

Name of the Student: \_\_\_\_\_

Max. Marks : 15 Marks

Time : 15 Minutes

**Q1.**(a)  $q\bar{q}$  ✓

1

(b) Total energy =  $2\text{keV} + 2 \times 511 \text{ keV} = 1024 \text{ keV}$  ✓

$$= 1024 \times 1.6 \times 10^{-19} = 1.64 \times 10^{-13} \text{ J} \checkmark$$

$$\text{Energy of each photon} = 1.64 \times 10^{-13} / 2 = 8.19 \times 10^{-14} \text{ (J)} \checkmark$$

*First mark for calculating the total energy in keV.**Second mark is for converting correctly into joules.**Third mark is for dividing by two so ecf for incorrect conversion into joules. Student must show at least 3sf.*

3

$$(c) \quad \lambda = \frac{hc}{E} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{8.19 \times 10^{-14}} \checkmark$$

$$= 2.43 \times 10^{-12} \text{ (m)} \checkmark$$

*First mark for the correctly rearranged equation or correct values substituted into equation.**Correct answer only scores 2 marks, ecf from 1 (b)*

2

$$(d) \quad E_k = 2 \text{ keV} = 2000 \times 1.6 \times 10^{-19} \text{ J} = 3.2 \times 10^{-16} \text{ J} \checkmark$$

$$v = \sqrt{\frac{2E_k}{m}} = \sqrt{\frac{2 \times 3.2 \times 10^{-16}}{9.11 \times 10^{-31}}} \checkmark$$

$$= 2.65 \times 10^7 \text{ (m s}^{-1}\text{)} \checkmark$$

*First mark for converting KE into joules.**Second mark for rearranging equation correctly or substituting correct values into equation.**Third mark for correct answer, must be to at least 3sf.*

3

$$(e) \quad \lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{9.11 \times 10^{-31} \times 2.65 \times 10^7} \checkmark$$

$$= 2.75 \times 10^{-11} \text{ (m)} \checkmark$$

*First mark for rearranging equation correctly or substituting correct*

values into equation.

Second mark for correct answer.

2

- (f) Recognition that separation is  $1.5 \times 10^{-10}$  m and compared to  $0.28 \times 10^{-10}$  (ecf)✓

wavelength is about 5 times less than gap width✓

$$\sin \theta = \frac{\lambda}{d} = 0.2 \rightarrow \theta \sim 11^\circ \quad \checkmark$$

yes (diffraction would be observable)✓

Or words to that effect

4

[15]