A-Level Chemistry

Fundamental Particles

Mark Scheme

Time available: 50 minutes
Marks available: 47 marks

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Mark schemes

1. (a)

Particle	Relative Charge	Relative mass
Proton	+1	1
Neutron	0	1

1

1

Need +1 for proton

(b) d block/ D block;

Or D or d

1

(c) (i) 74;

Not 74.0

1

(ii) 112;

Not 112.0

1

(d) (i) To accelerate/ make go faster;

1

To deflect/ to bend the beam;

Any order
Not just attract to negative plate

1

(ii) Electromagnet / magnet / electric field /accelerating potential or voltage;

Not electric current
Not electronic field

1

(e) None/ nothing;

If blank mark on.
If incorrect CE = 0

1

Same number of electrons (in outer orbital/shell)/ both have 74 electrons/same electron configuration;

Not just electrons determine chemical properties
Ignore protons and neutrons unless wrong statement.

1

(f) $$\frac{(182 \times 26.4) + (183 \times 14.3) + (184 \times 30.7) + (186 \times 28.6)}{100}$$;

If transcription error then
M1 = AE = −1 and mark
M2 consequentially

1

= 183.90; allow range from 183.90 – 184.00;

1

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2. (a) Number of protons in the nucleus

1

(b) They may have different numbers of neutrons

1

(c) (i) Mass spectrometer

1

(ii) $\frac{\text{Mean mass of an atom}}{\text{Mass of 1 atom of } ^{12}\text{C}} \times 12$

2

(iii) $A_r = \frac{\text{sum of relative m/z} \times \text{rel. abundance}}{\text{Total abundance}}$

1

= (82 × 12 + 83 × 12 + 84 × 50 + 86 × 26)/100 = 84.16

1

(d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$

1

(e) Krypton was thought to be an inert gas
(or has 8 electrons in outer shell)

1

(f) (i) Krypton has more protons than bromine

1

But its outer electrons are in the same shell
(or have similar shielding)

1

(ii) Al electron is in a 3p orbital, magnesium in 3s

1

Energy of 3p is greater than 3s

1

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3. (a)

Particle	Relative charge	Relative mass	
Proton	+1 **or** 1+	1	**(1)**
Neutron	0 **or** no charge/neutral/zero	1 (<u>not</u> – 1)	**(1)**
Electron	–1 or 1–	1/1800 to 1/2000	**(1)**

or negligible
or zero
or 5.0×10^{-4} to 5.6×10^{-4}
> *if 'g' in mass column - wrong*
> *penalise once*

3

(b) $^{38}_{18}Ar$ **(1)(1)**
> *Allow numbers before or after Ar*

2

(c)   *S*: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$ **(1)**
> *Allow upper case letters*

S^{2-}: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ **(1)**
> *If use subscript penalise once*

2

(d)   *Block*: p **(1)**
Explanation: Highest energy or outer orbital is (3) p
> *OR outer electron, valency electron in (3) p*
> *NOT 2p etc.*

2

(e)   (i)   *Bonding in Na_2S*: ionic **(1)**
Bonding in CS_2: covalent **(1)**
> *ignore other words such as dative / polar / co-ordinate*

(ii)   Clear indication of electron transfer from Na to S **(1)**
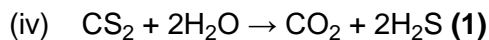1 e^- from each (of 2) Na atoms or 2 e^- from 2 Na atoms **(1)**
> *QoL correct English*

(iii)
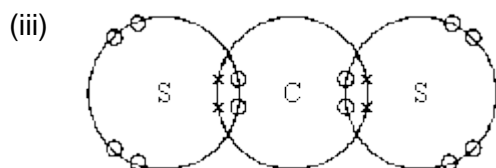
Correct covalent bonds **(1)**
<u>All correct</u> including <u>lone pairs</u> **(1)**

Allow all •s or all ×s

M2 tied to M1

NOT separate e⁻s in S•- 2 l p

(iv) $CS_2 + 2H_2O \rightarrow CO_2 + 2H_2S$ **(1)**

Ignore state symbols even if wrong

7

[16]

4. (a) Current model includes: neutrons <u>and</u> protons

Rutherford model does not include neutrons and protons

1

Current model shows electrons in different energy levels/orbitals

Rutherford model does not show electrons in different orbitals/energy levels

Allow 1ˢᵗ energy level only holds 2 electrons

1

(b) M1: $^{112}Sn^+$

1

M2   missing abundance = 30.84%
M3

If M2 missing then allow M3 if denominator = 69.16

1

$$RAM = \frac{(112 \times 22.41) + (114 \times 11.78) + (117 \times 34.97) + (120 \times 30.84)}{100}$$

1

M4 RAM = <u>116.5</u> answer must be to 1dp

Allow M4 ecf

1

[6]