I(1):

(1): The first ionisation energy increases with the number of protons and decreases with the atomic radius. As F and Ne have the smallest atomic radius (number of orbits) and Ne has the greater number of protons than F, Ne $\boxed{(2)}$ has the highest first ionisation energy.

I(2):

$\boxed{1)}$ CH_3COO^- ions undergo the equilibrium $CH_3COO^- + H^+ \iff CH_3COOH$. Hence it is a weak base.

2) Phenol is a weak acid.

3) NH_4^+ ions undergo the equilibrium $NH_4^+ + OH^- \iff NH_3 + H_2O$. Hence it is a weak acid.

4) KOH is a strong alkali.

I(3):

1) Acetic acid (CH_3COOH) contains a C=O double bond.

2) Formic acid (HCOOH) contains a C=O double bond.

$\boxed{3)}$ Hydrochloric acid (HCl) contains only a H-Cl single bond.

4) Sulfuric acid (H_2SO_4) contains S=O double bonds.

I(4):

The boiling points of substances are determined by the strength of their intermolecular forces.

1) The intermolecular forces between H_2O molecules are hydrogen bonds.

2)-4) The intermolecular force between their molecules is van der Waals' force, which becomes stronger with the molecular size.

As H_2S $\boxed{(2)}$ has the smallest molecular size among 2)-4), it has the lowest boiling point.

I(5):

1) Their atoms are connected by covalent bonds.

2) $SiCl_4$ is a liquid.*

3) SiO_2 has a giant covalent structure, where each Si atom is connected to 4 nearby O atoms with a single bond (and vice versa).

$\boxed{4)}$ True.

*: One may not be sure about which state $SiCl_4$ is in. As $SiCl_4$ is a simple molecule with molecular mass around 160, one may compare it to Br_2, which is also a simple molecule with molecular mass around 160.

I(6):

$\boxed{1)}$ $Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$ (redox)

2) $CaH_2 + 2H_2O \to Ca(OH)_2 + 2H_2$ (redox)

3) $2Na + 2H_2O \to 2NaOH + H_2$ (displacement)

4) $Zn + 2HCl \to ZnCl_2 + H_2$ (displacement)

I(7):

Properties of ideal gas:

-Its molecules are a point mass.

-There are no intermolecular forces between ideal gas molecules.

-It is in the gas state regardless of the surrounding condition.

-It obeys the ideal gas law (and hence the 3 fundamental gas laws)

Therefore, the answer is $\boxed{\text{3)}}$.

II:

(1): $NH_3 + H_2O \iff NH_4^+ + OH^-$

As NH_3 received H^+ and H_2O donated H^+, by Brønsted–Lowry's acid–base theory, we have NH_3 works as $\boxed{\text{base}}$ and H_2O does as $\boxed{\text{acid}}$.

(2): As acetic acid is a weak acid and $NaOH(aq)$ is a strong alkali, the equilibrium pH value is $\boxed{\text{greater}}$ than 7. Therefore, an appropriate indicator will be $\boxed{\text{phenolphthalein}}$.

Note: A common indicator for end point's pH valued less than 7 is methyl orange and that for end point's pH valued greater than 7 is phenolphthalein. Both of them can work for end point's pH valued around 7 and none of them can work for end point's pH valued far away from 7.

III:

(1): Referring to the table:

Chemical	H_2	I_2	HI
Number of moles before equilibrium	0.80	0.60	0
Number of moles after equilibrium	$0.80 - \frac{1.00}{2} = 0.30$	$0.60 - \frac{1.00}{2} = 0.10$	1.00

$\boxed{0.30}$ mol of H_2 remains in the vessel after equilibrium.

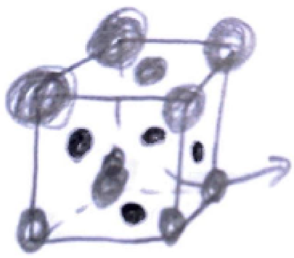
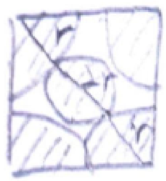
(2): $K_C = \frac{[HI]^2}{[H_2][I_2]} = \frac{(\frac{1.00}{volume})^2}{(\frac{0.30}{volume})(\frac{0.10}{volume})} \approx \boxed{33}$

IV:

(1): The reaction $Na \rightarrow Na^+ + e^-$ is $\boxed{\text{endothermic}}$ (the energy absorbed is called the ionisation energy).

