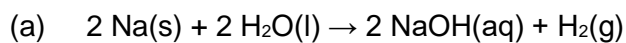
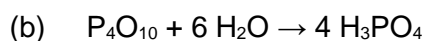


Mark schemes

Q1.**B***Molybdenum***[1]****Q2.****B***Silicon***[1]****Q3.****D** O^{2-} **[1]****Q4.****D***Selenium***[1]****Q5.***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***Allow ionic equations***1**

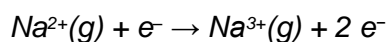
Allow -1 to + 1

Do not allow equations from P_2O_5 **1***Do not allow giant, giant atomic or giant ionic***1**

- M2 Strong covalent bonds (between atoms) or covalent bonds need a lot of energy to be broken/overcome 1
- M3 P₄O₁₀ is molecular or simple covalent molecule 1
- M4 Weak van der Waals forces between molecules or van der Waals forces between molecules break easily 1
- (d) Al₂O₃ 1
- $\text{Al}_2\text{O}_3 + 3 \text{H}_2\text{SO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + 3 \text{H}_2\text{O}$
or $\text{Al}_2\text{O}_3 + 6 \text{H}^+ \rightarrow 2 \text{Al}^{3+} + 3 \text{H}_2\text{O}$ 1
- (e) Mg(OH)₂ 1
- (f) Na / sodium 1
- [12]**

Q6.

- (a) Aluminium / Al 1
Allow M2/M3 if a Group 3 element is given
- (Outer) electron in (3)p orbital / sub-shell (level) 1
Not energy level
- (3p) higher in energy / slightly more shielded (than 3s) / slightly further away (than 3s) 1
- or **OR**
- Sulfur / S 1
Allow M2/M3 if a Group 6 element is given
- (Outer) electrons in (3)p orbital begin to pair 1
Do not allow just p⁴ vs p³
- Repel 1
- (b) Na²⁺(g) → Na³⁺(g) + e⁻
State symbols essential.
Allow



1

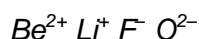
(c) **M1** Phosphorus / P*Mark independently***M2** large jump in ionisation energy for the 6th ionisation energy*Large jump after the 5 e⁻ is removed / when the 6th e⁻ is removed***M3** This is when the electron is being removed from the 2nd (principle) energy level / from a lower energy level / from a lower shell / from 2p / from an energy level that is closer to the nucleus

3

[7]

Q7.

C



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

- (e) $4\text{P} + 5\text{O}_2 \rightarrow \text{P}_4\text{O}_{10}$ OR $\text{P}_4 + 5\text{O}_2 \rightarrow \text{P}_4\text{O}_{10}$
 Allow multiples
 Ignore state symbols
 Do not allow equations with P_2O_5

1

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) $\text{As}_2\text{O}_3 + 6\text{Zn} + 12\text{HNO}_3 \rightarrow 2\text{AsH}_3 + 6\text{Zn}(\text{NO}_3)_2 + 3\text{H}_2\text{O}$
 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) S₈ molecules are bigger than P₄ molecules

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

1

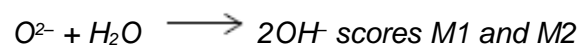
Therefore, van der Waals / dispersion / London forces between molecules are stronger in sulfur

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

1

1

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



1

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

1

[7]