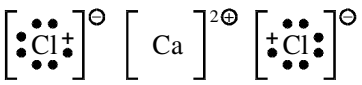
**1.** (a) (i) $(1s^2)2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^6$ **(1)** 1

(ii) 7 **(1)** 1

(b) (i) $Ca + Cl_2 \rightarrow CaCl_2$ **(1)** 1

(ii) Ionic **(1)** 1

(iii) 

- 1 mark for correct number of electrons on each ion **(1)**

1 mark for correct charges on each ion **(1)**
1 mark for correct ratio of ions **(1)** 3

**[7]**

**2.** (a) Damp litmus paper **(1)**
bleached **(1)** 2

(b) (i) Covalent **(1)** 1

(ii) Either
• HCl reacts with water **(1)**
• to form ions which are hydrated / bonded with water **(1)** 2

(c) $CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$ (2)
1 mark for substances and balance. / mark for state symbols 2

**[7]**

**3.** (a) (i) $2Li + 2H_2O \rightarrow 2LiOH + H_2(g)$ (2)
species **(1)** balance **(1)** 2

(ii) **Any two from**:
Solid floats / moves around on surface **(1)**
bubbles evolved / fizzes **(1)**
liquid remains colourless **(1)** 2

(b) Protons 3 **(1)**
Neutrons 4 **(1)**
Electrons 2 **(1)** 3

(c) Relative atomic mass

$$= \frac{(6.02 \times 7.39) + (7.02 \times 92.61)}{100}$$ **(1)**

6.95 (must be three s.f.) **(1)** 2

(d) • Dip Pt / nichrome wire in solid and place in hot/blue flame **(1)**
• Na salt gives yellow colour **(1)**
Li salt give deep / magenta red / crimson colour **(1)** 3

**[12]**

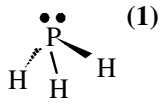
**4.** (a) • Magnesium ions are arranged in a regular lattice **(1)**
• surrounded by a sea of / cloud of / delocalised electrons **(1)**
which can move through the solid when a potential is applied **(1)** 3

(b) • At room temperature the ions are in a fixed position / in a lattice **(1)**
• as heat applied the ions vibrate more **(1)**
eventually ions have enough energy to overcome electrostatic attraction **(1)**
ions break free are able to move as solid melts **(1)** 4

(c) • Solid has ions in fixed sites / cannot move **(1)**
• molten has ions free to move and carry current to electrodes **(1)** 2

**[9]**

**5.** (a) (i) • Bond pairs 3 **(1)**
• lone pairs / **(1)** 2

(ii)  **(1)**

Angle (actual figure is 93) any value
between 108 and 93 is acceptable **(1)** 2

(b) (i) • Hydrogen bonds **(1)**
• Induced dipole-dipole interactions / van der Waals / London / dispersion **(1)** 2

(ii) • Phosphine does not have hydrogen bonds **(1)**
• Lack of hydrogen bond not compensated by / increased induced dipole-dipole **(1)** 2

(c) (i) • When the pair of electrons shared by two atoms (in covalent bond) **(1)**
• both come from the same atom **(1)** 2

(ii) The lone pair on the nitrogen **(1)** 1

(iii) • Tetrahedral **(1)**
• has four pairs of bonding electrons **(1)**
repel as far away from each other as, possible / minimum repulsion **(1)** 3

**[14]**

**6.** (a) An element with its highest energy electron in a *p* orbital **(1)** 1

(b) (i) Colour brown **(1)**
*State*: liquid **(1)** 2

(ii) The solution goes (from colourless to) dark brown / black solid produced **(1)** 1

(c) (i) $Br_2 + 2e^- \rightarrow 2Br^-$ **(1)** or ½ this 1

(ii) $Fe^{2+} \rightarrow Fe^{3+} + e^-$ **(1)** 1

(iii) $Br_2 + 2Fe^{2+} \rightarrow 2Br^- + 2Fe^{3+}$ **(1)**
or ½ this 1

(d) (i) $Br_2 + 2NaOH \rightarrow NaBr + NaOBr + H_2O$ (2)
1 mark for correct bromine products
Ionic equation acceptable 2

(ii) Disproportionation **(1)** 1

(e) (i) KBr −1 **(1)** $KBrO_3$ +5 **(1)** $Br_2$ 0**(1)** 3

(ii) • Oxidising agent: $KBrO_3$ **(1)**
• Oxidation number of Br in $KBrO_3$ goes down **(1)** 2

**[15]**

**7.** (a) (i) • Energy / enthalpy change per mole **(1)**
• required to remove an electron **(1)**
from / mole of gaseous atoms **(1)** 3

(ii) • The nuclear charge on K is greater than on Na **(1)**
• the outer electron is further from the nucleus **(1)**
but there is more shielding around K than Na **(1)** 3

(b) (i) 4.56 / 71 **(1)** = 0.0642 **(1)**mol 2

(ii) Answer from (i) − 2 **(1)** = 0.0321 mol 1

(iii) Answer from (ii) × 24 **(1)** 0.771 $dm^3$ 1

(iv) Answer from (iii) × 3/2 **(1)** 1.16 $dm^3$ 1

**[11]**