普通化学 1B 第一次作业答案及评分标准

(0.8')1.A possible practical way to eliminate oxides of nitrogen (such as NO_2) from automobile exhaust gases uses cyanuric acid, $C_3N_3(OH)_3$. When heated to the relatively low temperature of 625°F, cyanuric acid converts to gaseous isocyanic acid (HNCO). Isocyanic acid reacts with NO_2 in the exhaust to form nitrogen, carbon dioxide, and water, all of which are normal constituents of the air.

(a) Write balanced equations for these two reactions.

(b) If the process described earlier became practical, how much cyanuric acid (in kilograms) would be required to absorb the 1.7×10^{10} kg NO_2 generated annually in auto exhaust in the United States?

(a) $C_3N_3(OH)_3$====$3HNCO_{(g)}$

(b) $8HNCO + 6NO_2$====$7N_2 + 8CO_2 + 4H_2O$

$4C_3N_3(OH)_3 \sim 12HNCO \sim 9NO_2$

$m=2.1\times10^{10}$ kg

两问各 0.4 分，第二问写对方程式得 0.2 分，计算思路正确数值有误扣 0.1 分

(0.8')2. A sample of a substance with the empirical formula XBr_2 weighs 0.5000 g. When it is dissolved in water and all its bromine is converted to insoluble AgBr by addition of an excess of silver nitrate, the mass of the resulting AgBr is found to be 1.0198 g. The chemical reaction is $XBr_2 + 2AgNO_3 \rightarrow 2AgBr + X(NO_3)_2$

(a) Calculate the molecular mass (that is, formula mass) of XBr_2.

(b) Calculate the atomic mass of X and give its name and symbol.

(a) $XBr_2 \sim 2AgBr$

$M_{XBr2}=184.3$ g/mol

(b) $Mx+2M_{Br}= M_{XBr2}$

$M_X=24.3$, Mg

两问各 0.4 分，每处计算若思路正确数值错误扣 0.1 分

(0.8')3. Use the group structure of the periodic table to predict the empirical formulas for the binary compounds that hydrogen forms with the elements germanium, fluorine, tellurium, and bismuth.

GeH_4 HF H_2Te BiH_3

四个化学式各 0.2 分，若化学式写反但化合价正确（如写成 H_3Bi）扣 0.1 分

(0.8')4. An electron is located at the origin of the coordinates, and a second electron is brought to a position 2 Å from the origin.

(a) Calculate the force between the two electrons.

(b) Calculate the potential energy of the two electrons.

(a) $F=Q_1Q_2/4\pi\varepsilon r^2=5.767\times10^{-9}$ N

(b) $E=Q_1Q_2/4\pi\varepsilon r=1.153\times10^{-18}$ J

两问各 0.4 分，每处计算若公式正确数值错误扣 0.2 分

(0.8')5. The electron in a hydrogen atom is initially at a distance 2.12 Å from the proton, and then moves to a distance 0.529 Å from the proton.

(a) Calculate the change in the force between the proton and the electron.

(b) Calculate the change in the potential energy between the proton and the electron.

(c) Calculate the change in the velocity of the electron.

(a) $F=Q_1Q_2/4\pi\varepsilon r^2$

$\Delta F=-7.73\times10^{-8}$ N

(b) $E= Q_1Q_2/4\pi\varepsilon r$

$\Delta E=-3.27\times10^{-18}$ J

(c) $F=ma=Q_1Q_2/4\pi\varepsilon r^2$, $a=v^2/r$

$v=(Fr/m_e)^{½}$

$v=1.09\times10^6$ m/s

第一问 0.25 分，第二问 0.25 分，第三问 0.3 分，每处计算若公式正确数值错误扣 0.1 分