國立中山大學102學年度碩士暨碩士專班招生考試試題

科目名稱：工程力學（含靜力與材力）【海工系碩士班甲組選考】　　題號：459001

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）　　

1. Please draw the shear force and bending moment diagrams of the beam shown in Fig. 1-(a). If the beam section is shown as Fig. 1-(b), and the factor of the safety is 1.5, please calculate the allowable normal stress of the material. (The weight of the beam is neglected, and). (30%)

2. A steel bar is fractured (as shown in Figure 2) under a pure torque applied at both ends. Please explain the failure mechanism of the bar. (give your theoretical reason of the failure). (20%)

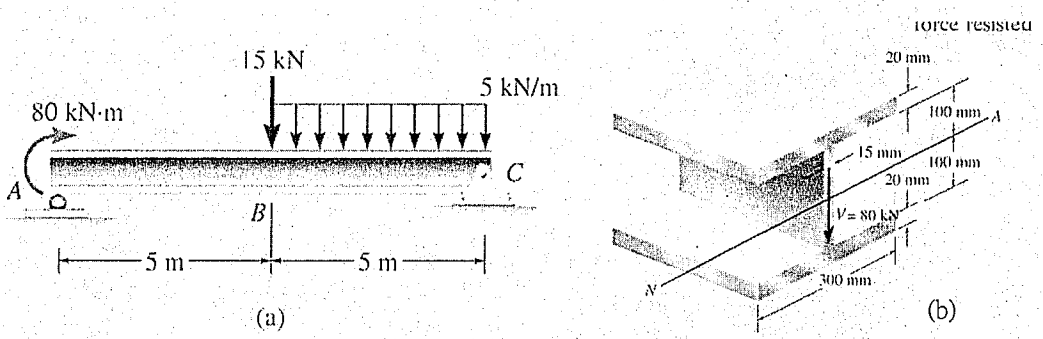


Fig. 1

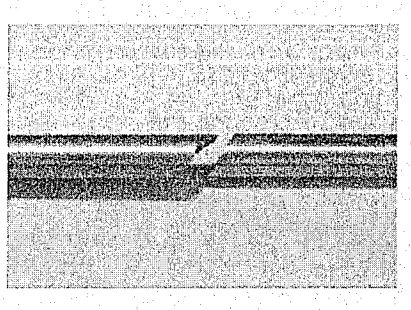


Fig. 2

3. The bar AB has a built-in support at A and is loaded by the forces as shown in Fig.3
   $\mathbf{F}_B = 2\mathbf{i} + 6\mathbf{j} + 3\mathbf{k}$ (kN),
   $\mathbf{F}_C = \mathbf{i} - 2\mathbf{j} + 2\mathbf{k}$ (kN).
   (a) Draw the free-body diagram of the bar. (10%)
   (b) Determine the reactions at A. (15%)

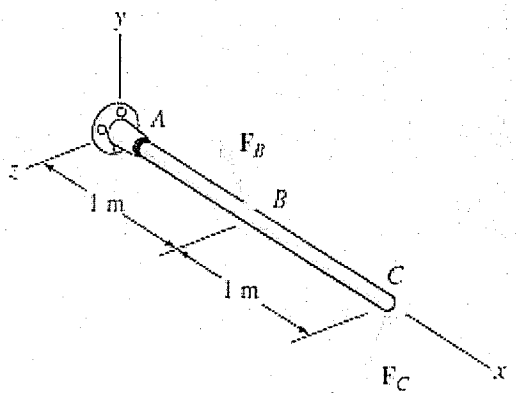


Fig.3

4. Determine the axial forces in the members in terms of the weight W as shown in Fig.4. (25%)

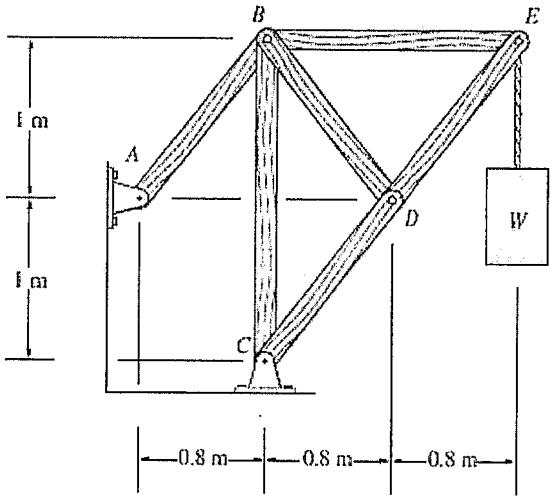


Fig.4

國立中山大學102學年度碩士暨碩士專班招生考試試題

科目名稱：流體力學【海工系碩士班甲組選考】　　題號：459002

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）　　

1. Explain the following terms: (10%)
   (1) No-slip condition (2) Irrotational flow (3) Energy grade line (4) Hydraulic jump (5) Pressure center

