

一、請解釋或比較下列專有名詞：
(10%)

1. 廢棄物最終處置
2. 3T原則 (3T principle)
3. 產品生命週期 (life cycle)
4. 吸收 (absorption) 與 吸附 (adsorption)
5. 一級(或原生)空氣污染物 (Primary air pollutants) 和 二級(或衍生)空氣污染物 (Secondary air pollutants)

二、某工廠之鍋爐廢氣經檢測後，其 SO_2 及 O_2 之分壓分別為 0.3 mmHg 及 91.2 mmHg ，廢氣條件為 1 atm 及 250°C ，試計算
(12%)

- (1) SO_2 之濃度為多少 ppm?
- (2) SO_2 之濃度為多少 mg/Nm^3 ? (N表 0°C , 1 atm)
- (3) 此廢氣中 SO_2 濃度是否符合現行排放標準 500 ppm (含氧量為 6%)?

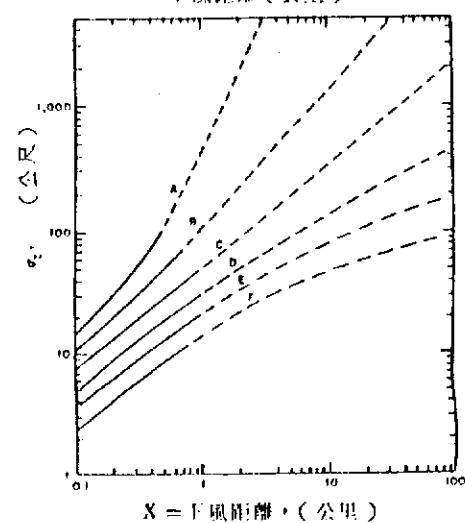
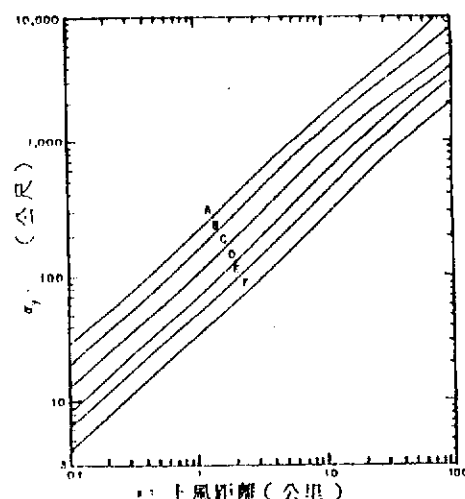
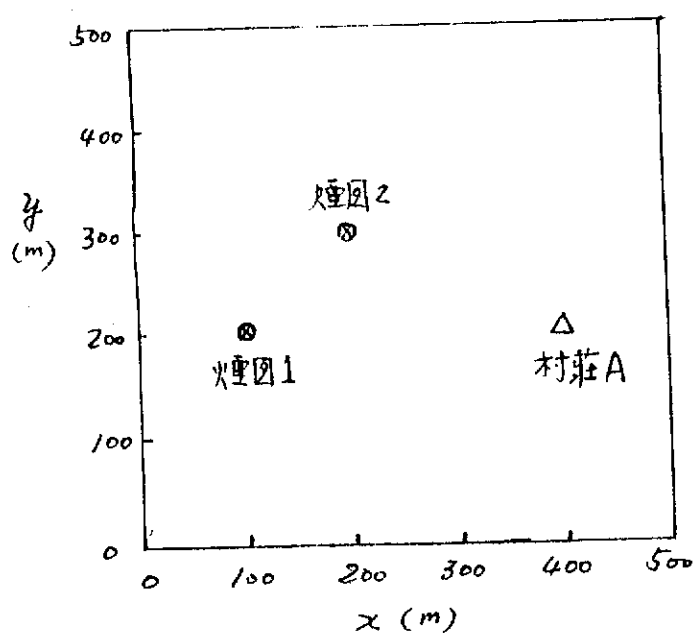
三、請以化學反應式描述下列現象：
(9%)

- (1) 光化學煙霧中 O_3 之生成
- (2) CFC 對臭氧層之破壞
- (3) 洗滌塔中 $\text{Ca}(\text{OH})_2$ 吸收液去除 SO_2 之過程

四、請說明廢棄物處理及管理之六種方式。
(6%)

