

**I. Multiple Choice – Circle the best answer.**

1. The atomic nucleus –

- a. takes up most of the volume of the atom
- b. contains most of the mass of the atom
- c. is neutral
- d. all of these

The next 3 questions refer to this nucleus:  ${}_{15}^{31}\text{P}$

2. The nucleus has \_\_\_\_\_ protons.

- a. 31
- b. 15
- c. 16

3. The nucleus has \_\_\_\_\_ neutrons.

- a. 31
- b. 15
- c. 16

4. The nucleus has \_\_\_\_\_ nucleons.

- a. 31
- b. 15
- c. 16

5. Isotopes are atoms of –

- a. the same element with different numbers of neutrons
- b. the same element with different numbers of protons
- c. different elements with the same number of neutrons
- d. the same element with the same masses

6. Strong forces between nucleons –

- a. are forces of attraction holding the particles together
- b. are independent of the charges of the particles
- c. are short range forces, acting between only the closest neighbors
- d. all of these

7. If the electrical forces of repulsion between protons is greater than the strong forces between the nucleons, the nucleus will be –

- a. stable
- b. unstable

8. Radioactive nuclei –

- a. are unstable
- b. emit alpha, beta, or gamma rays
- c. decay into another element
- d. all of these

9. Another term for radioactive decay into another element is –

- a. transportation
- b. mutation
- c. transmutation
- d. emission

questions continued on next page

For the next 5 questions choose the type of radiation from the box on the right and write the corresponding letter in the blank next to the statements below:

- a. alpha  
b. beta  
c. gamma

10. \_\_\_\_\_ identical to a helium nucleus
11. \_\_\_\_\_ has the greatest penetrating power
12. \_\_\_\_\_ can penetrate paper, but not a thick sheet of aluminum
13. \_\_\_\_\_ is identical to an electron
14. \_\_\_\_\_ has no mass or charge
15. Half-life –
- is the mass of an isotope remaining after half a second
  - depends on temperature and pressure
  - is the time it takes for half the mass of a sample to decay
  - can be changed by varying the conditions in the lab
16. The shorter the half-life of a radioactive isotope, the \_\_\_\_\_ dangerous it is.
- more
  - less
17.  ${}_{84}^{218}\text{Po} \rightarrow {}_{82}^{214}\text{Pb} + \text{_____}$
- ${}_{-1}^0\text{e}$
  - ${}_{+1}^0\text{e}$
  - ${}_{2}^4\text{He}$
  - ${}_{2}^4\text{He}$
18. During nuclear fission and fusion –
- the mass of the product particles is less than the mass of the reactants
  - matter is converted into energy
  - tremendous energy is produced, according to the equation,  $E=mc^2$
  - all of these
19. The minimum mass of fissionable material necessary for an uncontrolled chain reaction is called –
- critical mass
  - plasma
  - neutron mass
  - isotope mass
20. Nuclear \_\_\_\_\_ occurs naturally on the sun.
- fission
  - bombardment
  - fusion
  - half-life

**II. Discussion: Choose 1 question to discuss, using proper terms.**

1. What are the advantages of fusion over fission for energy production? What are the problems with fusion?

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2. What are some of the uses of radioactive isotopes?

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3. How are nuclear reactions different from ordinary chemical and physical changes?

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