2. A 0.45 kg, 0.24 m-diameter, 0.3 m-tall cylindrical tank slides slowly down a ramp with a constant speed of 0.03 m/s as shown in Fig. 1. The uniform-thickness oil layer on the ramp has a viscosity of 0.01 Ns/m^2 . Determine the angle, θ, of the ramp. (15%)

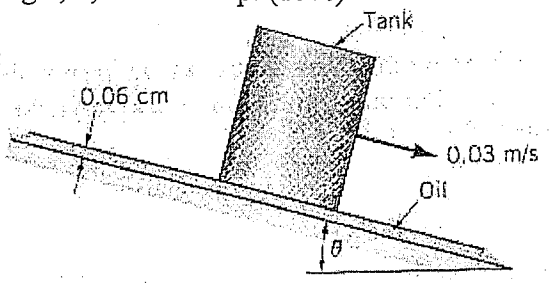


Fig. 1

3. A rectangular gate having a width of 1.2 m is located in the sloping side of a tank as shown in Fig. 2. The gate is hinged along its top edge and is held in position by the force P. Friction at the hinge and the weight of the gate can be neglected. Determine the required value of *P.* (15%)

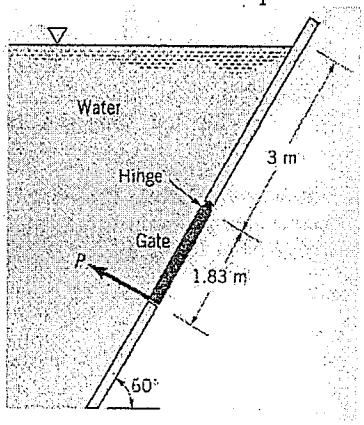


Fig. 2

4. A thin 1.2 m wide, right-angle gate with negligible mass is free to pivot about a frictionless hinge at point O, as shown in Fig. 3. The horizontal portion of gate covers a 0.3 m diameter drain pipe, which contains air at atmospheric pressure. Determine the minimum water depth, h, at which the gate will pivot to allow water to flow into the pipe. (15%)

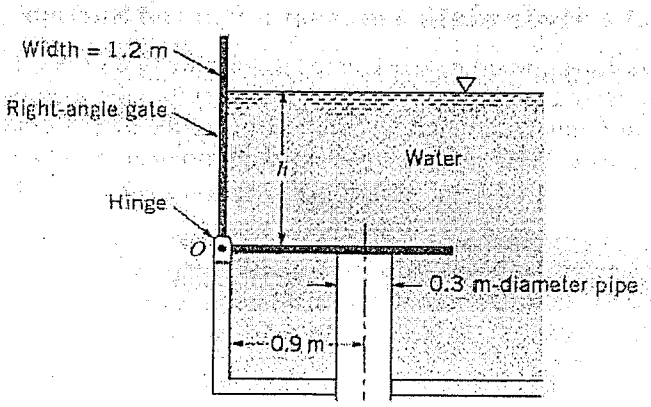


Fig. 3

5. A long water trough of triangular cross section is formed from two planks as is shown in Fig. 4. A gap of 0.25 cm remains at the junction of the two planks. If the water depth initially was 0.6 m, how long a time does it take for the water depth to reduce to 0.3m? (15%)

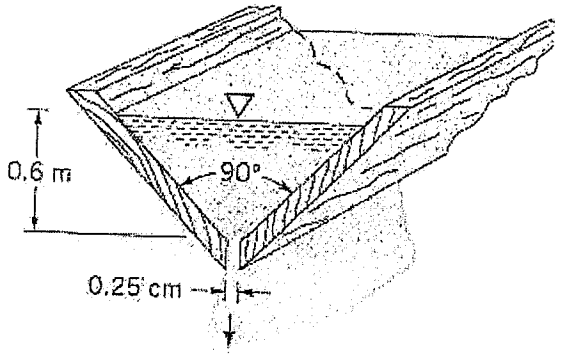


Fig. 4

6. Find a relationship between the acceleration of the cylinder cart and the variables shown in Fig. 5, neglect friction. The initial mass of the cart and water is Mo. (15%)

