## Solutions to Nuclear, Particle and Medical Physics – Test B

(a)  $^{234}_{90}\text{Th} \rightarrow ^{234}_{91}\text{Pa} + ^{0}_{-1}\beta + ^{0}_{v}$ 1.

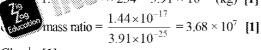
Accept e- in place of beta; accept subscript e on antineutrino and A / Z values of 0 on antineutrino

Thorium written correctly [1]

Pa as a product [1]

234 and 91 correctly written with product symbol (even if not Pa) [1]

- 0 and -1 correctly write: Wile green product [1] (b) charge =  $1.6 \times 30$  0...  $1.44 \times 10^{-17}$  (C) [1] 1.  $\times 234 = 3.91 \times 10^{-25}$  (kg) [1]



- Up to 0.5 fm  $/5 \times 10^{-16} \,\mathrm{m}$  [1] 2.
- 3. A photon [1] Incident on a nucleus [1] Produces a particle [1] and its equivalent antiparticle [1]
- Momentum [1] Energy [1]
- gamma radiation is ionising [1] gamma radiation has long range in air / is highly penetrating [1] Then any two from:
  - point the source away from peor.
  - keep the source as far from the compossible [1]
  - stand behind a 2 2 2 2 [1]
  - sca La inside a lead container when
- (before Rutherford) plum pudding model / atoms were solid balls [1] Rutherford model showed atoms were mostly empty space [1] nucleus known to contain positive charge and be at the centre [1] electrons in shells / different energy levels / orbitals [1]
- 7. intensity on the vertical axis [1] 1 / distance<sup>2</sup> on horizontal axis [1] graph should be a straight line [1] with positive gradient / gradient is k in  $I = \frac{k}{r^2}$  [1]
- background count rate is less significant / control of 8. to a small percentage of the count of the co accuracy not significantly I ciec 1



lnA calcu all value and no u

9.

	. 33
t/s	
0	
60	
120	2000
180	2000
240	
300	200
360	
420	700

- (b) graph wi horizont scaled so the grid all points straight 🏻
- (c) gradient ဳ the line all value calculati negative if all cor
- numeric positive \* unit as s
- 10.  $\lambda = 0.693 / 1.$  $3.59 \times 10^{-4} \text{ ye}$  $100 = 77 \times e^{-6}$  $\ln 77 - \ln 100 =$ 728 years [1]
- 11. charge on alpl  $= 3.2 \times 10^{-19}$ charge on nuc  $= 1.26 \times 10^{-14}$  $8.99 \times 10^9 \times 3.$ (3\$
  - 296 N [1]
- 12. reactants 5.02 products 5.01@ difference 0.0  $0.019431 \times 1.8$  $3.227 \times 10^{-29}$  $3.227 \times 10^{-29}$  $2.90 \times 10^{-12}$  (3)  $2.90 \times 10^{-12} \times$  $3.49 \times 10^{12} \,\mathrm{J}$

## COPYRIGHT **PROTECTED**



13. (a) Diagram/description to include:

Collimator [1]

Scintillator [1]

Detector [1]

computer / software / circuitry / display [1]

Functions to include two from:

collimator selects gamma rays / photons from one direction only [1]

scintillator amplifies signal / converts one gamma photos o many visible photos detector detects visible photons [1]

- 14. (a) attenuation [1]
  - (b) photoelectric effect

X-ray photon a' a genectron/atom [1]

- 15. (a) acc impedance [1]
  - (b) (i) blood is denser / liquids are denser than gases [1]
    particles/molecules packed more tightly [1]
    vibrations/compressions in longitudinal wave more easily passed on [1]
    - (ii)  $\lambda$  in air = 3.3 × 10<sup>-5</sup> m [1]  $\lambda$  in blood 1.5 × 10<sup>-4</sup> m [1] difference = 1.17 × 10<sup>-4</sup> [1]

$$\left(\frac{1.17 \times 10^{-4}}{3.3 \times 10^{-5}} \times 100 = \right) = 355 \% \quad [1]$$





## 

COPYRIGHT PROTECTED



Preview of Answers Ends Here				
			sta la alcina un avacuora ta	
This is a limited inspection		ends here to stop studer		
This is a limited inspection	copy. Sample of answers	ends here to stop studer		
This is a limited inspection	copy. Sample of answers	ends here to stop studer		