I(1):

The number of neutrons is equal to the mass number minus the number of protons (i.e. atomic number).

1) 1-1=0

2) 4-2=2

3) 6-4=2

$\boxed{4)}$ 5-4=1

I(2):

Across the same group, the atom with the smallest number of electron shells has the smallest atomic radius. Therefore, Si $\boxed{(1)}$ has the smallest atomic radius.

I(3):

1) B has 3 outermost shell electrons. Forming covalent bonds with the three F atoms used all and no lone pairs remain.

2) C has 4 outermost shell electrons. Forming covalent bonds (double bond) with the two O atoms used all and no lone pairs remain.

$\boxed{3)}$ N has 5 outermost shell electrons. Forming covalent bonds with the three H atoms shared three, and the remaining two formed one lone pair electron.

4) F has 7 outermost shell electrons. Forming a covalent bond with the H atom shared one, and the remaining six formed three lone pair electrons.

I(4):

The boiling point of a substance is determined by the strength of its intermolecular force.

He and Kr are monatomic molecules, the van der Waals' force between their molecules is very weak. Therefore, they will have the lowest boiling points.

On the other hand, He has smaller atomic size than Kr, therefore the van der Waals' force between He molecules are additionally weaker. Hence, He $\boxed{(1)}$ has the lowest boiling point.

I(5):

$\boxed{1)}$ Cu can form Cu^+ and Cu^{2+} ions. Zn can form Zn^{2+} ions.

2) Cu cannot dissolve in hydrochloric acid.

3) The oxidising power of HCl is not enough to displace Cu^{2+} ions.

4) Zn has a higher reactivity than Cu and hence is more easily oxidised.

I(6):

1) is a neutralisation reaction, no redox involved.

2) is the solution of P_4O_{10} in water, no redox involved.

3) Is a displacement reaction, no redox involved.

$\boxed{4)}$ I_2 is reduced to I^- and S_2O_3 is oxidised to S_4O_6.

I(7):

The mechanism of catalysts is to provide an alternative reaction path with lower activation energy such that the reaction rate can be increased. However, as the overall reaction did not change, the heat of reaction remains the same by Hess' law. Therefore, $\boxed{(2)}$ is not correct.

II:

Ag is oxidised by dilute and concentrated HNO_3 respectively, in which HNO_3 is reduced to $\boxed{NO}$ and $\boxed{NO_2}$ gases respectively. Addition of NH_3 into $AgNO_3$ generates $\boxed{Ag_2O}$ precipitate and the precipitate redissolves in excess $NH_3(aq)$ to form $\boxed{Ag(NH_3)_2^+}$ ions.

III:

Number of moles of neon$=\frac{1.0}{20} = 0.05\ mol$.

Number of moles of argon$=\frac{4.0}{40} = 0.1\ mol$.

The molar fraction of neon$=\frac{0.05}{0.05+0.1} \approx \boxed{0.33}$.

By $pV = nRT$, the partial pressure of argon

$=\frac{0.1 \cdot 8.3 \times 10^3 \cdot 300}{2.0} = 12.45 \times 10^4\ Pa \approx \boxed{0.12}\ MPa$.

IV:

(1): We have the thermochemical equations:

$H_2O(l) \rightarrow H_2O(g)\ \Delta H = 44.0\ kJ/mol$

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O(g)\ \Delta H = \Delta H_f[H_2O(g)]$

For the second equation, one H-H bond and $\frac{1}{2}$ O=O bond is broken, and two O-H bonds are formed. The energy absorbed for bond breaking

$=436 + \frac{498}{2} = 685\ kJ/mol$ and the energy released for bond forming

$=2 \cdot 463 = 926\ kJ/mol$. Therefore, the enthalpy change=685-926=-241 kJ/mol.

Combine the two equations, the enthalpy change when liquid water is formed

=-241-44.0=$\boxed{-285}$ kJ/mol.

