國立中山大學100學年度碩士班招生考試試題

科目：工程力學（含靜力與材力）【海工系碩士班甲組選考】

1. According to Fig.1, please find the x coordinate of the centroid of the line. (15%)

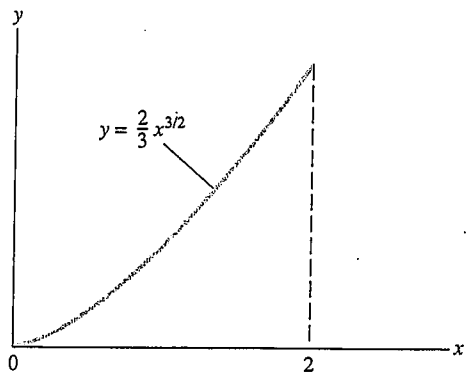


Fig.1

2. According to Fig.2 the masses m_1= 6 kg, m_2=12 kg are suspended by the cable system shown. The cable BC is horizontal. Please determine the angle α and the reactions at point P. (15%)

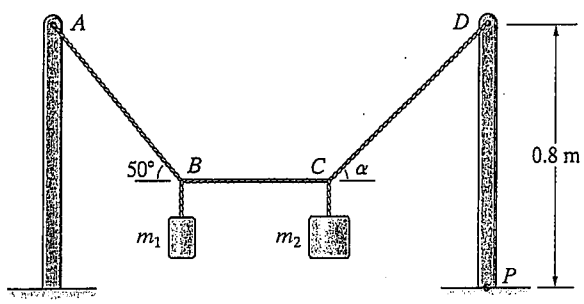


Fig.2

3. According to Fig.3, please find the axial forces in members AB, BC and CE. (20%)

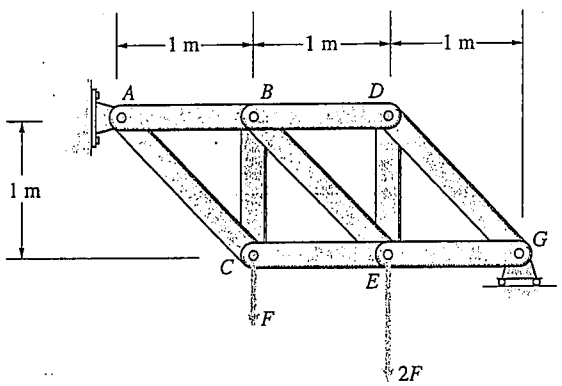


Fig.3

國立中山大學100學年度碩士班招生考試試題

科目：工程力學（含靜力與材力）【海工系碩士班甲組選考】

4. Please answer following terms: a. prismatic bar, b. proportional limit, c. Saint-Vennant's principle, d. stiffness. (20%)

5. Please draw shear and bending moment diagrams for the beam and loading shown. (10%) (Fig. 4)

6. A single horizontal force P of 150 lb magnitude is applied to end D of lever ABD. Determine (a) the normal and shearing stresses on an element at point H having sides parallel to the x and y axes, (b) the principal planes and principal stresses at the point H. (20%) (Fig. 5)

