Pages 14–16 Exam practice questions

1 D

2 B

3 B

4 C

5 B

6 A

7 C

8 D

9 B

10 C

11 a) i) Neutron [1]

ii) Electron [1]

iii) Neutron [1]

b) i) Anti-electron neutrino [1]

ii) A = 99 [1]; Z = 44 [1]

12 a) Same atomic number / number of protons [1]

different mass / nucleon number / different number of neutrons [1]

b) ${}^{A}_{Z}\mathrm{X} \rightarrow {}^{A-4}_{Z-2}\mathrm{Y} + {}^{4}_{2}\mathrm{He}$ [2]

c) Strong nuclear force is very short range [1], so once outside the nucleus the alpha particle no longer experiences the force [1]

13 a) p = 20; n = 28; e = 18 [1]

b) +2e = $+3.2 \times 10^{-19}$ C [1]

c) $\text{specific charge of ion} = \frac{\text{charge of ion}}{\text{mass of ion}}$;

Mass of ion = mass of protons + mass of neutrons + mass of electrons

= $(20 \times 1.673 \times 10^{-27}\ \text{kg}) + (28 \times 1.675 \times 10^{-27}\ \text{kg}) + (18 \times 9.11 \times 10^{-31}\ \text{kg})$

= 8.04×10^{-26} kg [1]; $\text{specific charge of ion} = \frac{+3.2 \times 10^{-19}}{8.04 \times 10^{-26}} = 3.98 \times 10^{6}\ \text{kg}$ [1]

14 a) Repulsive then attractive [1]

Short range [1]

Correct distance for cross over (a range of 0.1–1.0 fm) [1]

b) A helium nucleus (or 2p + 2n) [1]

c) ${}^{238}_{92}\mathrm{U} \rightarrow {}^{234}_{90}\mathrm{Th} + {}^{4}_{2}\alpha$ [2]

15 a) The charge per unit mass of a particle. [1]

b)

	Number of protons	Number of neutrons	Specific charge of nucleus/ **b. C kg^{-1} [1]**
First isotope	92	143	**d. = 92 × 1.6 × 10^{-19} [1]/ ((92 × 1.67 × 10^{-27}) + (143 × 1.67 × 10^{-27}) [1]= 3.8 × 10^{7} [1]**
Second isotope	**c. 92**	**e. 3.7 × 10^{7} = (92 × 1.6 × 10^{-19})/(*A* × 1.67 × 10^{-27}) [1]** ***A* × 1.67 × 10^{-27} = (92 × 1.6 × 10^{-19})/(3.7 × 10^{7}) [1] *A* = 238 [1]** **Number of neutrons = 238 – 92 = 146 [1]**	3.7 × 10^{7}

16 a) i) Select LED.

ii) Observe LED by eye through blackened tube.

iii) Increase potential difference across LED until photons observed.

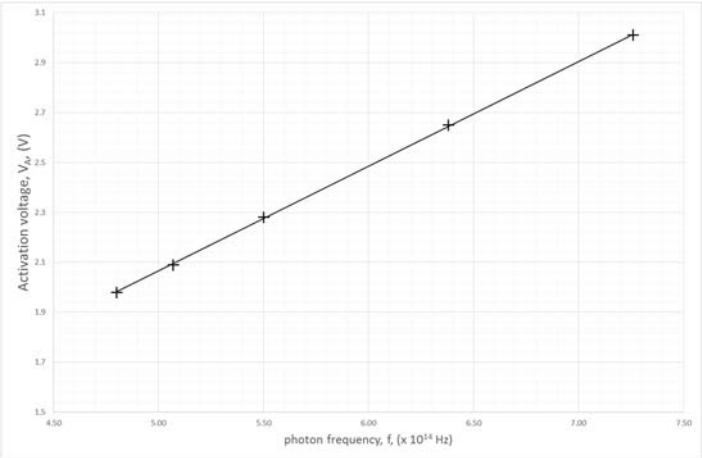
iv) Record activation voltage.

v) Repeat for other LEDs.

b)

LED number	Wavelength of emitted photons, λ /nm	Frequency of emitted photons, f /Hz	Activation voltage, V_A /V
1 violet	413	**7.26 × 10^{14}**	3.01
2 blue	470	**6.38 × 10^{14}**	2.65
3 green	545	**5.50 × 10^{14}**	2.28
4 yellow	592	**5.07 × 10^{14}**	2.09
5 red	625	**4.80 × 10^{14}**	1.98

c)



d) Gradient = 4.199×10^{-15} V Hz^{-1}

e) Gradient = $\frac{h}{e} \Rightarrow h$ = gradient × e = 4.199×10^{-15} V $Hz^{-1} \times 1.6 \times 10^{-19}$ C = 6.72×10^{-34} J s

17 a) $Z \rightarrow Z - 2;\ A \rightarrow A - 4$

b) $Z \rightarrow Z + 1;\ A \rightarrow A$

c) $Z \rightarrow Z + 1;\ A \rightarrow A + 2$

18 a) Electron (β^-); anti-electron neutrino

b) p = 20 ; n = 22 ; e = 19

19 Conservation of energy required:

$2m_e c^2 = 2hf\ [2] \Rightarrow hf = m_e c^2$

$= (1.88 \times 10^{-28}\ \text{kg}) \times (3.0 \times 10^8\ \text{m s}^{-1})^2$

$= 1.69 \times 10^{-11}\ \text{J}$