Problem set 1

Conor Redington

1. Materials used for smartphones:
   - Copper: metal; for the wires and circuit boards
   - Aluminum: metal; used as the casing
   - Plastics: polymer; buttons, casing
   - Silicon: metal; used in transistors in the smartphone
   - Indium tin oxide: ceramic; smartphone display
   - Lithium: metal; used in batteries of smartphone
   - Iron: metal; screws to hold phone together
2. Incandescent light bulbs are made using:
   - Ceramic: To encase the filament so that it does not evaporate. Needs to be resistant to high temperatures in that it does not discolour or break e.g. glass
   - Metals: It has to have a high melting point to maintain it's physical property at extremely high temperatures (the temp. needed to achieve white light) and be long lasting, a good conductivity to be efficient e.g. tungsten
3. If the total mass of the alloy is M_t, 63.5% of this is copper so $0.635M_t = n_c * M_c$ where M_c is the molar mass of copper (63.55 g/mol). Similarly if 36.5% of the total mass is zinc $0.365M_t = n_z * M_z$ where M_z is the molar mass of zinc (65.41 g/mol).
$$\frac{n_c * M_c}{0.635} = \frac{n_z * M_z}{0.365} \rightarrow \frac{n_c}{n_z} = \frac{0.635M_z}{0.365M_c} = 1.79$$
4. Balanced equation: $C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_20$. The molar mass of Heptane is 100g/mol. With 100ml of it at a density of 0.6795 g/mol thats $n = \frac{100*0.6795}{100}$ which is 0.6795 moles. Each of the stoichometric coefficients in the reaction are then scaled by this so the amount of CO_2 produced is
$$0.6795 * 7 = 4.75moles$$
5. a) Carbon: $1s^22s^22p^2$ carbon has Z= 6 and is period 2 with group 14. It's core shell is Helium with valence shell of primary quantum number 2 and it's valence shell has the orbital 'p'
   b) Calcium: $1s^22s^22p^63s^23p^64s^2$ Z = 20, n=4 so an Argon core shell and a valence shell of s group.
   c) Gallium: $1s^22s^22p^63s^23p^63d^{10}4s^24p^1$ Z = 31, n=4 so an Argon core shell and situated in the p block.
   d) Vanadium: $1s^22s^22p^63s^23p^63d^34s^2$ Z=23, n=4, d-block so the building up principle changes.
6. Molar mass of carbon is 12g/mol. there are 6×10^{23} atoms in a mole of carbon so this diamond is an extremely small amount of moles. Mass is approximately $\frac{6\times10^{23}}{1\times10^{20}} \times 12 = 7.2 \times 10^{-42}g$. In a diamond, Carbon will form a covalent bond with 4 other carbon atoms, sharing electrons in their valence shell. So approximately $\frac{1\times10^{20}\times3}{2} = 1.5 \times 10^{20}$ covalent bonds