Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Mark Schemes

Q1.

(a) (i) (Mass change in u=) 1.71×10^{-3} (u)
or (mass Be−7) – (mass He−3) – (mass He−4) seen with numbers

C1

2.84×10^{-30} (kg)
or Converts their mass to kg

Alternative 2nd mark:
Allow conversion of 1.71×10^{-3} (u) to MeV by multiplying by 931 (=1.59 (MeV)) ***seen***

C1

Substitution in $E = mc^2$ *condone their mass <u>difference</u> in this sub but must have correct value for c^2 $(3\times10^8)^2$ or 9×10^{16}*

Alternative 3rd mark:
Allow their MeV converted to joules ($\times 1.6 \times 10^{-13}$) ***seen***

C1

2.55×10^{-13} (J) to 2.6×10^{-13} (J)

Alternative 4th mark:
Allow 2.5×10^{-13} (J) for this method

A1
4

(ii) Use of $E=hc / \lambda$ ***ecf***

C1

Correct substitution in rearranged equation with λ *subject* ***ecf***

C1

7.65×10^{-13} (m) to 7.8×10^{-13} (m) ecf

A1
3

(b) (i) Use of E_p formula:

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C1

Correct charges for the nuclei **and** correct powers of 10

C1

$2.6(3) \times 10^{-13}$ J

A1
3

(ii) Uses K*E* = 3 / 2 *kT:* ***or*** *halves* KE_T*,* $KE = 1.3 \times 10^{-13}$ *(J)* ***seen ecf***

C1

Correct substitution of data **and** makes T subject **ecf**
Or uses KE_T value **and** divides T by 2

C1

6.35×10^9 (K) or 6.4×10^9 (K) or 6.28×10^9(K) or 6.3×10^9 (K) **ecf**

A1
3

(c) (i) Deuteron / deuterium / hydrogen−2

B1

Triton / tritium / hydrogen−3

B1
2

(ii) Electrical heating / electrical discharge / inducing a current in plasma / use of e−m radiation / using radio waves (causing charged particles to resonate)

B1
1

[16]

Q2.

(a) (i) λ (= ln 2 / $T_{1/2}$ = 0.693 / 5740) = 1.2×10^{-4} (yr^{-1}) ✓
(1.21×10^{-4} yr^{-1})

only allow 3.83×10^{-12} s^{-1} *if the unit has been changed*
working is not necessary for mark

1

(ii) (use of $N_t = N_o e^{-\lambda t}$ and activity is proportional to N
$A_t = A_o e^{-\lambda t}$)
$0.375 = \exp - (1.21 \times 10^{-4} \times t)$ ✓
$t = \frac{\ln\left(\frac{1}{0.375}\right)}{1.21 \times 10^{-4}}$ ✓
t = 8100 or 8200(yr) ✓

1st mark substitution, allow EC from (i)
2nd mark rearranging, allow EC from (i)
Allow $t / T_{1/2} = 2^n$ *approach*

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3rd mark no EC (so it is not necessary to evaluate a CE)
so max 2 for a CE
full marks can be given for final answer alone. A minus in the final answer will lose the last mark

3

(b) (i) (it is difficult to measure accurately)
the small drop / change in activity / count-rate
the small change / drop in the ratio of C-14 to C-12 ✓

the activity would be very small / comparable to the background
or the ratio of C-14 to C-12 is too small
or there are too few C-14 atoms
or there is very little decay
or the level of C-14 (in the biosphere) is uncertain (this long ago) ✓

1st mark needs some reference to a change in count-rate or activity for the mark
be lenient in 2nd mark
in reading a script assume C-14 is the subject. Eg 'there is little activity to work with' scores mark. Also allow any reasonable suggestion. Eg carbon may have been removed by bonding to surrounding material
Don't allow, 'All the carbon has decayed'

2

[6]

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