Mark schemes

1 (a) $1s^22s^22p^63s^23p^1$

1

$1s^22s^22p^63s^23p^63d^3$

1

If noble gas core used correctly in both then scores 1

Allow subscripts and capitals

Ignore $4s^0$

(b) Sr^{2+}

Ignore name and correct proton/mass number

Allow Sr^{+2}

1

(c) Ca_3P_2

Allow reversed or ionic formula

Ignore name

1

[4]

2 (a) Mg($^{2+}$) or Magnesium

Na^+ CE=0

1

Because Mg^{2+} has more protons
AND
With the same shielding/screening/electron arrangement/number of electrons (or isoelectronic)

Allow larger/stronger nuclear charge

Ignore atomic radius

1

(b) $Na(g) \rightarrow Na^+(g) + e^-$

1 for correct species and gas phase

Allow e without charge

Allow $Na(g) - e^- \rightarrow Na^+(g)$

$Na(g) + e^- \rightarrow Na^+(g) + 2e^-$

1

(c) Mg between 600-800

1

S between 800-1040

If S not lower than P on graph then M1 only

If no plots on graph must state S below P to access M3 & M4

1

e^- paired in (3)p orbital in S (owtte)

Allow (3)p subshell/sublevel provided pair mentioned

1

Paired e^- repel (so less energy needed to remove)

1

[7]

3 (a) (Ions accelerated by) attraction to negatively charged plate / electric field

Mark independently

1

Ions detected by gaining electrons

Allow the transfer of electrons

1

Abundance determined by (size) of current flowing (or amount of electrons gained) in the detector

Allow current is proportional to abundance

1

(b) Mass = $\frac{^{52}/_{1000}}{6.022\times10^{23}}$

Mass = 8.6(4) × 10^{-26}

1

(c) $V^2 = (2 \times 1.269 \times 10^{-13}) / 8.64 \times 10^{-26}$

Allow correct rearrangement for V or V^2

1

$V = 1.71 \times 10^6\ ms^{-1}$

Allow ecf from (b) (note if 8.6 × 10^{-23} in (b) leads to approx. 5.4 × 10^4 ms^{-1})

1

(d) Sketch with peaks at 158, 160, 162

Mark independently

1

In ratio 25%:50%:25%

Allow approx. ratio 1:2:1

1

(e) % abundance ^{m}Xe = 20(%)

Working must be shown

1

131.31 = (0.28*129) + (0.25*131) + (0.27*132) + (0.20*m)

1

131.31 – 104.51 = 0.2m

1

Mass number = 134

Answer must be an integer

1

[12]

4 D

[1]

5 C

[1]

6 (a) General increase

If not increase then CE

1

Greater nuclear charge / more protons

1

Same shielding / electrons added to same shell

Allow similar

1

Stronger <u>attraction</u> (from nucleus) for <u>outer electron(s)</u>

Allow electron in outer shell

1

(b) Aluminium / Al (lower than Mg)

CE if not Al or S

1

(Outer) electron in (3)<u>p</u> orbital / sub-shell (level)

If 2p or 4p orbital lose M2 and M3

1

(3p) higher in energy

Allow more shielded or weaker nuclear attraction

M3 is dependent on M2

1

or

Sulfur / S (lower than P)

(Outer) electrons in (3)<u>p</u> orbital begin to pair

Repel

If 2p or 4p orbital lose M2 and M3

Allow 2 electrons in (3)<u>p</u>

M3 is dependent on M2

(c) Sulfur / S

CE if not S

1

Large jump after 6th or between 6th and 7th

Do not allow M2 if atom/ion is removed

1

(d) Silicon

CE if not Si

1

Giant covalent structure / macromolecule

1

Covalent (bonds)

Giant covalent scores M2 and M3

1

Many / strong (covalent bonds) or
(covalent bonds) need lots of energy to break

CE for M2-M4 if molecules / metallic / ionic / IMFs mentioned

1

[13]

7 (a) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

Allow correct numbers that are not superscripted

1

(b) $Ca(s) + 2H_2O(l) \longrightarrow Ca^{2+}(aq) + 2OH^-(aq) + H_2(g)$

State symbols essential

1

(c) Oxidising agent

1

(d) $Ca(g) \longrightarrow Ca^+(g) + e^-$

State symbols essential

Allow 'e' without the negative sign

1

(e) Decrease

If answer to 'trend' is not 'decrease', then chemical error = 0 / 3

1

Ions get bigger / more (energy) shells

Allow atoms instead of ions

1

Weaker attraction of ion to lost electron

1

[7]

8 (a) Abundance of third isotope = 100 – 91.0 –1.8 = 7.2%

1

$$\frac{(32 \times 91) + (33 \times 1.8) + (y \times 7.2)}{100} = 32.16$$

1

$7.2y = 32.16 \times 100 - 32 \times 91 - 33 \times 1.8 = 244.6$

1

$y = 244.6 / 7.2 = 33.97$

$y = 34$

Answer must be rounded to the nearest integer

1

(b) (for electrospray ionisation)

A high voltage is applied to a sample in a polar solvent

1

the sample molecule, M, gains a proton forming MH^+

1

OR

(for electron impact ionisation)

the sample is bombarded by high energy electrons

1

the sample molecule loses an electron forming M^+

1

(c) Ions, not molecules, will interact with and be accelerated by an electric field

1

Only ions will create a current when hitting the detector

1

[8]

9 D

[1]

10 D

[1]