Question Number	Answer	Mark
14(a)	Use of trigonometrical function for *x* component of alpha momentum after collision **Or** Use of trigonometrical function for *y* component of alpha momentum after collision **(1)** Applies conservation of momentum in *x* direction **Or** Applies conservation of momentum in *y* direction **(1)** Applies trigonometry to calculate final angle for proton **(1)** Applies trigonometry or Pythagoras to calculate magnitude **(1)** Angle = 17.0(°) **(1)** Magnitude = 4.9×10^{-20} (N s) **(1)** <u>Example of calculation</u> x component of alpha after = 8.06×10^{-20} Ns × cos10.2° = 7.93×10^{-20} Ns y component of alpha after = 8.06×10^{-20} Ns × sin10.2° = 1.43×10^{-20} Ns x component of proton = 1.26×10^{-19} Ns – 7.93×10^{-20} Ns = 4.67×10^{-20} Ns y component of proton = 1.43×10^{-20} Ns tan θ = 1.43×10^{-20} Ns ÷ 4.67×10^{-20} Ns = 0.31 θ = 17.0° $p^2 = (4.67 \times 10^{-20}\text{ Ns})^2 + (1.43 \times 10^{-20}\text{ Ns})^2$ $p = 4.88 \times 10^{-20}$ N s	**6**
14(b)	Use of $E_k = \frac{p^2}{2m}$ **Or** Use of $E_k = \frac{1}{2} mv^2$ **and** $p = mv$ **(1)** Correct calculation of one kinetic energy (e.c.f from (a)) **(1)** Correct calculation of all kinetic energies (e.c.f from (a)) **(1)** Conclusion consistent with correctly calculated values of kinetic energy **(1)** <u>Example of calculation</u> $E_k = \frac{(4.88 \times 10^{-20}\text{ N s})^2}{2 \times 1.67 \times 10^{-27}\text{kg}} = 7.13 \times 10^{-13}$ J (proton after) $E_k = \frac{(8.06 \times 10^{-20}\text{ N s})^2}{2 \times 6.64 \times 10^{-27}\text{kg}} = 4.89 \times 10^{-13}$ J (alpha after) $E_k = \frac{(1.26 \times 10^{-19}\text{ N s})^2}{2 \times 6.64 \times 10^{-27}\text{kg}} = 1.20 \times 10^{-12}$ J (initial alpha) 7.13×10^{-13} J + 4.89×10^{-13} J = 1.2×10^{-12} J = initial alpha kinetic energy, so it is elastic	**4**
	Total for question 14	**10**