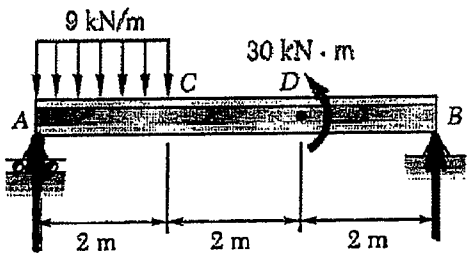


Fig. 4

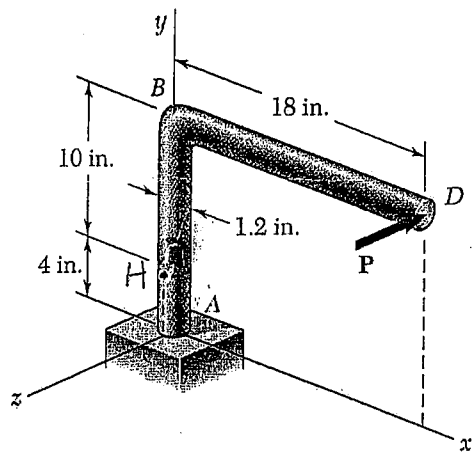


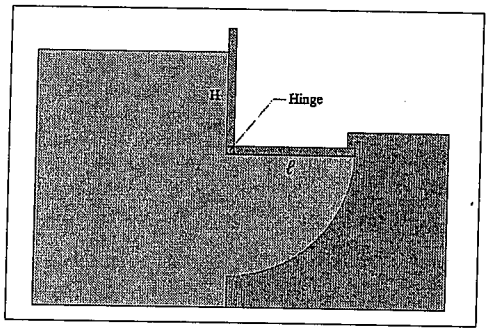
Fig. 5

國立中山大學100學年度碩士班招生考試試題

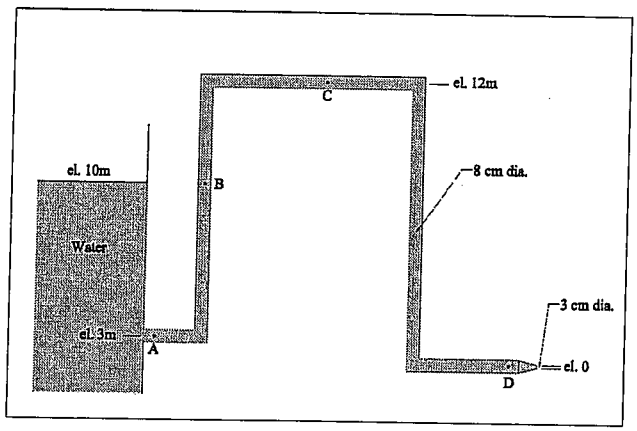
科目：流體力學【海工系碩士班甲組選考】

20% 1. Explain the following terms:
(1) Reynolds number (2) Froude number (3) total energy (4) friction loss
(2) Minor loss

20% 2. For the gate show in the figure calculate the height H that will result in the gate opening automatically. Assume $\ell = 2.0\ m$ and neglect the weight of the gate)



20% 3. The overall loss coefficient for the pipe shown in figure; up to A it is 0.8, from A to B it is 1.2, from B to C it is 0.8, from C to D it is 2.2. Estimate the flow rate and the pressure at A, B, C and D. (loss $h_L = \mathrm{k}\dfrac{V^2}{2g}$ where k is coefficient)



20% 4. A 1:20 scale model of a ship is used to test the resistance of water on the prototype ship. A drag of 10 N is measured at a model speed of 2.4 m/s. What speed is for the prototype ship? And how much is the total drag forces on the prototype ship. Neglect viscous effect and assume the same fluid for model and prototype.

20% 5. There are three very important laws for fluid mechanics to deal with the fluid problems such as the (1) conservation of mass (or continuity equation), (2) conservation of momentum, and (3) conservation of energy. Write their equations and explain how to apply them in the problems.

國立中山大學100學年度碩士班招生考試試題

科目：工程數學【海工系碩士班甲組】

1. 【Ordinary differential equations】20%

   (a) Solve the IVP $x^2y'' + 3xy' + y = 0,\ y(1) = 4,\ y'(1) = -2$ (10%)

   (b) Solve $y' + 4x^2y = (4x^2 - x)e^{-x^2/2}$ (10%)

2. 【Laplace transform】10%

   Solve the IVP $y'' + 2y' + 2y = e^{-t} + 5\delta(t-2),\ y(0) = 0,\ y'(0) = 1$, where δ is the unit impulse function.

3. 【Linear algebra】10%

   Given $\mathbf{A} = \begin{bmatrix} 5 & 4 \\ 4 & 11 \end{bmatrix}$ in an elastic deformation $\mathbf{y} = \mathbf{Ax}$, find the principal directions and corresponding factors of extension or contraction.

4. 【Vector calculus】10%

   Calculate the work integral $\int_C \mathbf{F}(\mathbf{r}) \bullet d\mathbf{r}$, if $\mathbf{F} = [e^x \quad e^y]$ is a force and the work is done in the displacement clockwise along the circle with center (0, 0) from (1, 0) to (0, –1).

5. 【Partial differential equation】10%

   Partial differential equations (PDE) may be classified as elliptic, parabolic or hyperbolic type.

   (a) Give the general expression of a second-order linear PDE for variable $u(x, y)$ or $u(x,t)$. (3%)

   (b) Give the criterion and solution (root) for each type of the PDE. (3%)

   (c) Give one example of the mathematical equation and the common name for this equation in each type of the PDE mentioned above. (4%)

6. 【Method of separation of variables】15%

   Apply the method of separation of variables to find all possible solutions for the PDE $u_{xx}^2(x, y) = u_y(x, y)$, where subscripts $(_{xx})$ and $(_y)$ denote partial differentiation.

   [Note: We may explicitly include the constant coefficients in the proposed solutions, because boundary conditions are not specified.]

