國立雲林科技大學 **105** 學年度
碩士班招生考試試題

系所：環安系
科目：流體力學

1. 解釋名詞 (a) Newtonian fluid and non-newtonian fluid (b) Confined flow (c) Cavitation (d) Viscous region and inviscid region (20%)

2. 30℃水在一直徑 $D = 0.02527$ m 之銅管內以 285 L/min 的流率流動，30℃水的運動黏滯係數(kinematic viscosity) $\upsilon = 0.801*10^{-6}$ m²/s。試求其為層流(laminar flow)或紊流(turbulent flow)。(15%)

3. 有一不等管徑之管子，其內部有 70℃ 的水在流動，斷面 1 處之內徑為 50 mm，斷面 2 處內徑為 100 mm，已知在斷面 1 處的平均流速為 8 m/s，試求水在流至斷面 2 時之下列數值（70℃時水的密度為 978 kg/m³）。(15%)
   (a) 流速(V)　(b) 體積流率 (Volume flowrate)　(c) 重量流率 (Weight flowrate)　(d) 質量流率 (Mass flowrate)

4. 某礦物置於 4℃純水中，量其重量為 40 N，而在比重 0.85 之油中，則顯示其重量為 55 N，試求該礦物之體積(m³)與密度(kg/m³)。(15%)

5. 水處理程序之膠凝單元常使用速度梯度 G 值(單位為 1/s)進行設計，已知 G 為動力(power) P、槽體積(volume) V 與水動力黏滯係數(dynamic viscosity) μ 之函數，試以因次分析(dimensional analysis)法，推導 $G = \sqrt{\dfrac{P}{\mu V}}$。(15%)

6. Hazen-Williams equation $(V = 0.84935 C R^{0.63} S^{0.54})$ 常被用來計算管流之水頭損失，假如某水管管徑 600 mm、管長 700 m、C = 100 (a)當流量為 0.4 m³/s 時，試問其流經此水管之水頭損失(m)為何？ (b)假如該管線前端之高程為 65 m，壓力為 132 kN/m²，管線末端之高程為 71 m，試問管線末端之壓力(kN/m²)為何？ (20%)

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一、名詞解釋 (10 分，5 分/題)

1. Parasitism

2. Passive diffusion
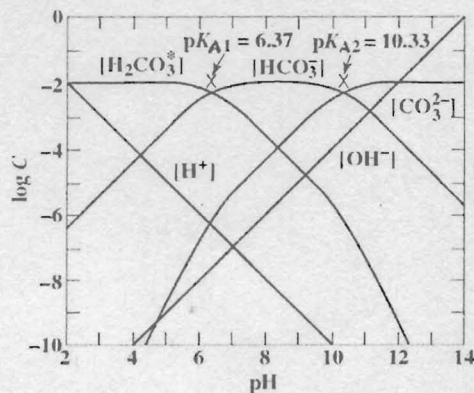
二、問答題與計算題 (共 90 分)

1. 請問 COD 實驗反應：

   (1) 亞鐵離子是重鉻酸鉀的還原劑，其反應方程式為何？(5 分)

   (2) 當加入硫酸汞時，為消除何種干擾？其反應方程式為何？(5 分)

   (3) 如未加入適量硫酸汞將導致 COD 之結果如何？(5 分)

   (4) 硫酸亞鐵銨忘記執行標定當量濃度，使用前兩周之標定濃度帶入計算，請解釋理由並說明導致 COD 之結果如何？(5 分)

2. 請說明 CFC 對臭氧層破壞的催化作用連鎖反應方程式為何？(5 分)又有 NO 存在時之促發反應為何？(5 分)

3. 於 25°C 下，加 $NaHCO_3$ 於水中至總濃度為 $10^{-2} M$，不計離子強度效應，請依下圖，圖解預測之 pH 為何？ (10 分)

4. 於 25°C 下，加 Na_2HPO_4 於水中至總濃度為 10^{-4} M，$K_{a1}=7.5\times10^{-3}$，
$K_{a2}=6.2\times10^{-8}$，$K_{a3}=4.8\times10^{-13}$ 設其完全溶解，請依序寫出

   (1) 質量平衡式(3 分)

   (2) 電荷平衡式(3 分)

   (3) 可能進行之反應及理由(4 分)

5. Sterilization 與 Disinfection 的差異為何？請各舉一種常見的處理方法。
(10 分)

6. 厭氧分解一般可分成哪三個階段，請說明之。(10 分)

7. 淨化過程主要可以分成微生物同化作用與微生物降解作用，後者的降解
機制有哪四項？(20 分)

Part A. Choose the correct answer.　(5 points/each)

Definition for question 1 to 5: A nonempty set V, any pair of whose elements can be added and each of whose elements can be multiplied by an arbitrary scalar of a set S, is a vector space over S if an only if for all $\vec{u}$, $\vec{v}$, and $\vec{w}$ in V and all a, b in S.

1. (　　) If $\vec{u} + \vec{v}$ is a membe of V, it is known as

    (1) V is closed under vector addition.
    (2) associative law of vector addition.
    (3) commutative law of vector addition.
    (4) existence of additive inverse.

