※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. For the complete combustion of ethanol, the amount of heat produced, as measured in a bomb calorimeter, is 1364.5 kJ mol^{-1} at 298 K. Please calculate ΔH_c for the reaction. (10%)

2. Using the half-reactions to balance the following reaction (galvanic cell reaction) (10%)

$$MnO_4^{2-}{}_{(aq)} + Fe^{2+}{}_{(aq)} \longrightarrow Fe^{3+}{}_{(aq)} + Mn^{2+}{}_{(aq)}$$

3. Nitrogen gas can be prepared by using gaseous ammonia over solid copper (II) oxide at high temperatures. The other products of the reaction are solid copper and water vapor. If 18.1 g of NH_3 is reacted with 90.4 g of CuO, which is the limiting reactant? (5%) How many grams of N_2 will be formed? (Cu atomic mass: 63.5 g) (10%)

4. Please explain the buffered solution and how to prepare buffered solution. (10%)

5. A certain first-order reaction has a half-life of 20 minutes.
(1) Calculate the rate constant for this reaction (5%)
(2) How much time is required for this reaction to be 75% complete? (10%)

6. Does the alkalinity of a nature water (isolated from the surroundings) increase, decrease, or keep constant upon addition of small quantities of following: (a) HCl (b) $NaHCO_3$ (c) CO_2 (d) Na_2SO_4 and please explain the reasons for your answers. (10%)

7. Please evaluate the possibility of ground water contamination by an industrial site with chemical compounds in the contaminated soil. The properties of the compounds can be seen in the following table. (10%)

Compound	Vapor pressure (mm Hg)	Water solubility (mm L^{-1})	Soil sorption coefficient, K_{oc}
phenol	0.2	67,000	2
Styrene	9.5	280	120
Tetrachloroethane	5	2900	480
Chloropyrifos	1.9×10^{-5}	2	13,000

8. Please define Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD) and illustrate what's the difference between them? (10%)

9. Please calculate what's the volume of 0.5 M KOH needed for complete reaction with 1.0 L of 0.5 M H_3PO_4? (10%)