For the reaction $H_2 + O_2 \rightarrow H_2O_2\ \Delta H = -142\ kJ/mol$:

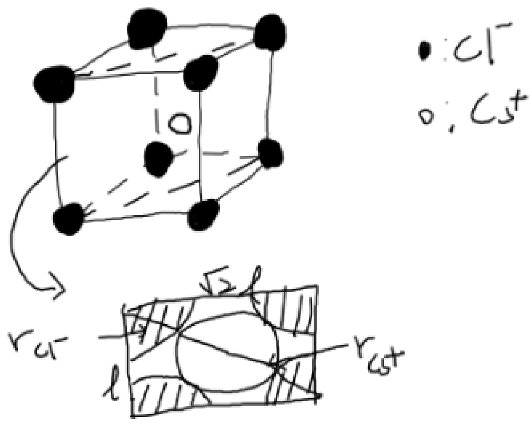
The bond energy at the product side

=(O-O)+2(O-H)=(O-O)+2 $\cdot$ 463=(O-O)+926 kJ/mol.

The bond energy at the reactant side=436+498=934 kJ/mol.

Therefore, the enthalpy change=934-(O-O)-926=-142, which implies the bond energy of O-O=$\boxed{150}$ kJ/mol.

(2): CsCl crystals have a body-centred lattice structure, where each Cs^+ ion is surrounded by $\boxed{8}$ nearby Cl^- ions, referring to the figure below:



Moreover, consider the diagonal cross section of the cube, by Pythagoras' theorem, we have $2r_{Cl^-} + 2r_{Cs^+} = \sqrt{3}l$, i.e. the radius of Cs^+ ion $= \frac{1.73 \cdot 0.412 - 2 \cdot 0.167}{2} \approx \boxed{0.189}\ nm$

V:

(1): The addition of Br_2 to $H_2C = CHCH_3$ gives $CH_2BrCHBrCH_3$ $\boxed{(4)}$.

The addition of H_2O to $H_2C = CHCH_3$ with H_2SO_4 catalyst gives $H_3CCHOHCH_3$ $\boxed{(10)}$.

Oxidising it gives H_3CCOCH_3 $\boxed{(12)}$.

Adding $H_2C = CHCH_3$ into benzene $\boxed{(18)}$ gives cumene. With the cumene process, phenol $\boxed{(20)}$ and acetone are produced.

Adding O_2 into $H_2C = CHCH_3$ with catalysts gives an aldehyde $H_2C = CHCHO$ $\boxed{(9)}$ and water. Oxidising the aldehyde gives $H_2C = CHCOOH$ $\boxed{(11)}$, which can form a water-absorbing resin (sodium polyacrlate) after polymerisation.

(2): Only $H_2BrCCHBrCH_3$ in $\boxed{A}$ exhibits enantiomerism.

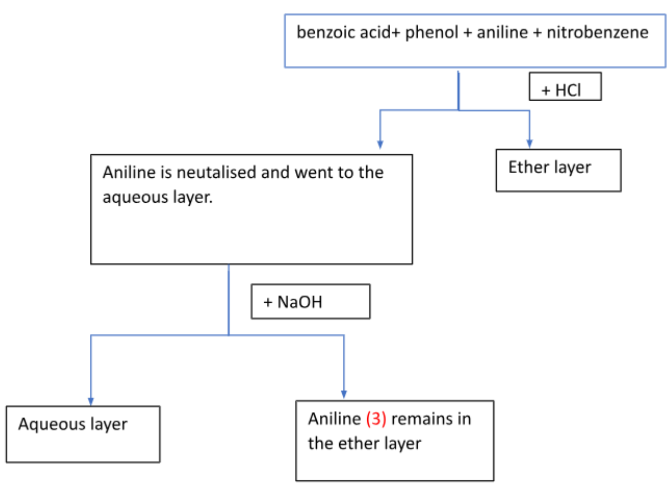
(3): $\boxed{B}$ itself is an alcohol, which can give rise to H2 after sodium is added. On the other hand, diethyl ether can be hydrolysed into two alcohols in the presence of H^+. $\boxed{E}$ and $\boxed{G}$ can dissociate H^+, therefore, they can also give rise to H_2 by hydrolysing the ether into alcohol.

(4): Phenol can produce a thermosetting resin with formaldehyde $\boxed{(2)}$.

