

- 8 (a) State what is meant by the de Broglie wavelength.

..... [1]

- (b) Calculate the de Broglie wavelength of an electron moving at a speed of  $4.9 \times 10^7 \text{ ms}^{-1}$ .

wavelength = ..... m [2]

- (c) State **one** similarity and **one** difference between an electron and a positron.

similarity: .....

.....

difference: .....

.....

[2]

- (d) An electron moving at a speed of  $4.9 \times 10^7 \text{ ms}^{-1}$  collides with a positron that is travelling at the same speed in the opposite direction. As a result of the collision, two gamma-ray photons are produced.

- (i) State the name of this type of reaction.

..... [1]

- (ii) State what happens to the electron and to the positron.

.....

.....

..... [2]



- (iii) Explain why two gamma-ray photons are produced, rather than just one.

.....  
.....

[1]

- (iv) Show that the kinetic energy of the electron before the collision is  $1.1 \times 10^{-15} \text{ J}$ .

[1]

- (v) Use the information in (d)(iv) to determine, to three significant figures, the wavelength associated with the gamma radiation emitted in the collision.

wavelength = ..... m [3]

[Total: 13]