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- 五. 某晴朗之夏日午後，吹正西風，平均風速為 4 m/sec (且假設風速在 10 公尺以上，即不隨高度而改變)，若已知煙囪 1 之有效高度為 15 公尺，煙囪 2 之有效高度為 20 公尺，試求下風處敏感地區村莊 A 之地面 SO_2 濃度為多少 mg/m^3 ？煙囪 1 及煙囪 2 之 SO_2 排放率分別為 0.01 及 0.02 Kg/sec ，大氣為 B 型穩定度。



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- 六. 何謂現代化自來水廠？其達成的策略為何？
(10%)

- 七. 某污水處理廠初沉池放流水 BOD_5 為 100 mg/l ，流量為 100 CMD ，曝氣槽大小為 $5 \text{ m} \times 2 \text{ m} \times 5 \text{ m}$ ， MLSS 為 4000 mg/l ，試求 $F/M = ?$ 操作員取出活性污泥 1 公升作污泥体积指標 (SVI) 實驗，結果 30 分鐘後沉降污泥体积為 200 ml ，試求 $\text{SVI} = ?$ 此污泥之沉降性是否良好？

八. 試列出好氧(aerobic)與厭氧(anaerobic)分解作用的基本方程式？假設某化合物分子式為 CH_2SNO_3 ，試列出好氧與厭氧反應之可能產物為何？

九. 請以流程圖表示焚化系統組成單元，並列出焚化處理方法之優劣點。

十. 危害性廢棄物之定義包含那四種特性？若採用掩埋處理時需注意那些安全的必要措施？

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一、試說明農藥(pesticides)在土壤表面與其中之三種主要分解方式(degradation ways)? (6%) 何謂酸度(acidity)與鹼度(alkalinity)。 (4%)

二、何謂微生物腐蝕(microbial corrosion)? (5%), 試畫圖說明之; 以鐵表面腐蝕為例說明。 (5%)

三、試畫簡圖表示下列滴定曲線(titration curve) (a) 強鹼(NaOH)滴定強酸 (b) 強鹼(NaOH)滴定弱酸(acetic acid) (c) 強酸(H_2SO_4)滴定弱鹼(sodium acetate) (10%)
(X軸: ml 酸或鹼; Y軸: pH)

四、已知過氯酸溶液($HClO_4$, perchloric acid) (a) $10^{-3} M$ (b) $10^{-8} M$, 求上述濃度之溶液 pH 值 (已知: $HClO_4 \rightleftharpoons H^+ + ClO_4^-$; $H_2O \rightleftharpoons H^+ + OH^-$, $K_w = 10^{-14}$) (10%)

五、何謂緩衝強度(buffer intensity)? 舉二個水化學方面應用例子說明。 (10%)

六、寫出下列農藥之結構式

(a) 2,4-Dichlorophenoxyacetic acid (2,4-D) (4%)

(b) 0,0-Diethyl-0-p-nitrophenylthiophosphate (parathion, 巴拉松) (4%)

(c) Isopropyl N-phenylcarbamate (IPC) (4%)

七、討論並比較上述(a)有機氯 (b)有機磷 (c)碳醯 三類農藥之「環境危害性」及「生物分解性」。 (8%)

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八、 CO_2 在 25°C 純水中之氣液平衡及第一解離反應式及平衡常數分別為

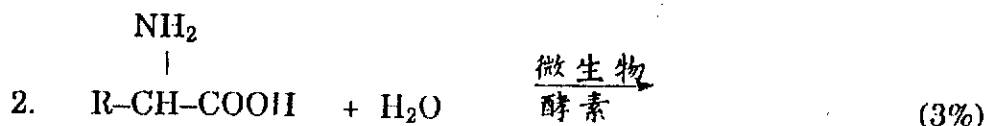
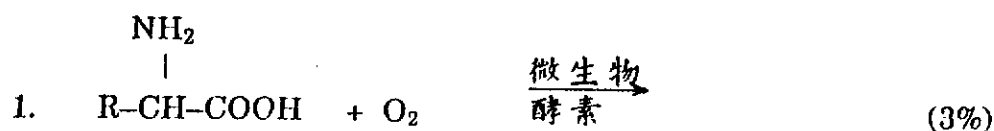
$$\text{CO}_2(\text{g}) = \text{CO}_2(\text{aq}) \quad K_c = \frac{\text{CO}_2(\text{aq}) (\text{moles / liter})}{\text{CO}_2(\text{g}) (\text{atm})} = 0.0373$$

$$\text{CO}_2(\text{aq}) + \text{H}_2\text{O} = \text{H}^+ + \text{HCO}_3^- \quad K_1 = \frac{[\text{H}^+][\text{HCO}_3^-]}{[\text{CO}_2(\text{aq})]} = 4.45 \times 10^{-7} (\text{liter/mole})$$