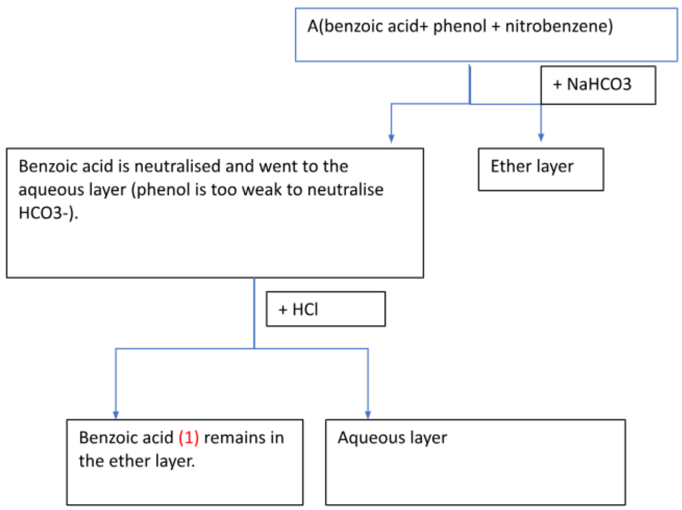
Note: Nearly all productions of thermosetting resin (plastic) require formaldehyde.

VI:

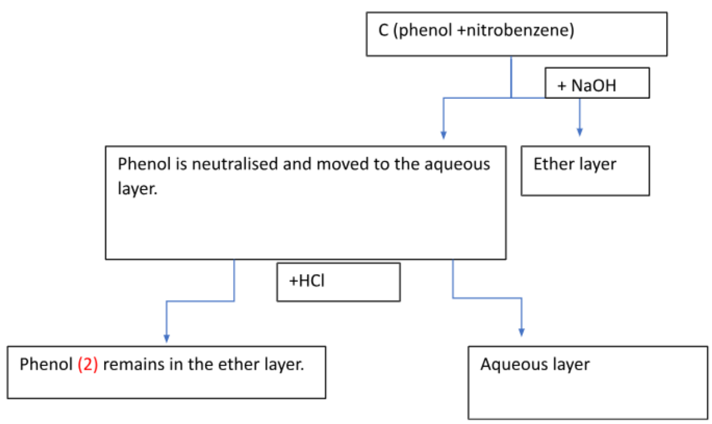
(1):



(2):



(3):



(4): Nitrobenzene $\boxed{(4)}$ remains in the ether layer E.

(5): Benzoic acid $\boxed{(1)}$ shows the strongest acidity as it contains a –COOH group.

(6): Sn can reduce nitrobenzene $\boxed{(4)}$ to aniline $\boxed{(3)}$.

VII:

(1): The polymerisation forms nylon-6,6 $\boxed{(5)}$.

Note: If one doesn't know what adipic acid is, the answer can also be deduced as the polymerisation is a condensation of hexamethylenediamine with a carboxylic acid.

(2): Number of moles of the reactant hexamethylenediamine

$=\frac{219}{2\cdot14.0+4\cdot1.0+(12.0+2\cdot1.0)\cdot6}=\frac{219}{116}\ mol.$

Number of moles of the reactant adipic acid

$=\frac{219}{(12.0+2\cdot16.0+1.0)\cdot2+(12.0+2\cdot1.0)\cdot4}=\frac{219}{146}\ mol.$

Therefore, a polymer with $\frac{219}{146}\ mol$ of repeating units is formed.

Therefore, the weight of polymer$=\frac{219}{146}\cdot(116+146-2\cdot(2\cdot1.0+16.0))=\boxed{339}\ g.$

(3): The reaction is xanthoproteic reaction $\boxed{(2)}$, which tests the presence of benzene ring in amino acids, it can also be used to test for proteins as proteins must contain such an amino acid.

(4): Glycine $\boxed{(1)}$ is the amino acid with the smallest molecular weight.

(5): Methionine $\boxed{(3)}$ and cysteine are the only two sulfur containing amino acids in protein.

(6): Phenylalanine $\boxed{(5)}$ contains a benzene ring, as suggested by its name.

Note: Another benzene ring containing amino acid is tyrosine.