I(1):

For an atom, its number of electrons is equal to the number of protons (i.e. the atomic number). Therefore, the element has 6 protons and 7 electrons.

Moreover, the mass number is equal to the total number of neutrons and protons. As there are 6 protons and the mass number of the element is 13, the element has 13-6=7 neutrons. $\boxed{(5)}$

I(2):

1) $NaHSO_4$ is an acidic salt. H^+ ions can be dissociated from the HSO_4^- ions. Therefore, $NaHSO_4(aq)$ is acidic.

2) Na_2SO_4 is an acidic salt and $Na_2SO_4(aq)$ is neutral.

$\boxed{3)}$ $NaHCO_3$ is an acidic salt. HCO_3^- ions can absorb H^+ ions to form H_2CO_3. Therefore, it is basic by Brønsted–Lowry acid–base definition.

4) Na_2CO_3 is a basic salt and $Na_2CO_3(aq)$ is neutral.

5) $Mg(OH)_2$ is a basic salt and $Mg(OH)_2(aq)$ is basic (alkaline).

6) $MgCl(OH)$ is a basic salt and $MgCl(OH)(aq)$ is acidic.

I(3):

The equation is given by $NaOH + HCl \rightarrow NaCl + H_2O$.

We have the table:

Ion	Na^+	OH^-	H^+
Number of moles before reaction	$0.1 \cdot \frac{200}{1000} = 0.02\ mol$	Around $0.1 \cdot \frac{200}{1000} = 0.02\ mol$	Around $0.1 \cdot \frac{100}{1000} = 0.01\ mol$
Number of moles after reaction	$0.02\ mol$	Around $0.02 - 0.01 = 0.01\ mol$	Around $0\ mol$

As the higher the number of moles, the higher the concentration, we have $\boxed{[Na^+] > [OH^-] > [H^+]}$.

Note: "Around" is used for H^+ and OH^- ions as those came from water ($10^{-7}\ mol$) are neglected.

I(4):

$NaOH$ is an ionic crystal in the solid state.

CO_2 is a molecular crystal in the solid state.

Diamond is a covalent crystal in the solid state.

Naphthene is a molecular crystal in the solid state.

Therefore, the correct combination is CO_2 and naphthene $\boxed{(5)}$.

I(5):

1) Both Ag^+ and Cu^{2+} ions form precipitate with $NH_3(aq)$ (where both precipitates redissolve in excess $NH3(aq)$).

2) Both Ag^+ and Cu^{2+} ions do not precipitate with $H_2SO_4(aq)$.

3) Both Ag^+ and Cu^{2+} ions form precipitate with $NaOH(aq)$.

$\boxed{4)}$ Only Ag^+ forms $AgCl$ precipitate with $HCl(aq)$.

5) Both Ag^+ and Cu^{2+} ions do not precipitate with $HNO_3(aq)$.

Note: The question has nothing to deal with the acid and base properties. Instead, it is just a question about the precipitation between cations and anions.

I(6):

The reaction is given by $FeS + H_2SO_4 \rightarrow FeSO_4 + \boxed{H_2S(g)}$ (double displacement reaction).

I(7):

Let m be the atomic mass of Rb.

Then, the weight fraction of Rb in $Rb_2O = \frac{2m}{2m+16}$.

As the weight of Rb is conserved, the have $3.280 \cdot \frac{2m}{2m+16} = 3.000$, i.e. $m \approx \boxed{85.7}$.

Alternative Consider the molar ratio $Rb : O = \frac{3.000}{m} : \frac{3.280-3.000}{16} = 2 : 10$, i.e. $m \approx \boxed{85.7}$.

I(8):

Let the solubility of $Na_2CO_3 \cdot 10H_2O$ be x g per 100 g water.

The weight fraction of H_2O in the compound$=\frac{10 \cdot 18}{2 \cdot 23+12+3 \cdot 16+10 \cdot 18} = \frac{90}{143}$.

Hence, the weight fraction of Na_2CO_3 in the compound$=1-\frac{90}{143}=\frac{53}{143}$.

Therefore, when x g of the compound is dissolved in water, the weight of water will be increased by $\frac{90x}{143}$ g and $\frac{53x}{143}$ g of Na_2CO_3 will be dissolved in water.

Considering the solubility of Na_2CO_3 in water, we have $\frac{\frac{53x}{143}}{100+\frac{90x}{143}}=\frac{25}{100}$, i.e. $x\approx\boxed{117}$.

II:

(1): The half equation at the cathode is

$MnO_4^- + \boxed{8}H^+ + \boxed{5}e^- \rightarrow Mn^{2+} + \boxed{4}H_2O$.

(Find the coefficient of H_2O first, then find those of H^+ and e^-.)

The half equation at the anode is $H_2C_2O_4 \rightarrow 2CO_2 + \boxed{2}H^+ + \boxed{2}e^-$

(2): By (1), the full equation of the reaction is

$2MnO_4^- + 6H^+ + 5H_2C_2O_2 \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2$.

Therefore, the molar ratio $MnO_4^- : H_2C_2O_4 = 2:5$.