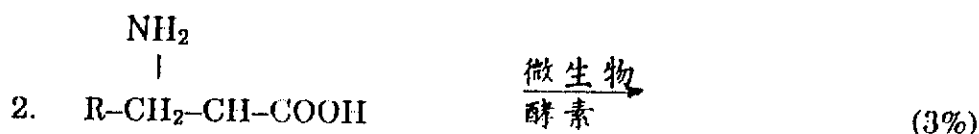
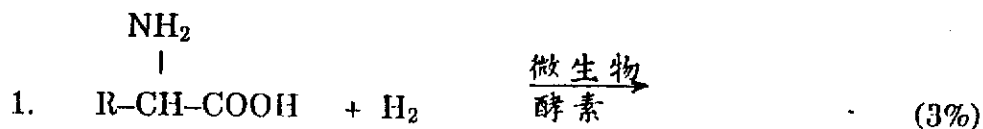
如大氣中 CO_2 之分壓為 0.00035 atm , 試估算該 CO_2 分壓平衡狀態下, 純水之氫離子濃度值。(10%)

九、試完成下列反應式:

(a) 胺基酸之喜氣脫胺 (deamination under aerobic conditions) 反應



(b) 胺基酸之厭氣脫胺 (deamination under anaerobic conditions) 反應



十、試寫出化學需氧量 (COD) 分析之: (a) 需用藥品 (b) 全部化學反應方程式。
(8%)

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1. Explain the following terms briefly:

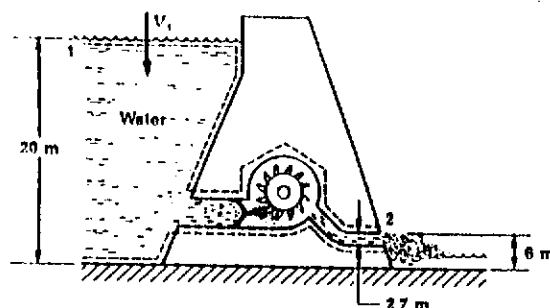
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|-----------------------------|------|
| (1) Reynolds number | (5%) |
| (2) Froude number | (5%) |
| (3) Weber number | (5%) |
| (4) Newtonian fluid | (5%) |
| (5) irrotational flow field | (5%) |

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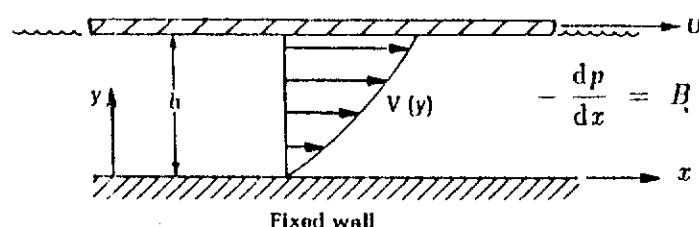
2. (15%) As is shown in the figure below, a turbine is used to convert the energy contained in a water reservoir into mechanical energy or shaft work at one atmosphere pressure. For the data given in the figure, determine the power in MW ($= 10^6 \text{ J/s}$) available to the turbine when the water discharge rate at the outlet is $30 \text{ m}^3/\text{s}$.

Notes: (1). Use the energy equation and neglect the friction losses.

(2). Density of water $\rho = 1,000 \text{ kg/m}^3$.

