Exercise 21.2a

Nuclear Equations

Name: _____

Date: _____ Per: _____

While chemical reactions occur when electrons are rearranged within the electron cloud (stolen, lost or shared with other atoms), nuclear reactions occur when protons and neutrons are rearranged within the nucleus of an atom. In both cases, the rearrangements are driven by the same thing – the tendency of matter to become more stable. Nuclear reactions, therefore, occur when the protons and neutrons are rearranged to form a more stable nucleus.

There are five common forms of changes (alpha decay, beta decay, gamma decay, positron decay, and electron capture). This worksheet does not include gamma decay. Alpha radiation occurs as particles made up of 2 protons and 2 neutrons (essentially the nucleus of a helium atom) split from the nucleus. Beta radiation also occurs as particles, but are simply high-energy, high-speed electrons. Positron decay involves the emission of an anti-electron (positron) from the nucleus. Electron capture occurs when an electron from the electron cloud is absorbed by the nucleus. The changes from these decay events can be summarized with equations:

Alpha $^{252}_{98}\text{Cf} \rightarrow {}^{248}_{96}\text{Cm} + \boxed{{}^{4}_{2}\text{He}}$ (Alpha Particle)

Beta $^{137}_{55}\text{Cs} \rightarrow {}^{137}_{56}\text{Ba} + \boxed{{}^{0}_{-1}\text{e}}$ (Beta Particle)

Positron $^{30}_{15}\text{P} \rightarrow {}^{30}_{14}\text{Si} + \boxed{{}^{0}_{+1}\text{e}}$ (Positron)

e⁻ Capture $^{125}_{53}\text{I} + \boxed{{}^{0}_{-1}\text{e}} \rightarrow {}^{125}_{52}\text{Te}$ (Electron Capture)

1) Notice that the superscript of the atom undergoing decay is equal to the sum of the superscripts of the decay products. The same goes for the subscript of the decaying atom and the subscripts of the decay products. They must be equal.

DIRECTIONS: *Complete the following equations in the space provided.*

1. $^{14}_{6}\text{C} \rightarrow {}^{\_\_}_{\_\_}\_\_ + {}^{0}_{-1}\text{e}$

2. $^{8}_{5}\text{B} \rightarrow {}^{\_\_}_{\_\_}\_\_ + {}^{8}_{4}\text{Be}$

3. $^{238}_{92}\text{U} \rightarrow {}^{\_\_}_{\_\_}\_\_ + {}^{4}_{2}\text{He}$

4. $^{81}_{36}\text{Kr} \rightarrow {}^{81}_{37}\text{Rb} + {}^{\_\_}_{\_\_}\_\_$

5. $^{212}_{84}\text{Po} \rightarrow {}^{208}_{82}\text{Pb} + {}^{\_\_}_{\_\_}\_\_$

6. $^{\_\_}_{\_\_}\_\_ \rightarrow {}^{209}_{82}\text{Pb} + {}^{4}_{2}\alpha$

7. $^{140}_{56}\text{Ba} \rightarrow {}^{\_\_}_{\_\_}\_\_ + {}^{0}_{-1}\text{e}$

8. $^{75}_{35}\text{Br} \rightarrow {}^{\_\_}_{\_\_}\_\_ + {}^{75}_{34}\text{Se}$

9. $^{38}_{18}\text{Ar} + {}^{\_\_}_{\_\_}\_\_ \rightarrow {}^{38}_{17}\text{Cl}$

10. $^{131}_{53}\text{I} \rightarrow {}^{\_\_}_{\_\_}\_\_ + {}^{0}_{-1}\beta$

11. $^{80}_{38}\text{Sr} + {}^{\_\_}_{\_\_}\_\_ \rightarrow {}^{80}_{37}\text{Rb}$

12. $^{11}_{6}\text{C} \rightarrow {}^{\_\_}_{\_\_}\_\_ + {}^{0}_{-1}\beta$

DIRECTIONS: *Describe the changes in the nucleus during each of the following:*

13. Alpha decay: _____

_____

14. Beta decay: _____

_____

15. Positron decay: _____

_____

16. Electron capture: _____

_____

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DIRECTIONS: *Write a complete nuclear decay equation for each of the following.*

17. The alpha decay of bismuth-213. _____.

18. The beta decay of silver-106. _____.

19. The positron decay of gallium-67. _____.

20. The beta decay of hydrogen-3. _____.

21. The electron capture of arsenic-73. _____.

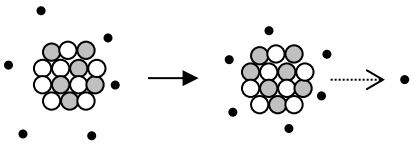
22. The alpha decay of uranium-238. _____.

23. The positron decay of titanium-45. _____.

24. The alpha decay of polonium-210. _____.

DIRECTIONS: Decipher the diagrams below and write a decay equation for each of the diagrams.

25. Describe the diagram below:



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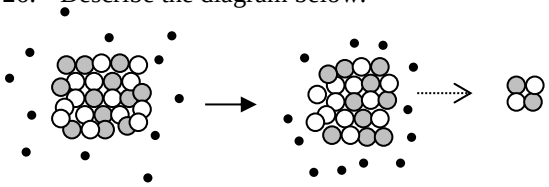
26. Describe the diagram below:



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27. What is the biggest problem with the diagrams in *Questions 25. & 26.* ? _____

_____

28. Draw a diagram showing electron capture.