WKS
Fusion Reactions

Name Answer Key
Period _____ Date _____

Complete the following fusion reactions.

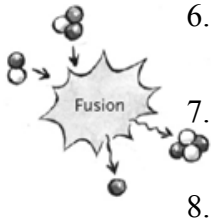
1. ${}^{9}_{4}\text{Be} + {}^{1}_{1}\text{H} \rightarrow {}^{4}_{2}\text{He} + \underline{{}^{6}_{3}\text{Li}}$ A = (9+1)−4=6, Z = (4+1)−2=3

2. ${}^{4}_{2}\text{He} + {}^{16}_{8}\text{O} \rightarrow \underline{{}^{20}_{10}\text{Ne}}$ A=(4+6)=20, Z=(2+8)=10

3. ${}^{1}_{1}\text{p} + {}^{6}_{3}\text{Li} \rightarrow {}^{4}_{2}\text{He} + \underline{{}^{3}_{2}\text{He}}$ A=(1+6)−4=3, Z=(1+3)−2=2

4. ${}^{2}_{1}\text{H} + {}^{2}_{1}\text{H} \rightarrow {}^{1}_{0}\text{n} + \underline{{}^{3}_{2}\text{He}}$ A=(2+2)−2=3, Z=(1+1)−0=2

5. ${}^{12}_{6}\text{C} + {}^{16}_{8}\text{O} \rightarrow \underline{{}^{28}_{14}\text{Si}} + {}^{0}_{0}\gamma$ A=(12+16)=28, Z=(6+8)=14



6. ${}^{2}_{1}\text{H} + {}^{6}_{3}\text{Li} \longrightarrow {}^{1}_{0}\text{n} + \underline{{}^{7}_{4}\text{Be}}$ A=(2+6)−1=7, Z=(1+3)−0=4

7. ${}^{16}_{8}\text{O} + {}^{1}_{1}\text{H} \longrightarrow \underline{{}^{17}_{9}\text{F}} + {}^{0}_{0}\gamma$ A=(16+1)=17, Z=(8+1)=9

8. ${}^{12}_{6}\text{C} + {}^{12}_{6}\text{C} \longrightarrow {}^{1}_{1}\text{H} + \underline{{}^{23}_{11}\text{Na}}$ A=(12+12)−1=23, Z=(6+6)−1=11

9. ${}^{20}_{10}\text{Ne} + {}^{4}_{2}\text{He} \longrightarrow \underline{{}^{24}_{12}\text{Mg}}$ A=(20+4)=24, Z=(10+2)=12

10. ${}^{28}_{14}\text{Si} + {}^{4}_{2}\text{He} \longrightarrow \underline{{}^{32}_{16}\text{S}}$ A=(28+4)=32, Z=(14+2)=16

11. Why does nuclear fusion require such high temperatures? What forces are involved and what is needed for two nuclei to successfully fuse together?
High temperatures are needed to give the nuclei enough energy to overcome the repulsion due to their positive charges and get them close enough for the Strong Nuclear Force to pull them together.

12. Why does the fusion of two He-4 nuclei require much higher temperatures than fusion of H-2 with H-3?
He-4 has a 2+ charge, so the repulsion of two He-4 nuclei is 4× the repulsion of two H nuclei each with a 1+ charge. Thus, more energy is needed to overcome this repulsion.

13. How is nuclear fission different from nuclear fusion? Describe the particles involved and the conditions necessary.
In fusion, two smaller nuclei are fused at extremely high temperatures to create one larger nucleus and release a large amount of energy. In fission, one larger nucleus is split into two smaller nuclei (high temperatures are not needed) and releases a large amount of energy.

For the next 3 questions, refer to the Average Mass per Nucleon Diagram

14. Why is Fe considered the most stable nucleus?
Fe has the smallest average mass per nucleon (proton or neutron), so can not release energy by either fission or fusion.

15. What happens in both fusion and fission to release energy? What famous equation describes this process?
The average mass per nucleon decreases and is converted into energy according to Einstien's famous equation, $E = mc^2$ (really $\Delta E = \Delta mc^2$), where ΔE is the energy change, Δm is the mass change, and c is the speed of light.

16. What process do elements lighter than Fe undergo to release energy? Elements heavier than Fe?
Lighter elements under fusion into a heavier element with lower average mass per nucleon. Heavier elements undergo fission into two lighter nuclei with lower average mass per nucleon.