On the other hand, the reaction $Cl + e^- \rightarrow Cl^-$ is $\boxed{\text{exothermic}}$ (the energy released is called electron affinity).

(2):

Refer to the graph, consider one face of the cube, by Pythagoras' theorem, we have the edge length=$\frac{4 \cdot 0.143}{\sqrt{2}} \approx 0.40\ nm$.

Moreover, each cube contains $\frac{1}{8} \cdot 8 + \frac{1}{2} \cdot 6 = 4\ Al^{3+}$ ions, which is weighted $4 \cdot \frac{27.0}{6.02 \times 10^{23}}\ g$.

Therefore, the density of aluminium$\approx \frac{4 \cdot \frac{27.0}{6.02 \times 10^{23}}}{(0.40 \times 10^{-9})^3} \approx \boxed{2.8}\ g\ cm^{-2}$.

Note: Using the approximate value of $\sqrt{2} \approx 1.4$ can give the official answer. However, it is not stated in the equation.

V:

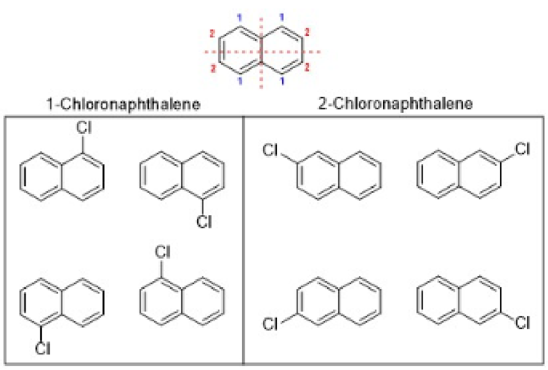
(1): Oxidation of naphthalene with V_2O_5 catalyst gives phthalic anhydride $\boxed{(8)}$. By heating with NH_3, phthalimide forms. On the other hand, hydrolysis of phthalic anhydride gives phthalic acid $\boxed{(12)}$, where it can also be formed by the oxidation of xylene $\boxed{(7)}$ or toluic acid. Moreover, neutralisation of it with KOH will give potassium salt.

Besides, substitution of H_2SO_4 to naphthalene gives naphthalene sulfonic acid, which undergoes alkali fusion to give sodium naphtholate $\boxed{(5)}$. Acidify it can form naphthol $\boxed{(6)}$.

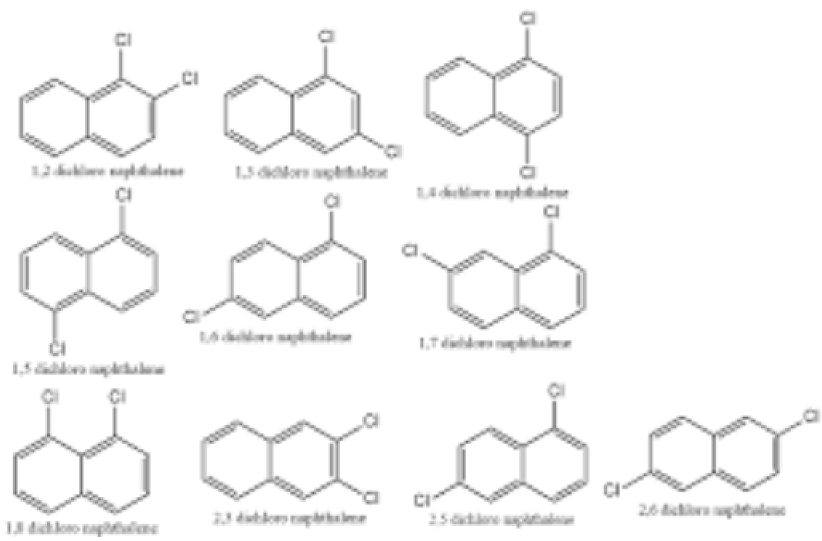
By somehow forming naphthol, treating it with $C_6H_5N_2Cl$ in an alkaline environment will undergo diazo coupling which gives $\boxed{(10)}$.