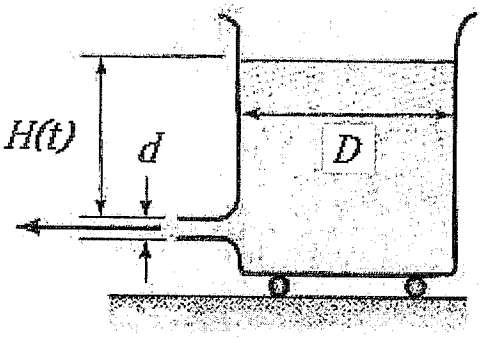


Fig. 5

7. Find the acceleration vector field where x, y, z are in meters. Evaluate the acceleration at (2, -1, 3) at t = 2s. (15%)

(a) $V = 2x\hat{i} - 2y\hat{j}$ m/s

(b) $V = x^2t\hat{i} + 2xyt\hat{j} + 2yzt\hat{k}$ m/s

(c) $V = x\hat{i} - 2xyz\hat{j} + tz\hat{k}$ m/s

國立中山大學102學年度碩士暨碩士專班招生考試試題

科目名稱：基礎環境科學【海工系碩士班乙組】　　題號：459005

※本科目依簡章規定「不可以」使用計算機　　

問答題：

1. 何謂自然資本(natural capital)？(20%)

2. 現今人類所面臨的二大核心環境問題為何？造成這些環境問題的基本成因為何？(20%)

3. 試分析台灣在水資源管理上有何問題存在？該如何解決？ (20%)

4. 面臨因全球暖化所導致的氣候變遷及極端氣候問題，因而致使「節能減碳」成為近來環境議題上的「顯學」，試問目前國際間發展出那些節能減碳的策略及技術？(20%)

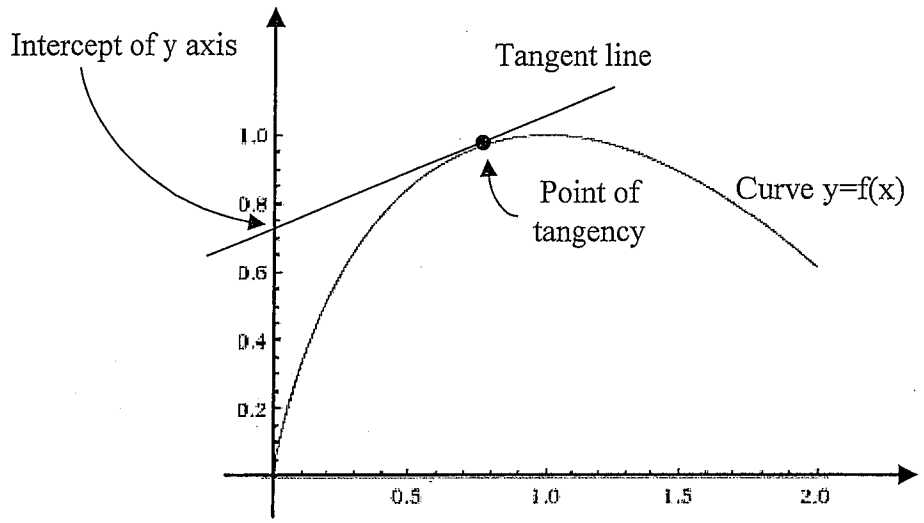
5. 何謂清潔生產(Cleaner Production)？何謂清潔發展機制(Clean Development Mechanism, CDM)？(20%)

國立中山大學102學年度碩士暨碩士專班招生考試試題

科目名稱：工程數學【海工系碩士班甲組】　　題號：459007

※本科目依簡章規定「不可以」使用計算機　　

1. [Ordinary Differential Equations] **(15%)**
A given curve $y = f(x)$ passes through the point (1, 1). The intercept of y axis for all the tangent lines of the curve are equal to the x coordinates of the points of tangency. Find the equation of the curve.



