

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

Max. Marks : 23 Marks

Time : 23 Minutes

Mark Schemes

**Q1.**

(a) to prevent the  $\alpha$  particles being absorbed or scattered (1)  
by air molecules (1) (2)

(b) (i) little or no deflection (1)  
by a majority of  $\alpha$  particles (1)

(ii) some  $\alpha$  particles suffer large deflection  
[or backscattering occurs] (1) (3)

(c) **first** path continues undeflected (1)  
**third** path shows backscattering (inside the dotted circle) (1)  
**second** path undeflected or deflected downwards and  
**fourth** path undeflected or deflected upwards (1) (3)

[8]

**Q2.**

(a)  $\alpha$  particles have a short range in air (3–5 cm) (1)  
(or to minimise collisions between  $\alpha$  particles and air molecules) (1)

(b) the  $\alpha$  particles must not be absorbed by the foil (1)  
(or the  $\alpha$  particles must only be scattered once) (1)

(c) a majority of  $\alpha$  particles pass straight through (1)  
most  $\alpha$  particles do not pass close enough to be deflected  
(or few pass close enough to be deflected significantly) (1)

atoms consist mainly of open space (1)

nuclei are very small (or nucleus much smaller than the atom) (1)

the nucleus is massive (or most of the mass of the atom is contained in the nucleus)

the nucleus is positively charged

(or the nucleus and the  $\alpha$  particle have the same charge) (1)

The Quality of Written Communication marks were awarded primarily for the quality of answers to this part.

[6]

**Q3.**

(a) (i)  $T_{1/2} = 50 \text{ s}$  (1) (from graph)

(ii)  $\lambda = \frac{\ln 2}{50}$  (1) =  $0.014 \text{ s}^{-1}$  (1)

(iii)  $N = \frac{A_0}{\lambda}$  (1) =  $\frac{2.4 \times 10^5}{0.014} = 1.7(1) \times 10^7$  (1)

(5)

(b) (i) elapsed time = 50 s = 1 half-life (1)

$$N_{30} = N_0 e^{-30\lambda} \text{ (1)} = 1.71 \times 10^7 e^{-30 \times 0.014} = 1.12 \times 10^7 \text{ (1)}$$

$$\therefore \text{no. decayed from } t = 30 \text{ s to } t = 80 \text{ s is } \frac{1.12 \times 10^7}{2} = 0.56 \times 10^7 \text{ (1)}$$

[alternative (b)(i)]

$$N_{30} = N_0 e^{-30\lambda} \text{ and } N_{80} = N_0 e^{-80\lambda} \text{ (1)}$$

give  $1.12 \times 10^7$  (1) and  $0.56 \times 10^7$  (1)

number decayed (=  $1.12 \times 10^7 - 0.56 \times 10^7$ ) =  $0.56 \times 10^7$  (1)]

(ii) energy released =  $0.56 \times 10^7 \times 1.0 \times 10^{-12} = 5.6 \times 10^{-6} \text{ J}$  (1)

(max 4)

[9]