

Name of the Student: _____

Max. Marks : 20 Marks

Time : 20 Minutes

Mark Schemes

Q1.

- (a) Lepton number = 0
- and**
- Strangeness = 0 ✓

charge = (+)1(e) ✓

*accept (+) 1.6×10^{-19} (C)**condone lack of unit*

2

- (b) Proton / p /
- ${}^1_1\text{H}$
- ✓

*Apply ECF to answers any particle other than a proton.**The particle must be correct for the given L, S and Q. (clip with (a))*

1

- (c) Tick in first box only ✓

(electron) antineutrino $\bar{\nu}_{(e)}$

1

- (d) The marking scheme for this question includes an overall assessment for the quality of written communication (QWC). There are no discrete marks for the assessment of QWC but the candidate's QWC in this answer will be one of the criteria used to assign a level and award the marks for this question.

Mark	Criteria	QWC
6	All 3 areas A, B and C covered Only allow minor omissions	The student presents the relevant information coherently, employing structure, style and SP&G to render meaning clear. The text is legible.
5	2 complete descriptions with one partial from A, B and C.	
4	Full description of one area, with partial description of two other. OR Full description of two areas with very little on third or nothing at all.	The student presents relevant information in a way which assists the communication of meaning. The text is legible. SP&G are sufficiently accurate not to obscure meaning.
3	A full description of one area and a partial description of one area. OR A partial discussion of all three areas.	
2	A full description of one	The student presents some

	area. OR A partial discussion of two areas.	relevant information in a simple form. The text is usually legible. SP&G allow meaning to be derived although errors are sometimes obstructive.
1	Only one area covered, and that partially.	
0	No relevant information	

The following statements are likely to be present.

Area A

Hadrons properties:

- Identifies hadrons as consisting of quarks
- May interact via the strong nuclear force

Area B

General structure:

- Two classes are mesons and baryons
- quark-antiquark: meson
- Quark, quark, quark: baryon

Area C

Stability of free hadron:

- Only stable free baryon is proton
- Example of decay of a free meson or baryon e.g. kaon decay into pions / states neutron decays into a proton

6

[10]

Q2.

- (a) (mass of ion =) $1.8(4) \times 10^{-26}$ (kg) ✓

1

- (b) (Mass of ion divided by mass of nucleon=) 10.6 or 10.8 ✓ ECF
allow 1 mark for 10 seen as final answer

(number of nucleons=) 11 ✓ ECF
whole number not in standard form

2

- (c) Same number of protons ✓

X has more neutrons (than Y)

Or

Y has fewer neutrons (than X) ✓

Allow 'same proton number' but **not** same 'atomic number'

Allow: isotopes have same number of protons

Condone any mention of electrons

'X has more nucleons' or 'Y has fewer nucleons' insufficient

2

- (d) Specific charge on ion X is less than specific charge on Y

Or

Specific charge on ion Y is greater than specific charge on X ✓

Specific charge is inversely proportional to mass (for the same charge) ✓

Or words to that effect

Where equation is stated, the symbols must be defined or standard symbols must be used.

2

(e) Specific charge of sample determined correctly ✓

Specific charge of each sample determined correctly ✓

Sample 2 has a greater percentage **because** it has a higher specific charge ✓

Or

Mean mass of a nucleon in a sample determined correctly ✓

Mean mass of a nucleon in each sample determined correctly ✓

Sample 2 has a greater percentage **because** the nucleons have a lower mean mass. ✓

Or

Mean mass of a nucleon in a sample determined correctly ✓

Multiplies by this average by number of nuclei in the other sample ✓

Sample 2 has a greater percentage **because** the nucleons in sample 2 have a lower average mass. Or

Sample 2 because it has a lower mass if both samples had the same number of ions ✓

Or

10^9 times smaller in number but more than 10^9 times smaller mass ✓

(Therefore) sample 2 must have a lower mean mass (than sample 1) ✓

Sample 2 has a greater percentage of **Y because Y** has less mass than X ✓

Mean mass of a nucleon sample 1 =

$$1.8 \times 10^{-26} \text{ kg}$$

Mean mass of a nucleon sample 2 =

$$1.77 \times 10^{-26} \text{ kg}$$

$$\text{Specific charge of sample 1} = 8.8 \times 10^6 \text{ (C kg}^{-1}\text{)}$$

$$\text{Specific charge of sample 2} = 9.0 \times 10^6 \text{ (C kg}^{-1}\text{)}$$

Conclusion must be supported by at least one relevant, correct calculation

Condone one power of ten error in one calculation.

Accept converse statements.

Condone incorrect units

3

[10]