7. 【Complex variables and Cauchy-Riemann equation】10%

   (a) Given function $w = f(z) = u(x, y) + iv(x, y)$ in a complex domain, and the Cauchy-Riemann equations can be defined as $u_x = v_y$ and $u_y = -v_x$, where subscripts $(_x)$ and $(_y)$ denote partial differentiation. Is $f(z) = z^3$ analytic? (5%)

   (b) Let $w = f(z) = z^2 + 3z$. Find u and v, and calculate the value of f at $z = 1 + 3i$ (5%)

國立中山大學100學年度碩士班招生考試試題

科目：工程數學【海工系碩士班甲組】

8. 【Fourier analysis】15%

Given a Fourier series for a periodic function by:

$$f(t)=\begin{cases}0, & -\pi<t<0,\\ t, & 0<t<\pi,\end{cases}$$

(a) Sketch the given function graphically and determine its period. (5%)

(b) Express the approximate solution in expanded form to the term including $n=4$. (10%)

國立中山大學100學年度碩士班招生考試試題

科目：基礎環境科學【海工系碩士班乙組】

一、解釋名詞：(40%，每小題 4 分)

1. sustainable development
2. biodiversity
3. industrial ecology
4. ecotone
5. carbon footprint
6. carbon trade
7. carbon tax
8. green building
9. blue carbon
10. hypoxic zone in marine environment

二、問答題：(60%)

1. 試列舉並詳細說明，目前我們所生存的地球所面臨的任何三項重大環境議題。(15%)

2. 何謂自然資本(natural capitals)？試分別說明及比較熱帶雨林、濕地及珊瑚礁等生態系之自然資本包括那些？(15%)

3. 何謂 UNFCCC? IPCC? CDM? REDD? Blue Carbon for Carbon Remission ? (15%)

4. 人類在面對氣候變遷下不斷帶來劇烈災害，因此需進行 adaptation 及 resilience。何謂 adaptation 及 resilience？在劇烈的氣候變化下，大高雄地區分別接連在 2009 及 2010 年發生「八八風災」及「九一九水災」，以至於造成郊區土石崩落而使小林村滅村，以及市區淹大水等巨大災變。在高雄縣市合併之後，為因應全球氣候變遷，對於新市府，請提出你對於水資源管理方面的 adaptation 及 resilience 策略之建議。(15%)

國立中山大學100學年度碩士班招生考試試題

科目：環境微生物學與環境化學【海工系碩士班乙組】

1. 在一固定基質量的培養瓶中，試繪出微生物(細菌)生物質量對時間的生長曲線圖，並對照出基質(以 BOD 表示)對時間的變化曲線圖。該圖中生長曲線的三個階段名稱為何？並由該三個階段，試分別說明每一階段各適合應用於何種不同型式的活性污泥法中，以及其原理。(15%)
2. 試問在檢測飲用水水質，可做為指標微生物的檢測方法包括那些項目？試分別說明其應用的時機及優缺點。(8%)
3. 何謂優養化？造成優養化的原因為何？優養化會造成什麼結果？引發何種環境問題？有那些微生物種類會參與優養化的過程？該如何防止優養化？(7%)
4. 含有酚(C_6H_5OH) 300mg/l 之水樣，其理論需氧量(Theoretical Oxygen Demand)值為多少？ (8%)
5. 請比較下列三種消毒方式的優缺點(1)次氯酸鈉(NaOCl)(2)ClO_2 (3)O_3。(8%)
6. 廢水中含 0.2M 鎘離子(Cd^{2+})，欲藉調整 pH 值使其濃度降低至 $2x10^{-4}M$, 請問 pH 值需調至多少？($Cd(OH)_2$ 的 K_{sp} 為 $2x10^{-14}$) (8%)
7. 試說明環境水質分析結果的可能誤差來源。 (8%)
8. 何謂緩衝溶液(buffer solution)?試舉一例說明其在環境工程之應用。(8%)
9. 試說明水中 pH 值與腐植質對金屬自沉積物中釋出之影響。(6%)
10. 試說明哪些因素會影響 BOD 試驗之生化氧化速率。(6%)
11. 試說明如何判定一化學反應是否會自然發生(spontaneous)。(6%)
12. 解釋名詞 (1)環境荷爾蒙(environmental hormones) (2)色層分析法(chromatography) (3) 吸附等溫線(adsorption isotherm) (12%)

國立中山大學100學年度碩士班招生考試試題

科目：海洋及海岸管理概論【海工系碩士班丙組選考】

一、 解釋名詞 **20%** (每小題 **4** 分，請解釋以下之詞句，非英翻中!!)