Note: Most reactions of naphthalene are the same as benzene.

(2): Use chloride as an example, there are only $\boxed{2}$ isomers due to symmetry:



(3): Use chloride as an example, there are $\boxed{11}$:



(4): Similar to other di-substituted benzene rings, phthalic acid has $\boxed{3}$ isomers: o-phthalic acid, m-phthalic acid and p-phthalic acid. As both of them can form two hydrogen bonds with water, the one with the largest surface area (i.e. the one with the flattest molecular shape) has the highest melting point. Therefore, p-phthalic acid $\boxed{(15)}$ has the highest melting point.

(5):

1) True.

$\boxed{2)}$ The non-polar ethyl group in ethanol will attract non-polar naphthalene molecules. Therefore, naphthalene is soluble in ethanol.

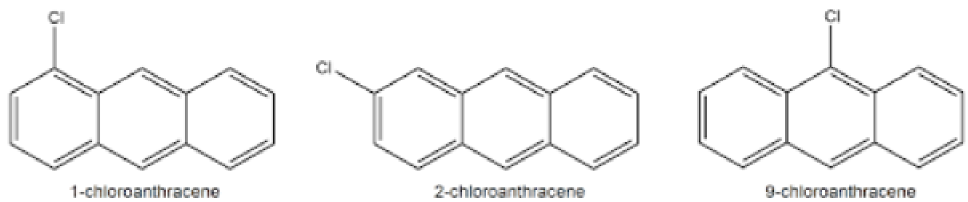
3) True, as it contains a benzene ring.

4) True, think about naphthalene balls that placed in your wardrobe.

$\boxed{5)}$ Not true, think about naphthalene balls, no liquid will remain after they have used up.

6) True, same as benzene.

(6): Use chloride as an example, there are $\boxed{3}$ isomers by symmetry:



VI:

(1):

Ethylene is lighter than air. Therefore, we collect it with either upward delivery or water displacement.

However, for upward delivery, we may potentially also collect evaporated ethanol.

Therefore, only water $\boxed{(3)}$ is suitable.

(2):

$\boxed{1)}$ True as ethylene has a linear shape.

2) There are no cis-trans isomers for ethylene.

3) Carbon-carbon triple bond is shorter as the charge of it is larger which can attract the nuclei closer.

4) False.

(3):

$\boxed{1)}$ True.

2) It can easily undergo complete combustion, so soot won't accumulate.

3) Same as 2), only CO2 and H2O formed, which are both not toxic.

4) False.

(4): The structure of polyethylene is given by $[-CH_2CH_2-]_n$.

The weight % of carbon in polyethylene is equal to the weight % of the repeating unit, i.e. $\frac{2\cdot 12.0}{2\cdot 12.0+4\cdot 1.0}\cdot 100\% \approx 85.7\%$

(5): The reaction equation is given by $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$.

The molar ratio $Br_2 : C_2H_4$ is 1:1. Therefore, $\boxed{1}$ mol of ethylene is required.

VII:

(1) Benzene is a solid at 0 degree Celsius $\boxed{(c)}$.

(2) Acetic acid has two hydrogen bonds per molecule and a larger molecular size than water. Hence, its melting point should be greater than water, i.e. it is a solid at 0 degree Celsius $\boxed{(c)}$.

(3) Acetaldehyde is liquid at room temperature. On the other hand, as its molecules do not form hydrogen bonds, it has a lower melting point than water. Therefore, it is a liquid at 0 degree Celsius $\boxed{(a)}$.

(4) When compared with water, methanol has only 1 hydrogen bond per molecule.

Hence, it has a lower melting point than water. Therefore, it is a liquid at 0 degree Celsius $\boxed{(a)}$.

(5) Ethylene has a very low boiling point, hence, is a gas in 0 degree Celsius $\boxed{(b)}$.

(6) Acetone is liquid at room temperature. On the other hand, as its molecules do not form hydrogen bonds, it has a lower melting point than water. Therefore, it is a liquid at 0 degree Celsius $\boxed{(a)}$.