Q1(A):

Element	$_6C$	$_8O$	$_{11}Na$	$_{16}S$	$_{20}Ca$
Number of valence electrons	4	6	1	6	2

Hence, the answer is $_{11}Na$, $\boxed{(3)}$.

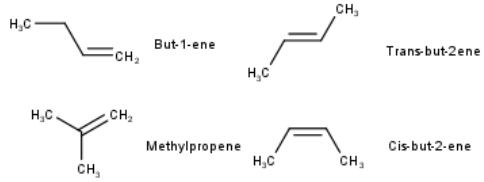
Q1(B):

Reaction	Atom	Oxidation number	Atom	Oxidation number	Change in oxidation number
$CO_2 + H_2 \rightarrow CO + H_2O$	H (in H_2)	0	H (in H_2O)	+2	+2
$2HI + Cl_2 \rightarrow I_2 + 2HCl$	Cl (in Cl_2)	0	Cl (in HCl)	-1	-1
$2Na + Cl_2 \rightarrow 2NaCl$	Na	0	Na (in $NaCl$)	+1	+1
$Mg + 2HCl \rightarrow MgCl_2 + H_2$	Mg	0	Mg (in $MgCl_2$)	+2	+2
$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$	Zn	0	Zn (in $ZnSO_4$)	+2	+2

The reactant that underwent a possitive change in oxidation number were being oxidised while those underwent a negative change in oxidation number were being reduced. Hence only b was a reduction while all other four were oxidations. Therefore, the answer is $\boxed{(1)}$.

Q1(C):

Alkenes with the molecular formula C_4H_8 are the following (enantiomorphisms are counted as different isomers as well):



Therefore, there are totally 4 isomers. The answer is $\boxed{(3)}$.

Q1(D):

State at room temperature, pressure	Elements
Solids	Li, Mg, Si, B, C
Monoatomic gases	Ar, He
Diatomic gases	H_2, O_2

The number of monoatomic gases at room temperature, pressure is 2. The answer is $\boxed{1}$.

Q1(E):

The answer is $\boxed{(4)}$. The correct statement for it should be "As molecular crystals have <u>weak intermolecular attraction (van der Waal's force)</u> between molecules, most of them have a low melting point."

Q1(F):

The nearer the position of an element in the periodic table to the top right hand corner, the higher the first ionisation energy of the element. Refering to the position of each element in the periodic table, we have the first ionisation energies:

(1): $He < Ne$, (2): $Li > Na$, $\boxed{(3)}$: $B > Be$, (4): $O < Ar$, (5): $F > Cl$

Q2:

(A) As the partial pressures of gases in the same system are directly proportional to their number of mole, we have $p_{N_2} : p_{H_2} = 1.00 : 3.00 = 1 : 3$. As $p_{N_2} + p_{H_2} = 30.0\ atm$, we have $p_{N_2} = \frac{1}{1+3} \cdot 30.0 = 7.5\ atm$ and $p_{H_2} = \frac{3}{1+3} \cdot 30.0 = 22.5\ atm$. Consider the reaction $3H_2 + N_2 \leftrightarrow 2NH_3$. Again, as the partials pressure of gases in the same system are directly proportional to their numbers of mole, we have the ratio of the change in pressure (p) is proportional to the molar ratio of each compound:

Partial pressure (atm)	p_{N_2}	p_{H_2}	p_{NH_3}
Before the reaction	7.5	22.5	0
After the reaction	7.5-p	22.5-3p	2p

After the reaction, the pressure$=p_{N_2} + p_{H_2} + p_{NH_3} = 30 - 2p\ atm = 25\ atm$. Hence, we have $p = 2.5\ atm$. Then, as the partial pressure is directly proportional to the number of mole, the molar fraction of $NH_3 = \frac{p_{NH_3}}{p} = \frac{2 \cdot 2.5}{25} = 0.20$. The answer is $\boxed{(1)}$.

(B) Denote the two isotopes of N and H be N, M and H, K respectively. Then, all possible combination of atoms of a molecule of NH_3 are: NH_3, MH_3, NH_2K, MH_2K, NHK_2, MHK_2, NK_3 and MK_3. The total number is 8 and the answer is hence $\boxed{(5)}$.

Q3:

(A) By the thermalchemical equation

$$C_3H_8 + 5O_2 \to 3CO_2 + 4H_2O \ \Delta H = -2220 \ kJ/mol,$$

we have $4\Delta H_f[H_2O] + 3\Delta H_f[CO_2] - \Delta H_f[C_3H_8] = -2220 \ kJ/mol$.

