科目：普通化學　適用：應化系二

編號：431

考生注意：
1.依次序作答，只要標明題號，不必抄題。
2.答案必須寫在答案卷上，否則不予計分。
3.限用藍、黑色筆作答；試題須隨卷繳回。

問答題：請詳列計算過程或算式 (100%)

1. Gas A (MW = 64.0 g/mol) and gas B (MW = 36 g/mol) are present in a mixture that contains 50 molecules A : 300 molecules B.
   1) What is the ratio of the root mean square velocities of A:B? (4%)
   2) If these gases effuse through a pinhole into a neighboring evacuated chamber, what will be the ratio of A:B in the chamber? (4%)

2. Balance each of the following equations.
   1) $Bi(OH)_3 + SnO_2^{2-} \rightarrow Bi + SnO_3^{2-}$ (base) (4%)
   2) $KI + HNO_3 \rightarrow KNO_3 + NO + I_2 + H_2O$ (4%)
   3) $Zn + As_2O_3 \rightarrow AsH_3 + Zn^{2+}$ (acid) (4%)

3. State Le Châtelier's principle. (6%)

4. Consider the reaction below at 25°C, for which the following data are relevant.

$$2N_2O_5(g) \rightleftharpoons 4NO_2(g) + O_2(g)$$

	ΔH°_f (kJ/mol)	S° (J/K•mol)
$N_2O_5(g)$	-42	178
$NO_2(g)$	34	240
$O_2(g)$	0	205

   1) Calculate ΔH°, ΔS°, and ΔG° for this reaction at 25°C. (12%)
   2) Is the reaction spontaneous? (2%) Why? (4%)

5. Differentiate between a formation constant and a solubility product constant. Provide examples of each. (8%)

6. Determine which of the following atoms is (are) paramagnetic in the ground state, and arrange the atoms in order of increasing paramagnetism. (9%)

   N　O　Ca　Al　Zn

7. Refer to the OCl_2 molecule:
   1) What is the electron arrangement around the central atom? (2%)
   2) What are the angles of the O-Cl bonds? (2%)

3) What is the shape of the molecule around the central atom? (2%)

4) Is the molecule polar or nonpolar? (2%)

8. Draw a molecular-orbital diagram for O_2 and N_2. (6%) Using molecular-orbital theory, explain why the removal of one electron in O_2 strengthens bonding (3%), whereas the removal of one electron in N_2 weakens bonding. (3%)

9. Draw the crystal field representations, that fits the transition metal atom in the following species, of d electrons in an octahedral field

1) $K_4Mn(CN)_6$ (assume strong field) (4%)

2) $Fe(OH_2)_6^{3+}$ (assume weak field) (4%)

10. For the reaction a A → products, use the following choices to select the reaction order(s) that best fit(s) the observations.

a) zero order in A　b) first order in A　c) second order in A
d) all of these　e) none of these

1) The half-life is constant. (3%)

2) A plot of [A] vs. *t* is a straight line. (3%)

11. Determine the molarity of a solution containing 4.00 g of sodium hydroxide (MW=40.0 g/mol) in 250.0 mL of solution. (5%)