# Higher Nuclear Reactions Answers

**1.** a) Rutherford deduced that an atom has a nucleus that is positive.

Mass is almost entirely contained in the nucleus.

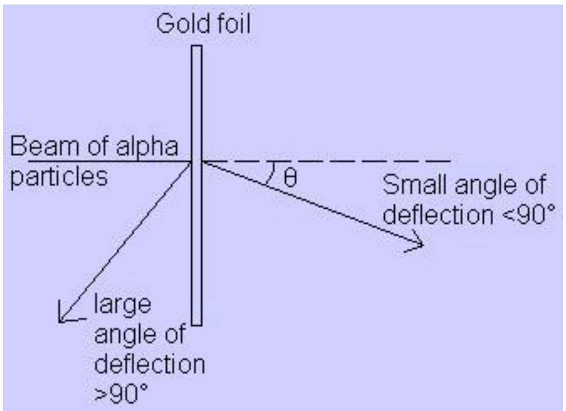
The nucleus has a volume which is extremely small in comparison to the overall size of the atom.

b) A beam of alpha particles from a radium source is fired at a thin film of Gold.

The vast majority of the alpha particles pass through the gold foil.

Some alpha particles are deflected at an angle of < 90°.

An extremely small number of alpha particles are deflected at angles > 90°.




**2.** a) 83 protons + 127 neutrons. Element = Bismuth.

b) 92 protons + 143 neutrons. Element = Uranium.

c) 88 protons + 138 neutrons. Element = Radium.

**3.** Beta then Alpha.

**4.** 1/256.

**5.** 9 minutes.

**6.** a) The activity is the number of decays/disintegrations of atoms per second.

b) $1.632 \times 10^{11}$ atoms.

**7.** a) A nuclei of large mass splits up into two nuclei of smaller mass with neutrons being released. The change in mass in the reaction is converted into energy

b) Two nuclei of smaller mass join together to form a nuclei of larger mass with energy being produced in the reaction.

**8.** a) Nuclear Fusion.

b) Nuclear Fission.

**9.** a) Induced Nuclear Fission.

b) $2.7 \times 10^{-11}$J.

**10.** a) Alpha particles.

b) The vast majority of the alpha particles pass through the gold foil.

Some alpha particles are deflected at an angle of < 90°.

An extremely small number of alpha particles are deflected at angles > 90°.

This shows that the mass of the atom is concentrated in the nucleus as the vast majority of the alpha particles pass straight through the Gold atom undeflected.

**11.** The nucleus is positive as the alpha particles will undergo an electrostatic repulsion when they are near the nucleus.

The nucleus is massive as some of the alpha particles at deflected at angles >90°.

The nucleus has a very small volume as the vast majority of alpha particles pass straight through the atom undeflected.

**12.** a) i) Beta.

ii) 238 – 92 = 146 neutrons.

iii) a = 230, b = 90, c = 4 and d = 2.

**13.** a) 241 – 95 = 146 neutrons.

b) i) r = 93 and s = 237.

ii) Np = Neptunium

c) $1.8 \times 10^{6}$ decays.

d) 10.8Ω.

**14.** a) i) Induced as a neutron has being fired at the Plutonium (Pu) nuclei.

ii) $1.53 \times 10^{-13}$J.

**15.** a) i) Induced Nuclear Fission.

ii) A -> $3 \times 10^{-28}$kg

B -> $4 \times 10^{-28}$kg

iii) Reaction B. From $E = mc^2$, the greater the change in mass the greater the energy.

b) i) 92 protons and 235 - 92 = 143 neutrons in the nucleus.

ii) y = 54.

**16.** a) Nuclear Fusion.

b) Using $E = mc^2$, where m is the change in mass of the nuclei before and after the reaction.

The change in mass is then converted into energy in the reaction.

**17.** a) i) Lithium (Li). i.e atomic number = 3.

ii) $1.165 \times 10^{-26}$kg.

**18.** a) i) Nuclear Fusion.

ii) $2.7 \times 10^{-12}$J.

**19.** a) i) 92 protons in the nucleus.

ii) 235 – 92 =143 neutrons in the nucleus.

b) The two neutrons produced in each nuclear fission reaction will then split two further Uranium nuclei and so on, providing a domino effect. 2->4->8->16 etc

c) $3.35 \times 10^{-11}$J.

**20.** a) Nuclear Fusion.

b) The mass of the nuclei before the nuclear reaction is greater than the mass of the products after the nuclear reaction. This change of mass is converted into energy using $E = mc^2$, where m is the change in mass.

c) $2.89 \times 10^{-12}$J.

d) $8.65 \times 10^{18}$ Reactions.