Consider the equation when CaC_2O_4 is dissolved in water:

$CaC_2O_4 + H_2O \rightarrow CaO + H_2C_2O_4$.

Therefore, the number of moles of $H_2C_2O_4$ is equal to the number of moles of $CaC_2O_4 = \frac{0.320}{40+2\cdot 12+4\cdot 16} = 2.5\times 10^{-3}\ mol$.

Hence, the number of moles of $KMnO_4(aq)$ used$=2.5\times 10^{-3}\cdot\frac{2}{5}=10^{-3}\ mol$ and therefore $[KMnO_4]=\frac{10^{-3}}{\frac{20}{1000}}=\boxed{0.05}\ mol/l$

III:

(1): $N_2(g) + 3H_2(g) = 2NH_3(g)$ can be written as:

$$N_2(g) + 3H_2(g) + \frac{3}{2}O_2(g) = N_2(g) + 3H_2O(l) = N_2(g) + 3H_2O(g) = 2NH_3(g) + \frac{3}{2}O_2(g).$$

The first reaction released $572 \cdot \frac{3}{2} = 858\ kJ$ of heat.

The second reaction absorbed $44 \cdot 3 = 132\ kJ$ of heat.

The third reaction absorbed $\frac{1268}{2} = 634\ kJ$ of heat.

Therefore, the overall equation released $858 - 132 - 634 = \boxed{82}\ kJ$ of heat.

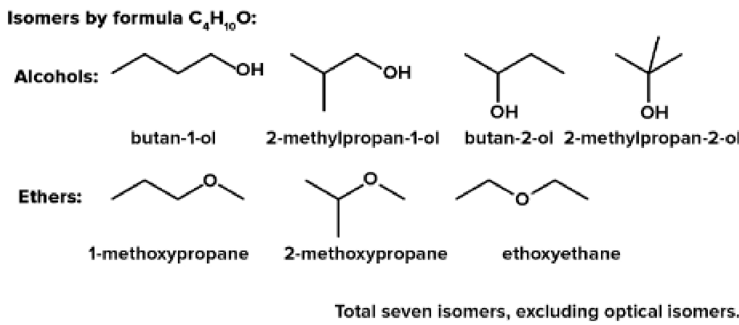
(2):

(a): By (1), the forward reaction is exothermic. By Le Chatelier's principle, the equilibrium position shifts to the left and NH_3 yield decreases $\boxed{(2)}$ when the temperature is increased.

(b): As the number of gas molecules in the reactant side is more than that in the product side, by Le Chatelier's principle, when the mixture is compressed (i.e. the pressure is increased), the equilibrium position will shift to the right and the NH_3 yield will increase $\boxed{(1)}$.

IV:

(1): $C_4H_{10}O$ is either an alcohol or an ether. Therefore, it has the following $\boxed{7}$ structural isomers:



(2): Referring to the above, there are $\boxed{4}$ alcohols.

(3): Referring to the above, there are $\boxed{3}$ ethers.

(4): An alcohol is active to the iodoform reaction if it has a $H_3C - CHOH - R$ structure.

Referring to above, there is $\boxed{1}$ such alcohol (butan-2-ol).

(5): 3-degree alcohols cannot be oxidised by $K_2Cr_2O_7$.

Referring to above, there is $\boxed{1}$ such alcohol (2-methylpropan-2-ol).

V:

(1): Alcohol and ether can be distinguished by adding a piece of metal Na $\boxed{(d)}$ into them. Alcohols react with Na to give H_2 gas bubbles while ethers have no reactions with Na.

(2): Aldehyde and ketone can be distinguished by Fehling's reagent $\boxed{(g)}$. Aldehydes form red Cu_2O precipitate with Fehling's reagent while ketones give a negative result.

(3): Carboxylic acid and ester can be distinguished by adding Na_2CO_3 $\boxed{(b)}$ into them. Neutralisation occurs and CO_2 gas bubbles form with carboxylic acids but not esters.

VI:

Adding propene into benzene with catalyst gives cumene $\boxed{(15)}$. The oxidation of cumene gives $\boxed{(14)}$. Treat it with H_2SO_4, phenol $\boxed{(11)}$ and acetone are formed (the whole process is called cumene process). Moreover, adding Br_2 into phenol will give tribromophenol $\boxed{(6)}$ and HBr.

Adding C_2H_5Cl into benzene with a catalyst gives ethylbenzene $\boxed{(4)}$ and HCl. After dehydrogenation, it becomes ethenylbenzene $\boxed{(13)}$.

On the other hand, oxidsing toluene with $KMnO_4$ can obtain benzoic acid $\boxed{(10)}$. After chloromethylbenzene is formed, $NaOH$ can undergo double displacement with chloromethylbenzene and give benzene methanol $\boxed{(7)}$. Oxidising it with $KMnO_4$ gives benzoic acid immediately. Or oxidise it with $K_2Cr_2O_7$ to get benzaldehyde $\boxed{(3)}$ first and further oxidising it with $KMnO_4$ can also obtain benzoic acid.