**Unit 5: Nuclear Chemistry**

If you can do all the things listed below, you are ready for the Unit 5 test.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

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| **\_\_\_\_\_1. I can compare types of radiation in terms of symbol, mass number, charge, penetrating power, shielding required, and biological hazard.** | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **Type** | **Symbol** | **Mass #** | **Charge** | **Penetrating Power** | **Shielding Required** | **Bio**  **Hazard** | | **alpha** | ****** | ***4*** | ***2*** | ***very low*** | ***paper, clothing*** | ***none unless inhaled*** | | **beta** | ******  ****** | ***0*** | ***-1*** | ***low*** | ***metal foil*** | ***eyes & skin*** | | **gamma** | ****** | ***0*** | ***0*** | ***very high*** | ***concrete & lead*** | ***whole body*** | | **neutron** | ***1***  ***0n*** | ***1*** | ***0*** | ***very high*** | ***water; lead*** | ***whole body*** | | **positron** | ***+*** | ***0*** | ***+1*** | ***low*** | ***metal foil*** | ***eyes & skin*** | |
| **\_\_\_\_\_2. I can identify the three types of nuclear reactions.** | The three types of nuclear reactions are:  a. **fission**  b. **fusion**  c. **transmutation** |
| **\_\_\_\_\_3. I can define transmutation, fission, and fusion.** | **Definitions:**  transmutation **– process of changing one element into another; may be natural or artificial**  fission – **process of splitting apart a large atom (usually U of Pu) into two roughly equal size pieces by hitting it with a neutron**  fusion – **process of putting small nuclei (usually H) together to form a larger nucleus (He)** |
| **\_\_\_\_\_4. I can state two synonyms for spontaneous decay.** | Two synonyms for spontaneous decay are:\_\_\_\_natural decay\_\_\_\_\_  and \_\_natural transmutation\_\_. |
| **\_\_\_\_\_5. I can show how mass number and electrical charge must be conserved in any nuclear reaction.** | Complete the following nuclear equation:  0  -1 e  \_\_\_\_\_\_\_\_ |
| **\_\_\_\_\_6. I can explain what makes a nucleus stable or unstable.** | The stability of the nucleus is dependent on the \_\_\_proton\_\_\_ to  \_\_\_\_\_neutron\_\_\_\_\_\_ ratio. |
| **\_\_\_\_\_7. I can explain the difference between natural transmutation and artificial transmutation.** | The difference between natural transmutation and artificial transmutation is that in natural transmutation an\_unstable\_ \_\_nucleus\_\_\_breaks apart on its own and in artificial transmutation a \_\_stable\_\_\_\_\_\_ \_\_nucleus\_\_\_\_ is made \_\_\_\_unstable\_\_\_\_\_\_ by hitting it with a high energy particle (such as a proton, neutron, or gamma radiation). |
| **\_\_\_\_\_8. I can identify a natural decay reaction from a list of reactions.** | Which equation represents a natural decay? |
| **\_\_\_\_\_9. I can identify an artificial transmutation reaction from a list of reactions.** | Which equation represents artificial transmutation? |
| **\_\_\_\_\_10. I can identify a fission reaction from a list of reactions.** | Which equation represents fission? |
| **\_\_\_\_\_11. I can identify a fusion reaction from a list of reactions.** | Which equation represents fusion? |
| **\_\_\_\_\_12. I can state the conditions of temperature and pressure that are needed for a fusion reaction to happen.** | The temperature and pressure conditions needed for fusion to happen are:  \_\_\_\_\_high\_\_\_\_\_ temperature and \_\_\_\_\_high\_\_\_\_\_\_\_ pressure |
| **\_\_\_\_\_13. I can explain why all nuclear reactions release LOTS more energy than chemical reactions do.** | Nuclear reactions release LOTS more energy than chemical reactions do because **some of the mass is converted to energy** |
| **\_\_\_\_\_14. Given a list of reactions, I can differentiate a “nuclear” reaction from a “chemical” reaction.** | Which of the following equations represent NUCLEAR reactions? |
| **\_\_\_\_\_15. I can define half-life.** | **Definition:**  half-life – **the amount of time required for one-half of a radioactive isotope to decay** |
| **\_\_\_\_\_16. Given the length of the half-life and the amount of time that has passed, I can determine the amount of radioactive sample.** | Based on Reference Table N, what fraction of a radioactive sample of Au-198 will remain unchanged after 10.78 days?  **1/16**  What was the original mass of a radioactive sample of K-37 if the sample decayed to 25.0 g after 4.92 seconds? The half-life of K-37 is 1.23 seconds)  **400 g** |
| **\_\_\_\_\_17. Given the length of the half-life and the amount of radioactive sample, I can determine the amount of time that has passed.** | A 100.0 g sample of Co-60 decays until only 12.5 g of it remains. Given that the half-life of Co-60 is 5.271 years, how long did the decay take?  **15.813 years** |
| **\_\_\_\_\_18. Given the amount of time that has passed and the amount of radioactive sample, I can determine the length of the half-life.** | What is the half-life of a radioisotope if 25.0 g of an original 200.0 g sample remains unchanged after 11.46 days?  **3.82 days** |
| **\_\_\_\_\_19. Using Table N, I can determine the length of half-life and/or decay mode for a specific radioactive isotope.** | Compared to K-37, the isotope K-42 has  A) shorter half-life and the same decay mode  B) shorter half-life and a different decay mode  C) longer half-life and the same decay mode  D) longer half-life and a different decay mode |
| **\_\_\_\_\_20. I can state 5 beneficial uses for radioactive isotopes.** | Five beneficial uses for radioactive isotopes are:  **a. radioactive dating**  **b. tracing chemical and biological processes**  **c. industrial measurement**  **d. nuclear power**  **e. detection and treatment of disease** |
| **\_\_\_\_\_21. I can state the scientific use of 4 specific radioactive isotopes.** | C-14 is used for \_\_\_\_\_dating previously living organisms\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  I-131 is used for\_\_\_\_\_treating thyroid disorders\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  U-238 is used for \_\_\_\_dating geologic formations\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Co-60 is used for\_\_\_\_\_\_treating cancerous tumors\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **\_\_\_\_\_22. I can state three risks associated with radioactivity and radioactive isotopes.** | Three risks associated with radioactivity and radioactive isotopes are:  **a. biological exposure**  **b. long-term storage and disposal**  **c. nuclear accidents** |