Solutions to Nuclear physics – Test A

1. *Any two from:*
   - cancer treatment / radiotherapy **[1]**
   - tracers **[1]**
   - sterilising equipment **[1]**

2. small in relation to atomic size **[1]**
   positively charged **[1]**
   alpha particles were repelled **[1]**

3. very short range in air **[1]**
   makes it difficult to get a reliable range and number of distance measurements **[1]**

4. (a) $\frac{732.1}{4.0^2}$ **[1]**
   731.2 or 731 **[1]**
   $\frac{732.1}{13.5^2}$ **[1]**
   4.01 units **[1]**
   (b) actual value will be greater **[1]**
   because of background radiation **[1]**

5. (a) graph with N on the vertical axis and t on the horizontal **[1]**
   line is decreasing **[1]**
   as an (approximately) exponential decay **[1]**
   do not accept line either becoming horizontal or touching the horizontal axis
   (b) (i) natural log of N / $\ln N$ **[1]**
   against t **[1]**
   (ii) natural log of number of active atoms at time zero / $\ln N_0$ **[1]**
   (iii) the negative **[1]**
   value of the decay constant **[1]**
   accept $-\lambda$ for 2 marks or λ for 1 mark

6. (a) 0.693 / 5730 **[1]**
   1.21×10^{-4} years^{-1} **[1]**
   (b) $100 \times e^{-(1.21 \times 10-4 \times 2000)}$ **[1]**
   $e^{-(1.21 \times 10-4 \times 2000)}$ = 0.785 **[1]**
   78.5% **[1]**

7. (a) **[1]**
   (b) (minus) **[1]**
   this increases the proton / Z number **[1]**
   so the nuclide will move closer to the stability line / become more stable **[1]**

8. density stays the same **[1]**
   protons and neutrons have the same density / the material in the nucleus is independent

9. (a) fusion **[1]**
   because two nuclei are joining **[1]**
   (b) reactants 5.029602 **[1]**
   products 5.010171 **[1]**
   difference 0.019431 **[1]**
   (c) $0.019431 \times 1.661 \times 10^{-27}$ **[1]**
   3.227×10^{-29} kg **[1]**
   (d) $3.227 \times 10^{-29} \times (3.00 \times 10^8)^2$ **[1]**
   2.90×10^{-12} **[1]**
   J **[1]**

10. (a) free neutrons **[1]**
    with relatively low kinetic energy **[1]**
    (energy) equivalent to surrounding particles **[1]**
    (b) nuclide absorbing many neutrons **[1]**
    does not itself undergo fission / contribute to the chain reaction **[1]**

11. *Any two from (3-mark answer must include at least one advantage and at least one*
    appropriate in the short term as no radiation will reach Earth's surface **[1]**
    relatively cheap way to dispose of the waste **[1]**
    in the long term the containers may corrode/leak **[1]**
    causing contamination of soil/water **[1]**
    future natural geological activity may damage the containers **[1]**

Preview of Answers Ends Here