I(1):

Note that the four options have the same electron configuration. Therefore, the more the number of protons, the stronger the attractive force between the nucleus and the electrons and hence smaller the radius.

As $\boxed{Mg^{2+}}$ has the greatest number of protons, it has the smallest ionic radius.

I(2):

The more the number of delocalised electrons or mobilised ions, the higher the electrical conductivity.

$\boxed{1)}$ It forms a divalent ion, where 2 electrons are delocalised per atom.

2) In solid state, AgI is an ionic crystal with no mobile ions.

3) Si is a covalent crystal with no delocalised electrons or mobile ions.

4) The covalent structure of graphite delocalised 1 electron per 6 atoms.

I(3):

1) Tetrahedral.

$\boxed{2)}$ Linear.

3) Bent.

4) Bent.

I(4):

Metals that react with $HCl(aq)$ (i.e. reactivity higher than Cu) and do not precipitate with Cl^- (i.e. Ca, Ba, Pb and Ag are excepted) can dissolve in $HCl(aq)$.

Therefore, only $\boxed{Cu}$ is insoluble in $HCl(aq)$.

I(5):

1) Althpugh the calculated value of pH is 2, as acetic acid is a weak acid, where H^+ ions are not completely dissociated, the actual pH value should be higher than 2.

2) 1 mol of $H_2SO_4(aq)$ can dissociate 2 mol of H^+. Therefore, $[H^+] = 2 \cdot 0.05 = 0.1\ mol/l$ and $pH = -\log 0.1 = 1$.

$\boxed{3)}$ 1 mol of $HCl(aq)$ can dissociate 1 mol of H^+. Therefore, $[H^+] = 0.01\ mol/l$ and $pH = -\log 0.01 = 2$.

4) The pH value of alkali ($NaOH(aq)$) cannot be lower than 7 in standard condition.*

*: For very diluted $NaOH(aq)$, the $[OH^-]$ due to water ($10^{-7}\ mol/l$) is not negligible.

I(6):

1) Oxidation number changed from $+2$ to -2, which is reduced.

$\boxed{2)}$ Oxidation number changed from $+4$ to $+6$, which is oxidised.

3) Oxidation number changed from $+4$ to 0, which is reduced.

4) oxidation number changed from $+7$ to $+2$, which is reduced.

I(7):

The equilibrium is $2NO_2 \iff N_2O_4$

1) As the total pressure is increased, by Le Chatelier's principle, the equalibrium postion will shift to produce more N_2O_4 so as to lower the total pressure.

2) As the temperature is increased, the reaction rate of the endothermic reaction will be increased by Le Chatelier's principle.

$\boxed{3)}$ As $[NO_2]$ increased, the equilibrium position will shift to lower $[NO_2]$ and increase $[N_2O_4]$. After a sufficient time, the equilibrium will reach again with the same molar ratio.

4) As the partial pressure of NO_2 and N_2O_4 decreased after N_2 is added at the same total pressure, the equilibrium position will shift to produce more NO_2 by Le Chatelier's principle.

II:

We have the thermochemical equations:

$C + O_2 \rightarrow CO_2\ \Delta H = -394\ kJ\ mol^{-1}$

$CO + \frac{1}{2}O_2 \to CO_2$ $\Delta H = -283\ kJ\ mol^{-1}$.

Combine the two equations together, we have

$C + \frac{1}{2}O_2 \to CO$ $\Delta H = -394 + 283 = -111\ kJ\ mol^{-1}$.

Therefore, $\frac{1}{2}$ mol, i.e. $\frac{1}{2} \cdot 22.4 = \boxed{11.2}$ L of O_2 is required to oxidise 1 mol of graphite to CO at $0°C$ and 1 atm, where the heat evolved is $\boxed{111}$ kJ.

III:

Among the three ions, the only one that will precipitate with Cl^- is Ag^+. Where the precipitate $\boxed{AgCl}$ is $\boxed{\text{white}}$ in colour.

The supernatant contains Cu^{2+} and Zn^{2+}. We are going to find a chemical (which will be a gas as the verb "bubble" is used) that precipitate with one cation in an acidic environment and precipitate another in an alkaline environment to form white precipitate.

The chemical will be $\boxed{H_2S}$, which forms $\boxed{\text{black}}$ CuS precipitate regardless of the environmental condition and forms white ZnS precipitate in an alkaline environment.

