. dxy, dxz
	2. dxy, dxz, dyz
	3. $d\_{z^{2}}, d\_{x^{2}-y^{2}}$
	4. $d\_{z^{2}}, d\_{xz}, d\_{yz}$
	5. none of the above
7. Name the following compound:
	1. 3-butyl-3-propyl-1-pentyne
	2. 3-butyl-3-propyl-4-pentyne
	3. 3-ethyl-3-propyl-1-heptyne
	4. 5-ethyl-5-propyl-6-heptyne
	5. 3-ethyl-3-butyl-1-hexne
8. Which of the following compounds exhibits geometric isomerism?
	1. CH2=CH-CH3
	2. CCl2=CBr2
	3. CH3CCl=CCl-CH3
	4. CBr2=CHBr
	5. all of the above
9. Choose the weak acid from the compounds below.
	1. CH3CH2NH2
	2. CH3CH2COOH
	3. CH3CH2OCH3
	4. CH3CH2I
	5. CH3SH
10. Which of the following is true regarding the state of a chemical as it is burning?
	1. Only liquids and gases can burn.
	2. Only liquids can burn.
	3. Only gases can burn.
	4. Solids, liquids, and gases can burn.
	5. When lighting a Bunsen burner turn on the gas first to avoid wasting matches.

# 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. Copper-64 is an unusual radionuclide in that it may undergo β decay, positron emission, or electron capture. What are the products of these decay processes (4 points)?

$$\rightarrow +$$

$$\rightarrow +$$

$$+\rightarrow $$

1. Fluorine-18 undergoes positron emission with a half-life of 1.10 × 102 minutes (10 points).
	1. Write the balanced decay reaction.

$$\rightarrow +$$

* 1. If a patient is given a 248 mg dose for a PET scan, how long will it take for the amount of fluorine-18 to drop to 83 mg? (Assume that none of the fluorine is excreted from the body?

$ln\left(\frac{N}{N\_{o}}\right)=-kt⇒t=-\frac{1}{k}ln\left(\frac{N}{N\_{o}}\right)=-\frac{t\_{\frac{1}{2}}}{ln 2}ln\left(\frac{N}{N\_{o}}\right)=-\frac{1.10×10^{2} min}{ln 2}ln\left(\frac{83 mg}{248 mg}\right)=174 minutes $

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)

$18 bodies×\frac{0.20 μCi}{body}×\frac{1 Ci}{10^{6} μCi}×\frac{3.7×10^{10} Bq}{1 Ci}×\frac{1\frac{decay}{s}}{1 Bq}=133200\frac{decay}{s}≈1.3×10^{5}\frac{decays}{s}$

1. Describe what is meant by the term "valley of stability" (4 points)?

If a plot of number of neutrons vs. number of protons is constructed, there are particularly stable isotopes that cluster together amid all of the other isotopes in the plot. These particularly stable isotopes are in the "valley of stability."

1. Explain why the compounds of most of the first-row transition metals are colored (4 points).

When the transition metals bond to ligands the d orbitals split in energy. If there is a d to d transition possible for the ion, the compound is likely to be colored.

1. For each species below complete the table (10 points):

|  |  |  |  |
| --- | --- | --- | --- |
|  | Name | Coordination Number of Central Atom | Geometry of Complex Ion |
| [Rh(NH3)5I]I2(Rh is rhodium) | Pentaammineiodiorhodium(III) iodide | 6 | octahedral |
| [Au(CN)2]- | dicyanoaurate(I) ion | 2 | linear |
| [Ni(H2O)2Cl2] (only one isomer) | Diaquadichloronickel(II) | 4 | tetrahedral |

1. The drug Nipride, Na2[Fe(CN)5NO], is an inorganic complex used as a source of NO to lower blood pressure during surgery (10 points).
	1. The nitrosyl ligand in this complex is believe to be NO+ rather than neutral NO. What is the oxidation state of iron, and what is the systematic name for Na2[Fe(CN)5NO]?

Fe2+, has an oxidation state of 2. Sodium pentacyanonitrosylferrate(II)

* 1. Draw a crystal field energy-level diagrams for [Fe(CN)5NO]2-, assign the electrons to orbitals, and predict the number of unpaired electrons.

Fe: [Ar] 4s2 3d6

Fe2+: [Ar] 3d6

CN- is a strong-field ligand

\_\_ \_\_

↓↑ ↓↑ ↓↑

 3d

* 1. Is the complex paramagnetic or diamagnetic? Diamagnetic
	2. What is the hybridization on the central metal atom? d2sp3
1. What is meant by the term "structural isomer"? Draw a structural isomer of

CH3-CH2-CH2-CH3 (4 points).

Structural isomers are compounds that have the same chemical formula but different atomic connectivity. The student should sketch a structural isomer of the compound given. One example would be (CH3)3CH.

1. Determine the products of the following reaction (6 points):
	1.  
	2. CH3CH2CH2NH2 + HCl → ? CH3CH2CH2NH3+Cl-
	3. CH3CH2COOH + CH3CH2CH2OH → ? CH3CH2COO CH2CH2CH3 + H2O (l)
2. Identify each as a saturated or unsaturated hydrocarbon (5 points):
	1. Chlorobenzene \_\_\_\_\_unsaturated\_\_\_
	2. Cyclobutene \_\_\_\_\_unsaturated\_\_\_
	3. 3-methylhexane \_\_\_\_\_\_saturated\_\_\_\_
	4. Propyne \_\_\_\_\_unsaturated\_\_\_
	5. Ethanoic acid \_\_\_\_\_unsaturated\_\_\_
3. Salsa has antibacterial properties because it contains dodecental, a compound found in the cilantro used to make salsa (5 points).



* 1. How many carbon atoms are in dodecental? \_\_\_\_12
	2. What functional group(s) is present in dodecental? \_Alkene and aldehyde
	3. What types of isomerism are possible in dodecental?

Cis-trans isomerism and structural isomerism

1. Draw a structure for each organic compound (12 points):
	1. 4,7-diethyl-2,2-dimethylnonane



* 1. 3,3-dimethyl-1-pentyne



* 1. Meta-dibromobenzene



* 1. 2-butanol



* 1. Triethylamine



* 1. 4-heptanone

