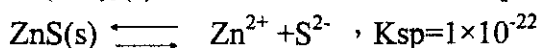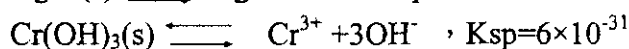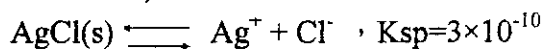環境化學部份

(一).You can calculate the soluble concentration of three metal ions at aqueous equilibrium with the solubility product as following. (molar concentration: mole/liter)

$AgCl(s) \rightleftharpoons Ag^+ + Cl^-$ ，$Ksp=3\times10^{-10}$

$Cr(OH)_3(s) \rightleftharpoons Cr^{3+} +3OH^-$ ，$Ksp=6\times10^{-31}$

$ZnS(s) \rightleftharpoons Zn^{2+} +S^{2-}$ ，$Ksp=1\times10^{-22}$

Which one has the lowest molar concentration?(12%)

(二).The conductivity of a wastewater is a measure of the total ionic strength to carry an electric current through a conductivity cell with a Wheatstone bridge. (14%)

(1)Please figure out the conductivity-measuring apparatus.

(2)The measured specific resistance ($R= \rho\dfrac{L}{A}$)

Shall be calculated to specific conductance ($\kappa = \dfrac{1}{\rho}$)

What is the normalized unit of specific conductance?

(三).Three chlorinated compounds were analyzed in a spent chemical manufacturer, An ping area, Tainan. Please Write ont their Chemical structure formula and Chinese name. (12%)

(1)Tri-Chloroethane (2)Penta-Chlorophenol (3)Tetra-Chloro-dibenzo p-dioxin.

(四).How to titrate the acidity and the alkalinity of a food-processing wastewater of soda water?The equivalent concentration shall be expressed as the unit.(12%)

環境化學部份

本試題是否可以使用計算機：☑可使用 ， □不可使用 （請命題老師勾選）

## Problem Sets for Environmental Microbiology

(五), **Tools to study microbial ecology.** The start of 21st century marks a period of revolutionary advancement in our ability to study microbial ecology. Please list 3 traditional and 3 molecular tools that can be used to study microbial ecology and comment on their advantages and disadvantages in studying microbial ecology. (8 pts)

Microbial growth kinetics. A strain of bacteria was grown in a batch culture on glucose and following data were obtained.

Time (h)	Cell Conc. (g/L)	Glucose (g/L)
0	1.25	100
9	2.45	97
16	5.1	90.4
23	10.5	76.9
30	22	48.1
34	33	20.6
36	37.5	9.38
40	41	0.63

a. Calculate the specific growth rate (4 pt)

b. Calculate the growth yield, $Y_{x/s}$. (4 pt)

c. What cell concentration could one expect if 150 g of glucose were used with same size of inoculum? (4 pt)

(六), **Biological Treatment Process.** An activated sludge system operated under the conditions presented below.

Q, S_0, X_0　　Q_e, S, X_e

X, V, S

Q_r, X_r, S

Q_w, X_w
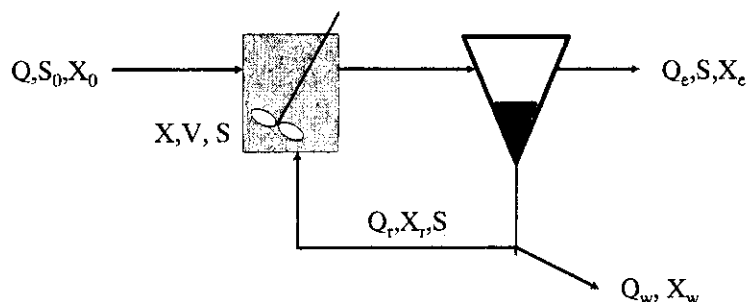
Q=flowrate=5 MGD
V=reactor volume = 1.4 MG
S_0=influent BOD = 150 mg/L
X_0=influent biomass concentration = 0 mg/L
S= BOD in reactor = 20 mg/L

Q_w=waste flowrate = 0.0615 MGD
Q_r=recycle flowrate = 1.25 MG
X_w=MLVSS in waste = 7000 mg/L
Q_e=effluent flowrate = 4.9385 MG

A. Define "mean cell residence time" (or sludge age) and calculate it (4 pt)
B. Define "F/M ratio" and calculate it (4 pt)
C. Calculate hydraulic retention time (4 pt)
D. Observed yield (hint: sludge wasted = sludge produced) and true yield (if k_d = 0.05 day^{-1}) (4 pt)
E. If mean cell residence time increased, will the sludge production rate increase, decrease, or remain the same? Explain your answer (4 pt)

(七), **Biological Nutrient Removal.** A wastewater with BOD = 120 mg/L, TKN 30 mg/L and total phosphorus = 12 mg-P/L. Sketch a treatment process flowsheet you might propose if (a) the phosphorus limitation is 1 mg/L and ammonia oxidation is required (5 pt). (b) to remove nitrogen to 2 mg-N/L and phosphorus to 1 mg-P/L (5 pt) (please provide explanations).