2. (　　) If $\vec{u} + \vec{v} = \vec{v} + \vec{u}$, it is known as

    (1) V is closed under vector addition.
    (2) associative law of vector addition.
    (3) commutative law of vector addition.
    (4) existence of additive inverse.

3. (　　) To each $\vec{u}$ in V there corresponds a vector $-\vec{u}$ in V such that

    $\vec{u} + (-\vec{u}) = \vec{0}$, it is known as

    (1) V is closed under vector addition.
    (2) associative law of vector addition.
    (3) commutative law of vector addition.
    (4) existence of additive inverse.

4. (　　) If $a\vec{u} = \vec{u}a$ is a member of V, it is known as

    (1) V is closed under multiplication by scalars.
    (2) scalars distrtribute over vector addition.
    (3) vectors distribute over scalar addition.
    (4) associative law of multiplication by scalars.

5. (　　) If $(a + b)\vec{u} = a\vec{u} + b\vec{u}$, it is known as

    (1) V is closed under multiplication by scalars.
    (2) scalars distrtribute over vector addition.
    (3) vectors distribute over scalar addition.
    (4) associative law of multiplication by scalars.

6. (　) Which statement is wrong?

   (1) The rank of a zero matrix is 0.

   (2) The rank of a nonzero matrix A is the largest integer r+1 for which there exists an rth-order minor of A whose value is not zero.

   (3) The rank of a matrix is not altered by any sequence of elementary operations.

   (4) A matrix B is equivalent to a matrix A if an only if nonsingular matrices P and Q exist such that B = PAQ.

7. (　) Which statement is wrong?

   (1) Any nonsingular n×n matrix can be reduced to the identity matrix I_n by elementary row operations or, equally well, by elementary column operations.

   (2) Any nonsigular matrix of order n can be obtained by performing elementary row operations or, equally well, elementary column operations on I_n.

   (3) The m×n matrices are equivalent if and only if they have different ranks.

   (4) If P, Q are arbitrary nonsingular matrices with $P = Q^{-1}$, then $B = Q^{-1}AQ$ is a similarity transformation and B is similar to A.

8. (　) Which statement is wrong?

   (1) A quatratic which is definite, that is, is either positive-definite or negative-definite, is necessarily nonsigular.

   (2) A necessary and sufficient condition that the real quadratic form X^tAX be positive-definite is that every principal minor of A be positive.

   (3) A necessary and sufficient condition that the real quadratic form X^tAX be negative-definit is that every principal minor of A of odd order be positive and every principal minor of even order be negative.

   (4) The value of a Hermitian form is real for all values of its variables.

9. (　) Which statement is wrong?

   (1) A matrix is singular if and only if at least one of its characteristic values is zero.

   (2) If A is a square matrix, A and A^T have the same characteristic values.

   (3) If A and B are similar mtrices, then A and B have the same characteristic equation.

   (4) A characteristic vector of a square matrix can correspond to two distinct characteristic values.

10. (　) Which statement is wrong?

   (1) The characteristic values of a hermitian matrix are all real..

   (2) The characteristic values of a real symmetric matrix are all complex.

   (3) The characteristic values of a skew-hermtian matrix are all pure imaginary.

(4) Every n×n hermitian matrix has n linearly independent characteristic vectors.

Part B.　(10 points/each)

1. $x^2 y' + xy = 1$ --(10%)

2. $(x - y)dx + xdy = 0$　--(10%)

3. $y'' + y = 2x \sin x$　---(10%)

4. $\mathcal{L}^{-1}\left\{ \dfrac{s}{(s+1)^2} \right\}$ ---(10%)

5. Apply the Laplace transform method to solve following initial value problem.
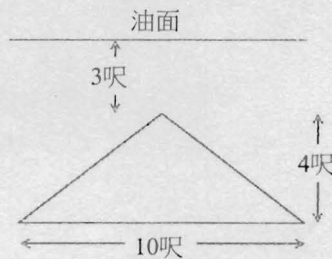$2y''' + 3y'' - 3y' - 2y = e^{-t}$, $y(0) = 0$, $y'(0) = 0$, $y''(0) = 1$ -----------------(10%)

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1. 求通過曲線 $x^2 + xy + y^2 = 3$ 上點 $(-1, -1)$ 的切線與法線的方程式？ (15%)

2. 求函數 $f(x) = x - x^{2/3}$ 在 $[-1, 2]$ 上的相對與絕對極值？ (15%)

3. 若 $y = \dfrac{(x^2 + 1)\sqrt{x + 5}}{x - 2}$，求 $\dfrac{dy}{dx}$？ (10%)

4. 求 $\displaystyle\int_0^1 \tan^{-1} x \, dx$？ (10%)

5. 求由拋物線 $y = x^2$ 與直線 $y = x$ 所圍成區域繞直線 $y = 2$ 旋轉所得旋轉體的體積？ (15%)

6. 底為 10 呎且高為 4 呎的等腰三角形平板垂直浸入油中，如下圖所示，若油的密度為 $\rho = 30$ 磅/立方呎，求正對平板表面的力？ (10%)

油面

3呎

4呎

10呎

7. 求 $\displaystyle\int_0^\infty x^6 e^{-2x} dx$？ (10%)

8. 計算 $\displaystyle\int_0^3 \int_{y^2}^9 y \cos x^2 \, dxdy$？ (15%)