Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Particle And Radiation

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Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Mark Schemes

Q1.

(a) (i) absorbs enough energy (from the incident) electron(by collision) OR incident electron loses energy (to orbital electron) ✓
exact energy / 10.1((eV) needed to make the transition / move up to level 2 ✓
For second mark must imply exact energy

2

(ii) *(use of $E_2 - E_1$) = hf*
$-3.41 - -13.6 = 10.19$ ✓
energy of photon = $10.19 \times 1.6 \times 10^{-19} = 1.63 \times 10^{-18}$ (J) ✓
$6.63 \times 10^{-34} \times f = 1.63 \times 10^{-18}$
$f = 2.46 \times 10^{15}$(Hz) ✓
(accept 2.5 but not 2.4)
CE from energy difference but not from energy conversion

3

(iii) Ek = $1.7 \times 10^{-18} - 1.63 \times 10^{-18}$ ✓ = 7.0×10^{-20} J ✓

2

(iv) energy required is 12.09 eV / 1.9×10^{-18} ✓
energy of incident electron is only 10.63 eV / energy of electron less than this (1.7×10^{-18} J) ✓
State and explain must have consistent units i.e. eV or J

2

(b) (i) Electrons return to lower levels by different routes / cascade / not straight to ground state ✓

1

(ii) 3 ✓
n=3 to n=1 or n=3 to n=2 and n=2 to n=1 ✓
no CE from first mark

2

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Q2.

(a) *Similarity:* momentum is conserved (in both cases) ✓

Difference: **kinetic** energy is conserved in an elastic collision but not in an inelastic collision ✓

*For 2nd mark allow ke is **only** conserved in elastic collision, **or** ke is not conserved in an inelastic collision.*

2

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(b) (i) in the Ce nucleus $A = 140$ $Z = 58$ and for α $A = 4$ and $Z = 2$

All four correct values required

1

(ii) $0 = 140\ v - 4 \times 9.3 \times 10^6$ ✓

Allow $140\ v = 4 \times 9.3 \times 10^6$ for 1st mark.
Allow ecf from values in (b)(i).

gives $v = 2.6\ (6) \times 10^5$ (m s^{-1}) ✓

Allow inclusion of mass of 58 electrons in recoil atom when shown.

2

(iii) E_k of α = ½ × 4 × $1.66 \times 10^{-27} \times (9.3 \times 10^6)^2$ ✓ (= 2.87×10^{-13} J)

E_k of Ce = ½ × 140 × $1.66 \times 10^{-27} \times (2.66 \times 10^5)^2$ ✓ (= 8.22×10^{-15} J)

$$\frac{E_k \text{ of Ce}}{E_k \text{ of } \alpha} = \frac{8.22 \times 10^{-15}}{2.87 \times 10^{-13}}$$ = 0.0286 or 2.86% ✓

For 3rd mark, answer must be evaluated to at least 2SF (3% alone is insufficient); note that use of $v_d = 2.7 \times 10^5$ m s^{-1} gives 0.0295 or 2.95%.

[**or** $\frac{E_k \text{ of Ce}}{E_k \text{ of } \alpha} = \frac{35 v_d^{\,2}}{v_\alpha^{\,2}}$ ✓ gives $\frac{35 \times (2.66 \times 10^5)^2}{(9.3 \times 10^6)^2}$ ✓

= 0.0286 or 2.86% ✓]

Allow ecf from values in (b)(ii).

[**or**

$\frac{E_k \text{ of Ce}}{E_k \text{ of } \alpha} = \frac{m_d v_d^{\,2}}{m_\alpha v_\alpha^{\,2}} = \frac{m_d}{m_\alpha} \times \left(\frac{m_\alpha}{m_d}\right)^2$ ✓

$= \frac{m_\alpha}{m_d} = \frac{1}{35}$ ✓

= 0.0286 or 2.86% ✓]

When ecf is applied, 3rd mark is only available for answers between 2.5% and 3.5%.

3

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