Mark schemes

## Q1.

**B**

*Molybdenum*

**[1]**

## Q2.

**B**

*Silicon*

**[1]**

## Q3.

**D**

$O^{2-}$

**[1]**

## Q4.

**D**

*Selenium*

**[1]**

## Q5.

(a) $2\ Na(s) + 2\ H_2O(l) \rightarrow 2\ NaOH(aq) + H_2(g)$

*Allow ionic equations*

*Allow multiples*

**1**

Temperature will go up more **or** reactants can shoot out of the tube

*Allow the mixture could explode or glass could shatter or hydrogen could ignite/is flammable*

*Ignore reaction is exothermic/vigorous*

**1**

(b) $P_4O_{10} + 6\ H_2O \rightarrow 4\ H_3PO_4$

*Allow ionic equations*

**1**

Allow –1 to + 1

*Do not allow equations from $P_2O_5$*

**1**

(c) M1 $SiO_2$ is macromolecular / giant covalent / giant molecule

*Do not allow giant, giant atomic or giant ionic*

**1**

M2 Strong <u>covalent</u> bonds (between atoms) or <u>covalent</u> bonds need a lot of energy to be broken/overcome

**1**

M3 $P_4O_{10}$ is <u>molecular</u> or <u>simple covalent molecule</u>

**1**

M4 Weak van der Waals forces <u>between molecules</u> or van der Waals forces <u>between molecules</u> break easily

**1**

(d) $Al_2O_3$

**1**

$Al_2O_3 + 3\ H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3\ H_2O$
or $Al_2O_3 + 6\ H^+ \rightarrow 2\ Al^{3+} + 3\ H_2O$

**1**

(e) $Mg(OH)_2$

**1**

(f) Na / sodium

**1**

**[12]**

## Q6.

(a) Aluminium / Al

*Allow **M2**/**M3** if a Group 3 element is given*

**1**

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

*Not energy level*

**1**

(3p) higher in energy / slightly more shielded (than 3s) / slightly further away (than 3s)

**1**

or

**OR**

Sulfur / S

*Allow **M2**/**M3** if a Group 6 element is given*

**1**

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

*Do not allow just $p^4$ vs $p^3$*

**1**

Repel

**1**

(b) $Na^{2+}(g) \rightarrow Na^{3+}(g) + e^-$

*State symbols essential.*

*Allow*

$Na^{2+}(g) + e^- \rightarrow Na^{3+}(g) + 2\ e^-$

**1**

(c) **M1** Phosphorus / P

*Mark independently*

**M2** large jump in ionisation energy for the 6th ionisation energy

*Large jump after the 5 $e^-$ is removed / when the 6th $e^-$ is removed*

**M3** This is when the electron is being removed from the 2nd (principle) energy level / from a lower energy level / from a lower shell / from 2p / from an energy level that is closer to the nucleus

**3**

**[7]**

## Q7.

**C**

$Be^{2+}\ Li^+\ F^-\ O^{2-}$

**[1]**

## Q8.

**C**

*Silicon*

**[1]**

## Q9.

(a) Cross at 1580

*Allow a cross drawn for Si that is between the values for Mg and Al*

**1**

(b) **M1** Na

**1**

**M2** $Na^+(g) \rightarrow Na^{2+}(g) + e^-$

***M2** Allow $Q^+(g) \rightarrow Q^{2+}(g) + e^-$*

*State symbols essential*

*Allow correct equation consequential on their element*

**1**

(c) The number of protons increases OR nuclear charge increases

**1**

Shielding is similar/same OR electrons are added to the same shell

*Allow same number of shells*

**1**

(d) Chlorine/Cl

**1**

(e) $4P + 5O_2 \rightarrow P_4O_{10}$ OR $P_4 + 5O_2 \rightarrow P_4O_{10}$

*Allow multiples*

*Ignore state symbols*

*Do not allow equations with $P_2O_5$*

**1**

**[7]**

## Q10.

(a) Repeating pattern/trends (of physical or chemical properties/reactions)

*Allow named property*

*Penalise groups*

**1**

(b) Bromine/Br

*Not $Br_2$*

*Accept Kr or Krypton*

**1**

(c) Potassium /K

*If Na or Rb lose **M1** but allow access to **M2** and **M3***

*If other incorrect elements 0/3*

**1**

Smallest number of protons/smallest nuclear charge

**1**

Similar shielding / same number of shells (as other elements in period 4)

*Allow same shielding*

**1**

(d) Amphoteric

**1**

(e) $As_2O_3 + 6\ Zn + 12\ HNO_3 \rightarrow 2\ AsH_3 + 6\ Zn(NO_3)_2 + 3\ H_2O$

*Accept multiples*

**1**

**[7]**

## Q11.

**D**

**[1]**

## Q12.

**B**

**[1]**

## Q13.

**A**

**[1]**

## Q14.

**C**

**[1]**

## Q15.

C

**[1]**

## Q16.

B

**[1]**

## Q17.

D

**[1]**

## Q18.

D

**[1]**

## Q19.

A

**[1]**

## Q20.

(a) The number of protons increases (across the period) / nuclear charge increases

**1**

Therefore, the attraction between the nucleus and electrons increases

*Can only score M2 if M1 is correct*

**1**

(b) $S_8$ molecules are bigger than $P_4$ molecules

*Allow sulfur molecules have bigger surface area and sulfur molecules have bigger $M_r$*

**1**

Therefore, van der Waals / dispersion / London forces between molecules are stronger in sulfur

**1**

(c) Sodium oxide contains $O^{2-}$ ions

**1**

These $O^{2-}$ ions react with water forming $OH^-$ ions

$O^{2-} + H_2O \longrightarrow 2OH^-$ *scores M1 and M2*

**1**

(d) $P_4O_{10} + 12OH^- \longrightarrow 4PO_4^{3-} + 6H_2O$

**1**

**[7]**