Practice Question Set For A-Level
Subject : Physics
Paper-2 Topic: Fields And Their Consequences(Nuclear Physics)

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Name of the Student:____
Max. Marks : 24 Marks **Time : 24 Minutes**

Mark Schemes

Q1.

(a) (i) $\Delta m = Zm_p + (A - Z)m_n - M$ **(1)**

(ii) binding energy per nucleon = $\frac{(\Delta m)c^2}{A}$ **(1)**

2

(b) (i) *A* in range 54 → 64 **(1)**
stability increases as binding energy per nucleon increases **(1)**
[or binding energy per nucleon is a measure of stability]
[or large binding energy per nucleon shows nucleus is difficult to break apart]

(ii) binding energy per nucleon increases from about 7.6 to 8.5 **(1)**
increase of about 0.9 MeV for 235 nucleons **(1)**
hence 210 MeV (≈ 200 MeV) in total **(1)**

5

[7]

Q2.

(a) reasons:
α particle has much more mass/momentum than β particle
α particle has twice as much charge as a β particle
α particle travels much slower than a β particle any **two** **(1)** **(1)**

2
QWC 1

(b) (i) energy absorbed per sec (= energy released per sec)
$= 3.2 \times 10^9 \times 5.2 \times 10^6 \times 1.6 \times 10^{-19}$ **(1)**
$= 2.7 \times 10^{-3}$ (J) **(1)** (2.66×10^{-3} (J))

(ii) temperature rise in 1 minute $\left(= \frac{\text{energy absorbed in 1 minute}}{\text{mass} \times \text{specific heat capacity}}\right)$

$= \frac{2.7 \times 10^{-3} \times 60}{0.20 \times 10^{-3} \times 900}$ (for numerator) **(1)** (for denominator) **(1)**

= 0.90 K (or °C) **(1)**

(allow C.E. for incorrect value in (i))

5

[7]

Q3.

(a) (i) energy (required to break nucleus up into / released when nucleus is formed from) separate nucleons **(1)**

(E_p of nucleons decreases when they come together / work is done on nucleons by the strong force) **(1)**

energy associated with the strong force **(1)**

(ii) mass of nucleus < total mass of constituent nucleons **(1)**
Δm is difference between mass of nucleus and total mass of nucleons **(1)**
[$\Delta m = Zm_p + (A - Z)m_n - m_{nucleus}$ **(1) (1)**]

$E_b = (\Delta m)c^2$ **(1)**
[or E_b is energy equivalent of mass defect using $E = mc^2$]

max 4
QWC 1

(b) mass of nucleus = 63.92915 – (30 × 0.00055) = 63.91265 (u) **(1)**
Δm = (30 × 1.00728) + (34 × 1.00867) – 63.91265 **(1)**
= 0.60053 (u) **(1)**
E_b = 0.60053 × 931.3 = 559.3 (MeV) **(1)**

E_b/nucleon = $\frac{559.3}{64}$ = 8.74 (MeV/nucleon) **(1)**

(allow C.E. for Δm and E_b)

5

(c) nucleus has high value of E_b/nucleon
[or is near maximum of E_b/nucleon vs A curve] **(1)**

1

[10]