2. [Laplace Transform] **(10%)**
Use **two** different methods to find the inverse transformation $\mathcal{L}^{-1}[\frac{1}{s^4-4s^2}]$

3. [Linear Algebra] **(10%)**
Find the values of k so that the vectors $[1 \quad -2 \quad 3 \quad 2]$, $[2 \quad k+1 \quad 6 \quad 8]$, and $[-1 \quad 3 \quad 2k-1 \quad -1]$ are linearly independent.

4. [Vector Calculus] **(15%)**
Given the motion on the curve $\mathbf{r}(t) = \cos t\,\mathbf{i} + 2\sin t\,\mathbf{j}$, find the points (coordinates) with maximum speed and acceleration. Also find the tangential acceleration $\mathbf{a}_t$ of the motion.

5. [Fourier Series] **(15%)**
Find the Fourier series for a given function $f(x)$ with intervals specified:
$f(x) = x, \ -\pi < x < \pi,$
$f(x + 2k\pi) = f(x), \ -\infty < x < \infty$ and $k = \pm$integer.

6. [Residue Integration] **(10%)**
Evaluate the improper integral $\int_0^\infty \frac{dx}{1+x^4}$
with four simple poles at $z_1 = e^{\frac{\pi i}{4}}$, $z_2 = e^{\frac{3\pi i}{4}}$, $z_3 = e^{\frac{-3\pi i}{4}}$, $z_4 = e^{\frac{-\pi i}{4}}$ on a full circle.

7. [Partial Differential Equation] **(25%)**
(a) What are the names of the three types of PDE and a typical field of application in each type? (5%)
(b) Solve the following PDE using the Method of Separation of Variables: (20%)
$\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$, for $0 \le x \le L, \ t > 0;$
for the motion of a string released from rest, subject to
boundary conditions $u(0,t) = 0, \ u(L,t) = 0, \ t > 0;$ and
initial conditions $u(x,0) = f(x), \ \frac{\partial u(x,0)}{\partial t} = g(x) = 0, \ 0 < x < L.$

國立中山大學102學年度碩士暨碩士專班招生考試試題

科目名稱：環境微生物學與環境化學【海工系碩士班乙組】　　題號：459010

※本科目依簡章規定「不可以」使用計算機　　

1. 何謂格蘭氏染色(Gram Stain)?格蘭氏染色的原理為何？試簡述格蘭氏色的實驗步驟。(10%)

2. 何謂 bioaugmentation？何謂 biostimulation? 何謂 rhizoremediation？(10%)

3. 何謂 ANAMMOX 反應？廢水處理上有何應用？(10%)

4. 試求 2.4 g CH_3COOH 及 0.73g CH_3COONa 混合於一公升所成之溶液的 pH? (10%)
(Given: C=12; H=1; O=16; Na=23 g/mole; CH_3COOH 之氫解離常數為 1.8×10^{-5})(請注意:本題不需計算機，如計算太難，列出式子，填入式中數字，解釋如何可解出亦可，不需解出最後數字解)

5. 請說明測量需氯量之主要應用？(5%)請說明測量餘氯之主要應用？(5%)

6. 請說明何謂界面活性劑的增溶作用(solubilization) (5%)，及此一作用在環境復育之可能應用？(5%)

7. 在河流中的同一點，取兩個水樣做溶氧分析，一個水樣在收集後，立刻加以固定(fixation of oxygen)，另一個水樣則稍後在實驗室中處理，說出可能造成第二個水樣(未立刻加以固定)溶氧值偏低之原因(5%)；也請說出可能造成第二個水樣(未立刻加以固定)溶氧值偏高之原因(5%)

8. 有三組空白水樣，在 310 ml BOD 瓶中培養 5 天後，其溶氧量分別為 7.7, 7.8, 7.9 mg/l，而在含有 2, 5, 10 ml 廢水水樣之 BOD 瓶，其溶氧量(培養 5 天後)分別是 7.3, 4.5, 及 0.2 mg/l，若未稀釋水樣在第 0 天之溶氧量為 0.0 mg/l，試求此廢水最可能之 BOD_5 為多少？(12%)(請注意:本題不需計算機，紙筆即可計算)

9. 請寫出下列化合物的化學式或畫出結構式 (9 %) (1) 五氯酚 (2) 三氯乙烯 (3) 多氯聯苯

10. 解釋名詞 (1)腐植質(humic substance) (2)鹼度(alkalinity) (3) 化學需氧量(chemical oxygen demand) (9%)