

Q1:

$\boxed{Ar}$  is a noble gas.

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Q2:

Note that  $Li$ ,  $F$  have the smallest number of electron shells.

Moreover, as  $F$  has more outermost shell electrons than  $Li$ , the attraction between electrons and the nucleus is stronger than that of  $Li$  and hence has a smaller atomic radius.

Given the above,  $\boxed{F}$  has the smallest atomic radius.

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Q3:

(1): Trigonal pyramidal

(2): Bent

(3): Bent

(4): Tetrahedral

(5): Linear

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Q4:

A nonelectrolyte cannot conduct electricity after dissolved in water.

(2) to (5) dissociate into ions when dissolved in water and hence are electrolytes.

Only  $\boxed{(1)}$  is a nonelectrolyte.

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Q5:

(2), (3) and (5) are very soluble in water.

Moreover,  $H_2S$  is fairly soluble in water while  $NO$  is only slightly soluble in water.

Given the above,  $\boxed{NO}$  is the most difficult one to dissolve in water.

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Q6:

$$\frac{2 \cdot 16.0}{2 \cdot 12.0 + 4 \cdot 1.0 + 2 \cdot 16.0} \times 100\% \approx \boxed{53\%}.$$

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Q7:

We have  $\rho = \frac{M}{V} = \frac{m_A}{22.4}$ .

The volume % of  $H_2$  is equal to the molar % by Avogadro's law.

We have  $\frac{2 \cdot 1.0 \cdot x + 2 \cdot 14.0 \cdot (1-x)}{22.4} = 0.670$ , i.e.  $x \approx \boxed{50\%}$ .

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Q8:

$$\frac{1.33x}{23.0 + 16.0 + 1.0} \cdot 1000 = 10.0, \text{ we have } x \approx \boxed{30\%}.$$

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Q9:

At 353 K, consider the solubility,  $\frac{x}{250-x} = \frac{51}{100}$ , there are  $x \approx 84.44$  g of  $KCl$  in the solution.

Then, consider the solubility at 273 K,  $\frac{84.44-x}{250-84.44} = \frac{28}{100}$ ,  $x \approx \boxed{38 \text{ g}}$  of  $KCl$  is crystallised out.

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Q10:

As the formation of 3.00 L, i.e.  $\frac{3}{22.4}$  mol of  $HCl$  releases 12.4 kJ of heat, the formation of 1 mol of  $HCl$  releases  $\frac{12.4}{\frac{3}{22.4}} \approx \boxed{+93 \text{ kJ/mol}}$  of heat.

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Q11:

Number of moles of  $H^+$  ion =  $8.0 \times 10^{-3} \cdot \frac{100}{1000} = 8 \times 10^{-4}$  mol.

Number of moles of  $OH^-$  ion =  $1.0 \times 10^{-2} \cdot \frac{50}{1000} = 5 \times 10^{-4}$  mol.

After neutralisation,  $3 \times 10^{-4}$  mol of  $H^+$  ion is remained and the volume of the solution becomes 150 mL.

Therefore,  $[H^+] = \frac{3 \times 10^{-4}}{\frac{150}{1000}} = 2 \times 10^{-3}$  mol/L and

$pH = -\log[H^+] = 3 - \log 2 \approx \boxed{2.70}$ .

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Q12:

By  $pV = nRT$ ,  $2.43 \cdot \frac{600}{1000} = \frac{m}{12.0+2 \cdot 16.0} \cdot 0.082 \cdot 350$ , i.e.  $m \approx \boxed{2.2 \text{ g}}$ .

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Q13:

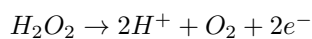
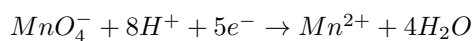
As  $Cr_2O_7^{2-}$  has the oxidation number of -2,  $Cr$  has the oxidation number of

$$\frac{7 \cdot 2 - 2}{2} = \boxed{+6}.$$

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Q14:

The half equations are:



The overall equation is  $2MnO_4^- + 5H_2O_2 + 6H^+ \rightarrow 2Mn^{2+} + 5O_2 + 8H_2O$ .

Number of moles of  $MnO_4^- = 0.020 \cdot \frac{12.0}{1000} = \frac{2}{5} \cdot M \cdot \frac{10.0}{1000}$ , i.e.  $M = \boxed{0.060 \text{ mol/L}}$ .

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Q15:

The half equation at the anode is  $2Cl^- \rightarrow Cl_2 + 2e^-$ .

$$Q = It = 15 \cdot 60I = 900I \quad C = \frac{900}{9.65 \times 10^4} I \text{ F.}$$

Number of moles of  $Cl_2 = \frac{315}{22.4 \cdot 1000} = \frac{1}{2} \cdot \frac{900}{9.65 \times 10^4} I$ , i.e.  $I \approx \boxed{3.0 \text{ A}}$ .

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Q16:

$\boxed{(1)}$ : Colourless

$\boxed{(2)}$ : Brick-red flame

$\boxed{(3)}$ : Yellowish-green

(4): Golden yellow flame

(5): Violet flame

Note: In fact, burning Mg will give a bright white colour. So the flame test is still applicable.

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Q17:

$\boxed{Ba}(OH)_2$  is soluble.

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Q18:

It is either a alkene or a cyclic alkane.

Alkene: But-1-ene, Cis-but-2-ene, Trans-but-2-ene, Methylpropene

Cyclic alkane: Cyclobutane, Methylcyclopropane

There are  $\boxed{6}$  isomers.

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Q19:

Consider the weight percentage of  $C$  atoms in  $CO_2$ , the mass of  $C$  atoms in the compound =  $17.6 \cdot \frac{12.0}{12.0 + 2 \cdot 16.0} = 4.8 \text{ mg}$ .

Similarly, the mass of  $H$  atoms in the compound is 0.8 mg.

Therefore, the mass of  $O$  atoms is  $8.8 - 4.8 - 0.8 = 3.2 \text{ mg}$ .

The molar ratio  $C : H : O = \frac{4.8}{12.0} : \frac{0.8}{1.0} : \frac{3.2}{16.0} = 2 : 4 : 1$ .

The empirical formula is  $C_2H_4O$ .

Solving  $n(2 \cdot 12.0 + 4 \cdot 1.0 + 16.0) = 88$ , we have  $n = 2$ .

Therefore, the molecular formula is  $C_4H_8O_{\boxed{2}}$ .

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Q20:

A  $-C(OH)HCH_3$  or  $-COCH_3$  branch is responsible for a positive result in the iodoform test.

Among the options, only Acetic acid does not contain such a branch.