1)

D

The alkali metals react with the halogens.
The alkali metals lose a valence electron to form a positive ion (cation).
As we go down a group, the ionisation energy decreases because the valence shell is further from the positive nucleus and is shielded by more electrons.
The halogens gain an electron to form a negative ion (anion).
Their electron affinity decreases down a group because the pull of the nucleus is weaker. This is because as we descend the group, the valence shell is further from the nucleus and the nucleus is shielded by more electrons.

2)

i) The magnesium ion is much smaller than the atom because: a) It has one less shell of electrons b) It has a positive charge and so pulls the remaining electrons in more tightly
ii) Silicon loses 4 electrons and phosphorus gains 3 electrons. As such silicon is negative and electron-electron repulsion increases the radius. Phosphorus is positive and so it pulls the electrons in more tightly. But **more importantly** P^{3-} has 18 electrons (3 shells) and Si^{4+} has 10 electrons (2 shells).
iii) Na^+ and F^- are isoelectronic (have the same number of electrons), 10. However the sodium ion has 11 protons and the fluoride ion has 9 and so the valence shell in the sodium ion is held more tightly.

3)

Be

4)

$F(g) \rightarrow F^+(g) + e^-$
The first ionisation energy is the energy required to remove a valence electron from a gaseous atom to give a 1+ gaseous cation.

5)

XY

An ionic compound made of 2+ ions and 2- ions. For this ionic compound to be neutral the ratio of X^{2+} and Y^{2-} must be 1:1.

6)

A

This is an example of a halogen displacement reaction. The more reactive halogen removes the electrons from the less reactive halide. The second reaction does not happen because chlorine is more reactive than bromine.

7)

The atomic number increases in steps of one across a period in the periodic table. Atomic number is the number of protons in an atom. An atom is neutral and so the number of protons equals the number of electrons.

8)

C

Group 1 metals all react vigorously with water. Melting point increases across a period and the group 1 metals have a relatively low melting point.

9)

$K^{=}$, Ar, Cl^{-}

They all have the same number of electrons (they are isoelectron). However Cl has fewer protons than Ar in its nucleus and Ar has fewer than K. As such Cl has the weakest pull on the electrons.

10)

<u>Similarities</u>

They both give of H_2,
They give off heat,
They give an alkaline solution,
They fizz on the surface of the water.

<u>Differences</u>

Potassium reacts more violently,
Potassium reacts faster,
The hydrogen may light because more heat is given off.

$2K(s) + H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$
KOH(aq) is alkali.
Alkaline solutions have a pH of more than 7.

11)

Al_2O_3 is an ionic compound made of 3+ ions and 2- ions. For this ionic compound to be neutral the ratio of X^{3+} and Y^{2-} must be 2:3.

12)

PCl_3

It is an empirical formula because it cannot be simplified any further.

13)

CH_2 is the empirical formula with a relative mass of 14 (C = 12 & H_2 = 2 x 1)

The M_r is 56 and so we need to multiply the empirical formula by 4 to get the molecular formula. Therefore, C_4H_8.

14)

$C_2H_4O_2$

C 12/12 = 1
H 2/1 = 2
O 16/16 = 1

Empirical formula = CH_2O which has a relative mass of 30.

Mr = 60 therefore we need to multiply the empirical formula by 2. Therefore, $C_2H_4O_2$