

國立中央大學 111 學年度碩士班考試入學試題

所別： 大氣科學學系大氣物理 碩士班 不分組(一般生)

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大氣科學學系大氣物理 碩士班 不分組(在職生)

科目： 普通化學

問答題與計算題 ※計算題需計算過程，無計算過程者不予計分

- Describe the following gas laws: (16 points)
 - Boyle's Law (4 points)
 - Charles's Law (4 points)
 - Avogadro's Law (4 points)
 - The Ideal Gas Equation (4 points)
- Following questions are about our atmosphere: (18 points)
 - What are the three major constituents of the atmosphere and their relative proportions? (6 points)
 - Roughly calculate the molecular weight of the air. (6 points)
 - If the mixing ratio of water vapor in a moist air mass is 2%, please calculate the molecular weight of this moist air. (6 points)
- The exhaust gas from an automobile contains 0.001% by volume of nitrogen dioxide (NO_2). The molecular weight (MW) of NO_2 is $46 \text{ g}\cdot\text{mole}^{-1}$. The universal gas constant is $0.082 \text{ L}\cdot\text{atm}\cdot\text{K}^{-1}\cdot\text{mole}^{-1}$. (16 points)
 - What is the concentration of NO_2 in $\mu\text{g}\cdot\text{m}^{-3}$ at 15°C and 1 atm pressure? (8 points)
 - What is the concentration of NO_2 in molecules $\cdot\text{cm}^{-3}$ at 15°C and 1 atm pressure? (8 points)
- Multiple choice. Please complete this problem by matching the following chemical species to each of questions. The proper answer to each of questions may be more than one choice. (10 points)

(A) O	(J) SO_2
(B) O_2	(K) H_2SO_4
(C) O_3	(L) NO
(D) CFCs	(M) NO_2
(E) COS	(N) N_2O
(F) CO	(O) HNO_3
(G) CO_2	(P) HF
(H) CH_4	(Q) HBr
(I) H_2S	(R) H_3PO_4

 - Which four species are the primary greenhouse gases? (4 points)
 - Which two gases are the major anthropogenic (human-made) sources of acid rain? (2 points)
 - Which two acids will you expect to detect in highly acidic rain water samples? (2 points)
 - What industrial product (products) has been entirely banned since 1996 according to Montreal Protocol for saving the atmospheric ozone? (2 points)
- What volume of a 0.200 M HCl solution is needed to neutralize 60.0 mL of a 0.450 M NaOH solution? (10 points)
- Considering only the following two reactions:
 $\text{H} + \text{CO} + \text{M} \rightarrow \text{HCO} + \text{M}, k_1 = 1.0 \times 10^{-34} \text{ cm}^6 \text{ molecule}^{-2} \text{ s}^{-1}$
 $\text{H} + \text{HCO} \rightarrow \text{H}_2 + \text{CO}, k_2 = 3.0 \times 10^{-10} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$
If this cycle were in steady state, and if the concentrations of CO and M were 2.0×10^{12} and 3.5×10^{19} molecule cm^{-3} , respectively, what would have been the concentration of the radical HCO? (10 points)
- Answer the following questions: (20 points)
 - Write the balanced chemical equation for burning coal in air, assuming that coal is pure carbon (6 points)
 - Write a new equation if coal is 5% S by weight. (6 points)
 - What will be the concentration of SO_2 in the power plant plume (1.0 atm and 150°C) in ppm? (8 points)