Solutions FORM 10

1. (1)($S(s) + O_2(g) \longrightarrow SO_2(g)$;
(2) $2\ SO_2(g) + O_2(g) \longrightarrow SO_3(g)$
(3) $SO_3(g) + H_2O(l) \longrightarrow H_2SO_4(aq)$; (4) $H_2SO_4(aq) + 2\ KOH(aq) \longrightarrow K_2SO_4(aq) + 2\ H_2O(l)$
(5) $SO_2(g) + 2\ KOH(aq) \longrightarrow K_2SO_3(aq) + H_2O(l)$; (6) $S(s) + H_2(g) \longrightarrow H_2S(g)$
(7) $H_2S(g) + 2KOH(aq) \longrightarrow K_2S(aq) + 2\ H_2O(l)$;
(8) $SO_2(g) + I_2(aq) + 2\ H_2O(l) \longrightarrow H_2SO_4(aq) + 2\ HI(aq)$
(9) $HS_2(aq) + I_2(aq) \longrightarrow S(s) + 2\ HI(aq)$ 1 point/each reaction

2. Visual inspection only solution with color is iron(III) chloride (yellow).
After that few drops Fe(III) chloride solution to other solution, when
$Fe(III)Cl_3(aq) + 3NaOH(aq) \longrightarrow Fe(III)(OH)_3(s)\downarrow + 3\ NaCl(aq)$
(brown)
$Fe(III)Cl_3(aq) + 3\ AgNO_3(aq) \longrightarrow 3\ AgCl(s)\downarrow + Fe(NO_3)_3(aq)$
(white)
After that few drops of NaOH – solution to NH_4Cl – and HNO_3 – solution, when
$NaOH(aq) + NH_4Cl(aq) \longrightarrow NH_3(g) + NaCl(aq) + H_2O(l)$
smell 1 – 6 points

3. a. Reaction (1) $2HNO_3(aq) + Na_2CO_3(aq) \longrightarrow H_2O(l) + CO_2(g) + 2\ NaNO_3(aq)$
$m(HNO_3)$ $0.700x1{,}42g/cm^3x7600x10^3cm^3 = 75544x10^3g$
$n(HNO_3) = 75544x10^3g/63.02g/mol = 1199$ mol
from (1) => $n(Na_2CO_3) = 1/2x\ n(HNO_3) = 599{,}5$ mol
$m(Na_2CO_3) = 599{,}5\ molx106{,}0g/mol = 63547$ g <u>V = 63500 kg</u> 4 points
b. Temperature rises strongly and water is vaporized and nitric acid decomposes producing oxides of nitrogen ($NO_2$and NO) which are very hazardous to the environment. (reaction for decomposition for example $4HNO_3 \longrightarrow 2H_2O(g) + 4NO_2(g) + O_2(g)$ reaction not needed) To prevent decomposition reaction must be cooled somehow for example using water or doing neutralization more slowly. Also other harmful things possible. Oxidation. 3 points

4. (1) $C(s) + H_2O(g) \rightarrow CO(g) + H_2(g)$ A = carbon monoxide and B = hydrogen
A B
(2) $2H_2(g) + O_2(g) \rightarrow 3H_2O(l)$ and $2CO(g) + O_2(g) \rightarrow CO_2(g)$; C = water and D = carbon dioxide
C D
(3) $CO_2(g) + Ca(OH)_2(aq) \rightarrow CaCO_3(s) + H_2O(l)$; E = calcium carbonate
E
(4) $2Mg(s) + CO_2(g) \rightarrow 2MgO(s) + C(s)$; F = magnesium oxide and G = carbon
F G
(5) $CO_2(g) + C(s) \rightarrow 2CO(g)$ right compounds 7x0.5 points; reactions 5x1 point

5. a) butane (dispersion forces) < propanone (dipole – dipole forces) < propan-1-ol (hydrogen forces)
3x1 point for the right bonding type + 1point for the right order in boiling points altogether 4 points
b) (i) not homogenous; (ii) homogenous (dispersion forces); (iii) homogenous (ion-dipole attraction); (iv) homogenous (hydrogen bonding) 4 x ½ point = 2 points
c) metallic bonding; sea of electrons model; free movement of electrons 3 points