

國立清華大學命題紙

98 學年度__工學院分子工程學程__碩士班入學考試

科目__普通物理及普通化學__ 科目代碼__0902__ 共__1__ 頁第__1__ 頁 *請在【答案卷卡】內作答

General Chemistry

- Four reagents were mixed. The solutions mixed together are 150.0 mL of 0.100 M hydrochloric acid, 100.0 mL of 0.200 M of nitric acid, 500.0 mL of 0.0100M calcium hydroxide, and 200.0 mL of 0.100 M rubidium hydroxide. Is the resulting solution neutral? If not, calculate the concentration of excess H^+ or OH^- ions left in solution. [8%]
- For the reaction
$$P_{4(g)} \rightleftharpoons 2P_{2(g)}$$
At 520 K and a pressure of 128 torr an equilibrium mixture P_4 and P_2 has a density of 0.4 g/L. Calculate K_p for the above reaction at 520 K. (Atomic mass of P is 31 g/mol.) [8%]
- The ionic product $[H^+][OH^-]$, which is the equilibrium constant for the dissociation of water,
$$H_2O \rightleftharpoons H^+ + OH^-$$
is $1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ at 25.0 °C and $1.45 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ at 30.0 °C.
 - Deduce ΔH° and ΔS° for the process. [5%]
 - Calculate the value of the ionic product at body temperature (37 °C). [5%]
- What is the maximum number of electrons in an atom that have these quantum numbers? [6%]
 - $n = 4, m_s = +1/2$
 - $n = 2, l = 2$
 - $n = 1, l = 0, m_l = 0$
- Predict the molecular structure and the bond angles for each of the following. [6%]
 - ICl_3
 - TeF_4
 - PCl_5
- Which has the lowest (ground-state) energy, an electron trapped in a one-dimensional box of length 10^{-6} m or 10^{-8} m? Why? [4%]
- Rearrange ionization energies of the following gas species in the order from large to small. [4%]
 - $Si_{(g)} \rightarrow Si^+_{(g)} + e^-$
 - $Ar_{(g)} \rightarrow Ar^+_{(g)} + e^-$
 - $P^+_{(g)} \rightarrow P^{+2}_{(g)} + e^-$
 - $Br_{(g)} \rightarrow Br^+_{(g)} + e^-$
- Rearrange the following lattice energy values in the order from large to small. [4%]
 - CaSe, (b) Na_2Se , (c) CaTe, (d) Na_2Te

General Physics

- Viewed from a large scale (such as in satellite images), typhoons attacking Taiwan always swirl in a counterclockwise manner. Explain why. [10%]
- Explain the following terms. Be as specific as you can. [10%]
 - Aberration; (b) Single-slit diffraction.
- Explain the basic structure and the operating principle of (a) gratings and (b) beam splitters as frequently used components in spectroscopy. Be as specific as you can. [10%]
- Under atmospheric pressure, the sound velocity σ in air is expected to vary with temperature T . Explain why and find the exponent n in the power-law dependence of $\sigma \propto T^n$. [10%]
- Show that a pair of electric dipoles separated by a center-to-center distance r experience dipole-dipole interaction potential that is proportional to r^{-n} . Should the interaction attractive or repulsive? What is the value of n ? [10%]