On the other hand, by the two given thermalchemical equations

$$C(graphite) + O_2 \to CO_2 \ \Delta H = -394 \ kJ/mol$$

and

$$2H_2 + O_2 \to 2H_2O \ \Delta H = -572 \ kJ/mol,$$

we have $\Delta H_f[CO_2] = -394 \ kJ/mol$ and $\Delta H_f[H_2O] = \frac{-572}{2} = -286 \ kJ/mol$.

Combine the above, we have $\Delta H_f[C_3H_8] = 4\Delta H_f[H_2O] + 3\Delta H_f[CO_2] + 2220 = -4 \cdot 286 - 3 \cdot 394 + 2220 = -106 \ kJ/mol$. Hence, the answer is $\boxed{(3)}$.

(Note: The entahlphy change and the amount of heat released have opposite sign.)

(B) Let n be the number of mole of propane required. Then, as the heat released by combusting propane is the only sources of heat for heating the water, we have the equation $n\Delta H_f[C_3H_8] = -m_{water}c_{water}\Delta T$. By substituting the corresponding values, we have $2220n = (2 \cdot 1000 \cdot 1.00)(4.18)(95 - 15)$ and $n = \frac{33440}{111} \ mol$. As 1 mol of gas in room temperature pressure is equivalent to 22.4 ml in volume, we have the required amount of propane$=\frac{33440}{111} \cdot 22.4 \approx 6748 \ ml \approx 6.75 \ l$. Hence the answer is $\boxed{(2)}$.

Q4:

We have the chemical equation for the reaction:

$$HCl + NaOH \to NaCl + H_2O,$$

which is a complete neutralisation, where the limited reagent uses up after the reaction.

Before the reaction, the numbers of mole of HCl and $NaOH$ are $0.14 \cdot 50 \times 10^{-3} = 7 \times 10^{-3}\ mol$ and $0.10 \cdot 50 \times 10^{-3} = 5 \times 10^{-3}\ mol$ respectively. Hence $NaOH$ is the limited reagent and the number of mole of HCl after the reaction is $(7-5) \times 10^{-3} = 2 \times 10^{-3}\ mol$. Then $[HCl]$ after the reaction$=\frac{2\times 10^{-3}}{(50+50)\times 10^{-3}} = \frac{2}{100}\ mol/dm^3$.

The pH value$=-\log[H^+] = -\log[HCl] = -\log\frac{2}{100} = -\log 2 + \log 100 \approx 2 - 0.3 = 1.7$. Hence, the answer is $\boxed{(2)}$.

Q5:

(A) By $I = \frac{Q}{t}$, we have the number of charges used during the electrolysis$=At = 863 \times 10^{-3} \cdot (1 \cdot 60 \cdot 60) = 3106.8\ C$. As 1 C of charge is equivalent to $\frac{1}{9.65\times 10^4}\ mol$ of electrons (by the Faraday constant), we have the number of mole of electrons flowed$=\frac{3106.8}{9.65\times 10^4} \approx 3.22 \times 10^{-2}\ mol$. Hence, the answer is $\boxed{(2)}$.

(B) We have the half-equation in the anode:

$$4OH^-(aq) \to 2H_2O(l) + O_2(g) + 4e^-.$$

Hence the molar ratio of the gas (O_2) to electron is $1:4$. As 3.22×10^{-2} mol of electrons have flowed, $\frac{1}{4} \cdot 3.22 \times 10^{-2} = 0.805 \times 10^{-2}$ mol of gas has evolved. By $pV = nRT$, the corresponding volume is $\frac{0.805\times10^{-2}\cdot0.082\cdot(25+273)}{0.90} \approx 0.219\ l =$ $219\ ml$. Hence the answer is $\boxed{(3)}$.

(C) By the half-equation:

$$Cu^{2+} + 2e^- \to Cu,$$

we have the molar ratio $Cu^{2+} : e^- = 1:2$. As 3.22×10^{-2} mol of electrons have flowed, $\frac{1}{2} \cdot 3.22 \times 10^{-2} = 1.62^{-2}$ mol of Cu^{2+} has been reduced.

Initially, the number of mole of $CuSO_4 = 0.100 \cdot 300 \times 10^{-3} = 3 \times 10^{-2}$ mol.

Therefore, the number of mole of $CuSO_4$ after the electrolysis$= (3 - 1.62) \times 10^{-2} = 1.38 \times 10^{-2}$ mol. The corresponding concentration is $\frac{1.38\times10^{-2}}{300\times10^{-3}} = 4.6 \times 10^{-2}$ mol/dm^3. Hence the answer is $\boxed{(2)}$.

(Note: The error is due to the round-off when calculating the number of mole of electrons flowed.)

Q6:

(A) Note that all the H atoms and C atoms are come from the organic compound while some O atoms are come from the air.