IV:

(1): As 9.0 g, i.e. $\frac{9.0}{6 \cdot 12 + 12 + 6 \cdot 16} = 0.05$ mol of glucose can lower the freezing point of 100 g, i.e. 0.1 kg of water by $0.94°C$, the molar freezing point depression is $\frac{0.94 \cdot 0.1}{0.05} \approx \boxed{1.9}$ $K\ kg/mol$.

Note: The formula of molar freezing point depression can be deduced by the unit.

(2): Let m be the formula mass.

As 1 mol of the salt can dissociate 2 mol of ions, consider the molar freezing point depression of water, we have $2 \cdot \frac{2.0}{m} \cdot 1.9 = 1.3 \cdot 0.1$, i.e. $m \approx \boxed{58}$.

V:

(1): Adding H_2O into $H_2C = CH_2$ with H_2SO_4 catalyst gives H_3CCH_2OH $\boxed{(3)}$. Oxidising the alcohol will give aldehyde H_3CCHO $\boxed{(1)}$ and the further oxidation of the aldehyde will give carboxylic acid H_3CCOOH $\boxed{(6)}$.

On the other hand, adding H_2O into acetylene $\boxed{(16)}$ can also give H_3CCHO as the intermediate $H_2C = CHOH$ is very unstable.

Now, neutralise H_3CCOOH using $Ca(OH)_2$ will give $(H_3CCOO)_2Ca$ $\boxed{(7)}$, where H_3CCOCH_3 $\boxed{(15)}$ can be obtained from it by dry distillation.

Besides, similar to that of $H_2C = CH_2$, adding H_2O into $H_3CCH = CH_2$ with H_2SO_4 catalyst gives $H_3CCHOHCH_3$ $\boxed{(19)}$, which can be oxidised to H_3CCOCH_3 using $KMnO_4$ as the oxidising agent.

Adding $H_3CCH = CH_2$ into benzene will form cumene $\boxed{(20)}$. Adding O_2 into cumene will give $\boxed{(5)}$. Treat it with H_2SO_4 will give phenol $\boxed{(4)}$ and H_3CCOCH_3. The whole process is called cumene process.

(2): Referring to the above, we have:

$\boxed{\text{(a): addition (b): oxidation (c): neutralisation (d): oxidation}}$

VI:

(a) Phenol is a weak acid which is slightly soluble in water. It shows positive result and give blue or purple colour with $FeCl_3$ test. $\boxed{(3)}$

(b) Benzaldehyde gives positive result with silver mirror test. However, as it is an aromatic aldehyde, it shows negative result with Fehling's test. Moreover, it is a neutral liquid at room temperature pressure. $\boxed{(4)}$

(c) Aniline is insoluble in water. But, after neutralised with $HCl(aq)$, it becomes a salt and dissolves in the solution. Moreover, it gives a purple colour with bleach ($CaOCl_2$). $\boxed{5}$

(d) Benzene sulforic acid is soluble in water and the solution is strongly acidic. $\boxed{(2)}$

(e) Benzoic acid is insoluble in cold water but soluble in hot water. The $-COOH$ group allows it to undergo esterification with alcohols. $\boxed{(6)}$

(f) Nitrobenzene is yellow in colour and insoluble in water. Trinitrobenzene is used as an explosive. $\boxed{(8)}$

(g) Toluene is insoluble in water and show negative results with tests for aldehydes (including the silver mirror test). It is generally used as an organic solvent. $\boxed{(7)}$.

(h) Benzyl alcohol is liquid at room temperature pressure and show negative results with tests for aldehydes (including the silver mirror test). Moreover, the $-OH$ group allows it to undergo esterification with carboxylic acids. $\boxed{(1)}$

VII:

(1): The mass of C atoms in X=The mass of C atoms in CO_2=$176 \cdot \frac{12}{44} = 48\ mg$.

The mass of H atoms in X=The mass of H atoms in H_2O=$108 \cdot \frac{2}{18} = 12\ mg$.

Therefore, the mass of O atoms in X=$124 - 48 - 12 = 64\ mg$.

Consider the molar ratio $C : H : O = \frac{48}{12} : \frac{12}{1} : \frac{64}{16} = 1 : 3 : 1$.

Hence, the empirical formula of X is $\boxed{CH_3O}$.

(2): By $pV = nRT$, we have $p = \frac{\rho}{m}RT$, or $\rho = \frac{pm}{RT}$.

Under the same pressure and temperature, the density of gas is directly proportional to the molecular mass of the gas.

Therefore, the molecular mass of X is approximately $2 \cdot 32 = 64$.

Solving $n(12 + 3 + 16) \approx 64$ for an integer n, we have $n = 2$.

Therefore, the molecular formula of X is $\boxed{C_2H_6O_2}$.