Answer on Question #63998 - Chemistry – Cheneral Chemistry

1) Why is the first ionization energy of a nonmetal much higher than that of an alkali metal in its same period? Provide an answer using 3 – 4 sentences in your own words.
2) What is the reason the group 13 metals have a typical charge of 3+?
3) How many non-bonding electrons does phosphorus have?
4) Identify the precipitate in this reaction: calcium nitrate reacts with sodium phosphate.
5) The following is a Limiting Reactant problem:
Magnesium nitride is formed in the reaction of magnesium metal with nitrogen gas in this reaction: $3Mg(s) + N_2(g) \rightarrow Mg_3N_2(s)$
How many grams of product are formed from 2.0 mol of $N_2(g)$ and 8.0 mol of Mg(s)? Show all calculations leading to an answer.

Solution.

1) The first ionisation energy is the energy required to remove the most loosely held electron from one mole of gaseous atoms to produce 1 mole of gaseous ions each with a charge of 1+
   For example: $K + energy = K^+ + e^-$
   Ionisation energy is a measure of the energy needed to pull a particular electron away from the attraction of the nucleus. A high value of ionisation energy shows a high attraction between the electron and the nucleus. Moving left to right within a period or upward within a group, the first ionization energy generally increases. As the nuclear charge of the nucleus increases across the period, the atomic radius decreases and the electron cloud becomes closer towards the nucleus.
2) 13 represents the number electrons of elements in that group. Base on octet rule, element needs 2 or 8 electrons on its valence shells to be stable and happy. The first shell contains 2 electrons, the second shell contains 8 electron and the last shell has 3 electrons left. the third shell is away from the nuclei, there is no much attract force from the nuclei, these 3 electrons are easily donated to others and being stable and happy.
3) Neutral phosphorus atom has a total of 15 electrons surrounding the nucleus (atomic number = 15). Phosphorus has [Ne]3s23p3 electron configuration. That's why it has five (2+3=5) bonding electrons and non-bonding $e^- = 15 - 5 = 10$.
4) $3Ca(NO_3)_2 + 2Na_3PO_4 \rightarrow 6NaNO_3 + Ca_3(PO_4)_2\downarrow$
   $Ca_3(PO_4)_2$ – precipitate
5) $3Mg(s) + N_2(g) \rightarrow Mg_3N_2(s)$
   1 mol of $N_2(g)$ reacts with 3 mol of Mg(s)
   2 mol of $N_2(g)$ reacts with 6 mol of Mg(s)
   We have 8 mol of Mg(s): Mg – excess reactant; N_2 – limiting reactant
   1 mol N_2 – 1 mol Mg_3N_2
   2 mol N_2 – x mol Mg_3N_2
   x = 2 mol Mg_3N_2
   $m(Mg_3N_2) = n(Mg_3N_2) \times M(Mg_3N_2) = 2 \times 100 = 200$ g