Name:_______________________________

Date:____________________

Period:_______

Ms. Hart/Mr. Kuhnau

UNIT 4: NUCLEAR REACTIONS
UNIT QUEST REVIEW STUDY GUIDE

<table>
<tr><th>Concept</th><th>KEY POINTS</th><th>STEPS/METHODS</th><th>PRACTICE</th></tr>
<tr><td>Benefits/Costs of Radioisotopes</td><td><u>Benefits</u>
• Co-60 is used to treat cancer
• I-131 is used for thyroid treatment / detection
• U-238 is used for geological dating (e.g. rocks)
• C-14 is used for organic dating (e.g. living things)
• Nuclear Power – lower greenhouse gases, low cost to produce, more efficient (e.g. more energy produced than fossil fuels because some mass is converted to energy)
<u>Risks</u>
• Nuclear Power – Potential exposure of workers to radiation, disposal of nuclear waste is difficult, risk of meltdown could expose people to radiation or contaminate (e.g. – Chernobyl, Fukoshima)
• Radiation can cause damage to DNA which can kill cells or cause mutations.</td><td>• Memorize each radioisotope with its use. Use repletion and/or a mnemonic device to help you (example of a mnemonic device: the Red Door Marks Kids' Cheeks (Radiation causes Damage, Mutation and Kills Cells)</td><td>1. Brain tumors can be located by using an isotope of
(1) C-14 (3) Tc-99
(2) I-131 (4) U-238

2. State one risk to human tissue associated with the use of radioisotopes to treat cancer.</td></tr>
<tr><td>Nuclear Radiation</td><td>• Found in Table O of your Chemistry Reference Table (CRT).
• The top number is the mass; the bottom number is the charge.
• The higher the mass, the lower the penetrating power.</td><td>• Remember to refer back to Table O whenever you are unsure.</td><td>3. Which type of radiation has neither mass nor charge?
(1) alpha (3) neutron
(2) beta (4) gamma</td></tr>
<tr><td>Nuclear Reactions (Spontaneous Transmutation)</td><td>• Use Tables N on the CRT to find different radioisotopes, their decay modes and their half-lives.
• Spontaneous transmutation is the nuclear reaction that happens automatically because the radioisotope is unstable. Unstable nuclei tend to happen when atoms have many more protons than neutrons, many more neutrons than protons, or an atomic # greater than 83.
• Spontaneous transmutation, also called natural transmutation will be an element on its own on the left side of the equation decaying into 2 or more new substances on the right with an alpha particle, beta particle, or positron.</td><td>• Use Table N and Table O
• When you write the nuclear reaction or you fill in the missing reactant/product, remember that the masses (the top number in the isotopic notation) of the reactants must equal the masses of the products. Also, the charge (the bottom number in the isotopic notation) of the reactants must equal the charge of the products.</td><td>4. A change in the nucleus of an atom that converts the atom from one element to another element is called
(1) combustion
(2) neutralization
(3) transmutation
(4) polymerization

5. Complete the nuclear equation below for the beta decay of the Co-60 by writing an isotopic notation for the missing product.

$^{60}_{27}Co \rightarrow ^{0}_{-1}\beta$ + _______</td></tr>
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<tr><th>Concept</th><th>KEY POINTS</th><th>STEPS/METHODS</th><th>PRACTICE</th></tr>
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<td>Nuclear Reactions (Artificial Transmutation)</td>
<td>• Artificial transmutation will have an element plus a form of radiation (alpha, beta, positron or neutron) that you are bombarding the element with on the left side of the equation.
• Artificial transmutation only happens because people cause them to happen.</td>
<td>• Use Table O and the information given in the problem.
• The masses of the reactants must still equal the masses of the products. Also, the charge of the reactants must equal the charge of the products.</td>
<td>6. Which equation represents artificial transmutation?
(1) $^{11}_{6}C \rightarrow ^{0}_{+1}e + ^{11}_{5}B$
(2) $^{27}_{13}Al + ^{4}_{2}He \rightarrow ^{30}_{15}P + ^{1}_{0}n$
(3) $^{87}_{37}Rb \rightarrow ^{0}_{-1}e + ^{87}_{38}Sr$
(4) $^{277}_{92}U \rightarrow ^{223}_{90}Th + ^{4}_{2}He$</td>
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<td>Half-Life</td>
<td>• Remember that every half life means the time it takes for half of the mass of the original element to change into a different element.
• There are four basic types of half-life problems depending upon what you are asked to find:
1. Fraction Remaining
2. The Number of Half Lives
3. The Total Time
4. The Length of One Half Life
<u>Half Life Chart</u>
<table>
<tr><th>Number of Half Lives</th><th>Fraction</th></tr>
<tr><td>0</td><td>1</td></tr>
<tr><td>1</td><td>½</td></tr>
<tr><td>2</td><td>¼</td></tr>
<tr><td>3</td><td>1/8</td></tr>
<tr><td>4</td><td>1/16</td></tr>
<tr><td>5</td><td>1/32</td></tr>
</table>
<u>Half Life Equation</u>
length of one half life X # of half lives = total time</td>
<td>• <u>Fraction Remaining:</u> Identify the mass of the part and the mass and the whole. Create a fraction with the part over the whole.
• <u>Determine the Number of Half-Lives:</u> Identify the mass of the part and whole. Start with the whole mass divide it in half until you have the mass of the part. Count up the number of times you divided in half. –OR– Find the fraction and use your half-life chart.
• <u>Calculating Total Time:</u> Find the the length of one half life and the number of half lives and multiply (see the Half Life Equation)
• <u>Determine the Half Life:</u> Find the total time and the number of half lives. Divide the total time by the number of half lives.</td>
<td>7. What is the half-life and decay mode of Rn-222?
(1) 1.91 days and alpha decay
(2) 1.91 days and beta decay
(3) 3.82 days and alpha decay
(4) 3.82 days and beta decay

8. If 1/8 of an original sample of krypton-74 remains unchanged after 34.5 minutes, what is the half-life of krypton-74?
(1) 34.5 min (3) 46.0 min
(2) 23.0 min (4) 11.5 min

9. Determine the total time that will have elapsed when 12.5 grams of the original 100 grams Co-60 sample at the hospital remains unchanged.</td>
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<td>Fission/ Fusion</td>
<td>• Energy released in a nuclear reaction (fission or fusion) comes from the fractional amount of mass that is converted into energy. Nuclear changes convert matter into energy. Energy released during nuclear reactions is much greater than the energy released during chemical reactions.
• Fusion is 2 lighter atoms creating one heavier atoms.
• Fission is one heavier atom being bombarded with a neutron to split into 2 lighter atoms + more neutrons which create a chain reaction.
• Both produce much more energy than chemical reactions because some mass is converted into energy.</td>
<td>• Remember the sun has fusion and it is Hot Hot Hot!!!! (H + H → He)</td>
<td>10. Which equation represents a fusion reaction?
(1) $C(s) + O_2(g) \rightarrow CO_2(g)$
(2) $H_2O(g) \rightarrow H_2O(\ell)$
(3) $^{2}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}He + ^{1}_{0}n$
(4) $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{142}_{56}Ba + ^{91}_{36}Kr + 3\,^{1}_{0}n$</td>
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