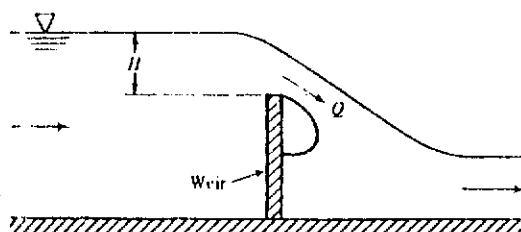


3. (15%) A parallel duct is formed by two infinite plates at a distance h , as is shown below. The upper plate is moving at speed U , while the lower one is fixed. There is an incompressible fluid of density ρ and viscosity μ in the duct subjected to a constant pressure gradient ($-dp/dx = B = \text{constant}$). Determine the steady-state, laminar, horizontal velocity profile $V(y)$.



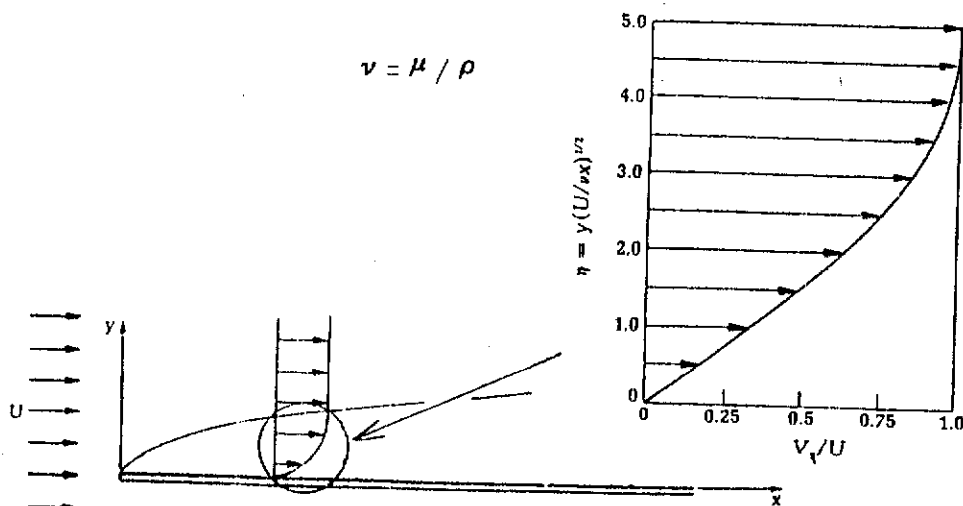
4. (15%) A weir is an obstruction in a channel which can be calibrated to measure flow rate, as is shown below. The volume flow rate Q varies with gravity g , weir width b into the paper, and upstream water height H above the water crest. If it is known that Q is proportional to b , use the pi theorem (or other dimensional analysis) to find the functional relationship $Q(g, b, H)$.

Note: You should first write out the units of Q, g, b, H .



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5. (15%) A sharp flat plate with length $L = 1.0$ m and width $W = 1.0$ m is immersed in and parallel to a stream of velocity $U = 0.1$ m/s, density $\rho = 1,000$ kg/m³, and viscosity $\mu = 0.01$ kg/m·s. The velocity profile (V_x/U) of the stream along the plate is given in the attached diagram shown below. Find the drag on one side of the plate.



6. (15%) By Darcy's law, the local flow velocity V of a groundwater in a homogeneous and isotropic soil or rock medium can be expressed as

$$V = -K \frac{dH}{dR}$$

where V : velocity

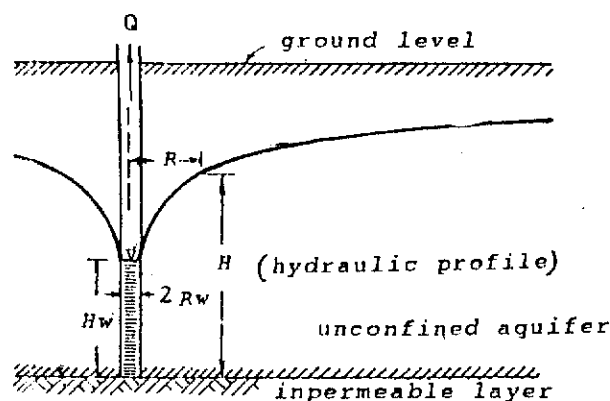
K : coefficient of permeability of the medium

H : hydraulic head or profile

R : radial distance.

If a well extracts a constant flowrate Q of groundwater from an unconfined aquifer as shown in the figure below, express the hydraulic profile (H) in terms of K , H_w , R_w , R , and Q .

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R_w : inner radius of the well

H_w : perforated height of well wall