The fractional masses of H in H_2O and C in CO_2 are $\frac{2\cdot1.0}{2\cdot1.0+16.0} = \frac{1}{9}$ and $\frac{12.0}{12.0+2\cdot16.0} = \frac{3}{11}$ respectively. Hence the masses of H and C atoms are $14.4\ \cdot$

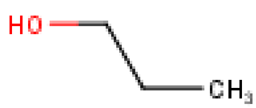
$\frac{1}{9} = 1.6\ mg$ and $26.5 \cdot \frac{3}{11} = \frac{159}{22}\ mg$ respectively. Moreover, as the organic compound is consisted by H, C, and O atoms only, the mass of O atoms in the compound=(the mass of the compound)-(the total mass of H and C atoms in the compound)$=12.0 - (1.6 + \frac{159}{22}) = \frac{349}{110}\ mg$.

Therefore, the atomic ratio of $H : C : O$ in the compound$=\frac{1}{1.0} \cdot 1.6 : \frac{1}{12.0} \cdot \frac{159}{22} : \frac{1}{16.0} \cdot \frac{349}{110} \approx 8 : 3 : 1$. Hence, the empirical formula of the compound is C_3H_8O.

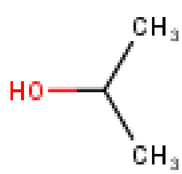
Now, let m be its molecular mass. By $pV = nRT$, substituting the given data, we have $0.60 \cdot 20.5 \times 10^{-3} = \frac{30\times10^{-3}}{m} \cdot 0.083 \cdot (27 + 273)$ and $m \approx 60$. Solving $n(3 \cdot 12.0 + 8 \cdot 1.0 + 16.0 = 60)$, we have $n = 1$. Therefore, the molecular formula of the compound is C_3H_8O and the answer is $\boxed{(6)}$.

(B) As the ratio of numbers of C and H is $n : 2n + 2$ (take $n = 3$), we have the compound is a derive of alkane. Hence it is either alcohol and ether. The following are all possible structures of it:

Alcohol:

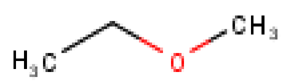


propan-1-ol



propan-2-ol

Ether:



methoxyethane

There are total 3 isomers. Hence, the answer is $\boxed{(3)}$.

Q7:

The organic compound who will react will the aqueous reactant to form a salt will be separated to the aqueous layer.

Note that the acidities of the compounds are the following:

Phenol: very weak acidic

Acetic acid: weak acidic

Aniline: very weak alkaline

Nitrobenzene: neutral

The one who reacts with Na_2CO_3 (basic) should be acidic. Hence, it is acetic acid (A).

The one who reacts with $NaOH$ (alkaline) should show acid properties. Hence, it is phenol (B).

The one who reacts with HCl (acidic) should show alkali properties. Hence, it is aniline (C).

The remaining one is nitrobenzene (D).

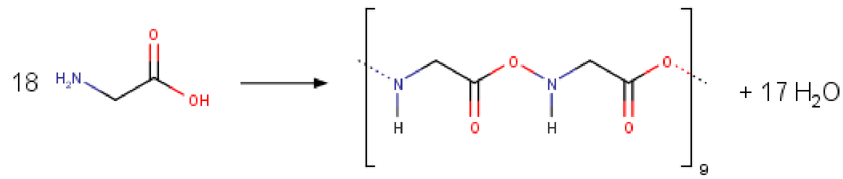
Given the above, the answer is $\boxed{(2)}$.

Q8:

(A) We are going the find the formula of the branch R. As the formula mass of the chain $-CH(NH_2)COOH$ is $12+1.0+(14.0+2\cdot1.0)+12.0+2\cdot16.0+1.0 = 74$, we have the formula mass of the branch $R-=75-74=1$. Hence R can only be H and the condense formula of the amino acid is hence $CH_2(NH_2)COOH$.

The answer is $\boxed{(2)}$.

(B) Consider the equation of condensation polymerisation:



Total molecular mass of side products (H_2O)=$17 \cdot (2 \cdot 1.0 + 16.0) = 306$. Therefore, the molecular mass of the polymer=(the total molecular mass of reactants)-(the total molecular mass of side products)=$(18 \cdot 75) - 306 = 1044$. The answer is $\boxed{(2)}$.

Q9:

Compound	Condense formula	Functional group
Vinyl acetate (1)	$H_2C = CH - OCOCH_3$ (e)	Ester (1)
Styrene (2)	$CH_2 = CH - C_6H_5$ (a)	Aromatic hydrocarbons (3)
Adipic acid (3)	$HOOC - (CH_2)_4 - COOH$ (d)	Carbonic acid (5)
Ethylene glycol (4)	$HO - (CH_2)_2 - OH$ (b)	Alcohol (4)
Isoprene (5)	$CH_2 = CH - C(CH_3) = CH_2$ (c)	Diene (2)

Hence, the answer is $\boxed{(3)}$.