

## TUTORIAL ANSWERS\_NUCLEAR PHYSICS

### Question 1

35 nucleons

### Question 2

- a.)  $a = 4, b = 2$
- b.)  $a = 4, b = 2$
- c.)  $a = 7, b = 3$
- d.)  $a = 1, b = 14$
- e.)  $a = 3, b = 1$
- f.)  $a = 239, b = 92, c = 0, d = -1$

### Question 3

$9.62 \times 10^{-13} \text{ J}$

### Question 4

C

### Question 5

A beta-particle has less charge, less massive and travels faster.

Air is much less dense and so less ionization is caused per unit distance travelled.

### Question 6

Most strongly ionizing implies many more collisions occur, so there is greater loss of momentum and therefore less penetration.

### Question 7

a.) Most of the mass is concentrated in a small region/space called the nucleus.

The region/space/nucleus is positively charged.

b.) Most alpha particles pass undeviated through the gold, showing that most of an atom is empty space.

Some alpha particles are deflected through large angles, showing that there is a region/part of the atom which is much heavier than alpha particle and is positively charged.

### Question 8

The same graph is obtained, with exactly the same amount of randomness.

Increasing the temperature has no effect on the nucleons inside the nucleus.

### Question 9

a.) Ratio =  $V_{\text{gold atom}} / V_{\text{gold nucleus}}$   
 $= [4/3 \pi (10^{-10})^3] / [4/3 \pi (10^{-15})^3]$   
 $= (10^{-10})^3 / (10^{-15})^3$   
 $= \underline{10^{15}}$

b.) Assume the mass of gold nucleus and gold atom are the same ( $\text{mass}_{\text{gold nucleus}} = \text{mass}_{\text{gold atom}}$ ), thus

$$\begin{aligned}\rho_{\text{gold nucleus}} V_{\text{gold nucleus}} &= \rho_{\text{gold atom}} V_{\text{gold atom}} \\ \rho_{\text{gold nucleus}} &= \rho_{\text{gold atom}} (V_{\text{gold atom}} / V_{\text{gold nucleus}}) \\ \rho_{\text{gold nucleus}} &= (19000) (10^{15}) \\ \rho_{\text{gold nucleus}} &= \underline{1.9 \times 10^{19} \text{ kgm}^{-3}}\end{aligned}$$

### Question 10

B

### Question 11

A

### Question 12

C