1. Carrying Capacity
2. Marine Protected Area Networks
3. Wetland
4. Convention on the Law of the Sea
5. Coastal Zone

二、 問答題 **80%**

1. 何謂「整合性海岸管理」？(5%) 並請說明「整合性海岸管理」存在之義意與重要性。(5%)

2. 請列舉海岸地區可能涉及之相關機關與法令有哪些？(10%) 並說明臺灣在制訂海岸法 (現為草案階段) 之過程所面臨之挑戰與問題。(10%)

3. 請您以圖示方式說明下列海域區劃名詞所表示之區位及重要性：
   1) 專屬經濟區(Exclusive Economic Zone)；(5%)
   2) 臨接區 (Contiguous Zone)；(5%)
   3) 領海 (Territorial Sea)；(5%)
   4) 臺灣海岸法(草案)所定義之海岸地區。(5%)

4. 請您評估臺灣何處應劃設為海洋保護區？(10%) 並請詳細說明您的評估依據。(10%)

5. 何謂「自然海岸零損失政策」？(5%) 請您以此政策之理念為出發，說明台灣海岸之特性，以及該如何達成海岸地區之永續發展策略？(5%)

國立中山大學100學年度碩士班招生考試試題

科目：線性代數【海工系碩士班丙組選考】

(1) (20%) Given a matrix $\mathbf{A}=\begin{bmatrix}1 & 2 & -9\\ -2 & -4 & 19\\ 2 & -1 & 2\end{bmatrix}$. (a) Find the trace and the determinant of **A**. (10%)

(b) Find the inverse of **A**, that is $\mathbf{A}^{-1}$. (10%)

(2) (20%) Given the matrix $\mathbf{A}=\begin{bmatrix}1 & 2 & 3 & 4\\ 2 & 3 & 4 & 5\\ 3 & 4 & 5 & 6\\ 4 & 5 & 6 & 7\end{bmatrix}$. (a) Find the rank of matrix **A**. (10%) (b) Consider the linear system $\mathbf{Ax}=\mathbf{0}$, where **A** is given above, Find a null space of matrix **A** and its nullity. (10%)

(3) (30%) Given a matrix $\mathbf{A}=\begin{bmatrix}-6 & -6 & 10\\ -5 & -5 & 5\\ -9 & -9 & 13\end{bmatrix}$. (a) Find the eigenvalues and the corresponding eigenvectors. (15%) (b) Diagonalize the matrix **A**, and calculate $\mathbf{A}^5$. (15%)

(4) (15%) Transform the quadratic form $6x_1^2+16x_1x_2-6x_2^2=20$ to the principal axes y_1 and y_2. Express $\mathbf{x}^T=[x_1 \quad x_2]$ in terms of the new coordinate vector $\mathbf{y}^T=[y_1 \quad y_2]$, such as $\mathbf{x}=\mathbf{Ty}$.

(5) (15%) The Leslie model describes age-specified population growth. Let the oldest age attained by the females in some animal population be 9 years. Divide the population into three classes of 3 years each. Let the "Leslie matrix" be $\mathbf{L}=[l_{jk}]$, where l_{1k} (the 1st row vector) is the average number of daughters born to a single female during the time she is in age class k, and $l_{j,j-1}\,(j=2,3)$ is the fraction of females in age class *j-1* that will survive and pass into class *j*. What is the number of females in each class after 3, 6, 9 yeárs if each class initially consists of 400 females? The Leslie matrix is shown following. (Hint: consider 3 years is one period for population change)

$$\mathbf{L}=\begin{bmatrix}0 & 2.3 & 0.4\\ 0.6 & 0 & 0\\ 0 & 0.3 & 0\end{bmatrix}$$

國立中山大學100學年度碩士班招生考試試題

科目：統計學【海工系碩士班丙組選考】

第一部份：數學公式/簡要說明題 【50%】

1. (10%)(各 5%)

(a) 以標題方式簡述統計學的五大主要內容。

(b) 以標題方式簡述"假設與檢定"的五大步驟。

2. (10%)(各 5%)

假設大樣本隨機抽樣 x_i ($i=1\sim N$)之樣本個值出現機率符合常態分佈 $N(\bar{x},\sigma)$；式中 $\bar{x}$ 為樣本平均數，σ為樣本標準偏差。

(a) 機率密度函數 $p(x)$的數學式為何？

(b) 在以 $z_i=(x_i-\bar{x})/\sigma$ 標準化後的對稱常態分佈圖上，z_i 在 $\pm\sigma, \pm2\sigma$ 及 $\pm3\sigma$ 的三個區間的累積機率各若干%?

3. (10%)(各 5%)

(a) 機率統計最常使用的四種機率分配名稱及其數學代表式？

(b) 分別簡述上述四種機率分配的主要應用目的。

4. (10%)(各 5%)

在假定一個 "顯著水準"α值後，可依樣本（N）大小及樣本標準偏差σ之已知或未知情況，選擇一種適當的機率分配，估計樣本平均數或變異數之信賴區間。

(a) N 大時，樣本平均數及變異數之信賴區間數學式各為何?

(b) N 小時，樣本平均數及變異數之信賴區間數學式各為何?

5. (10%)(各 5%)

(a) 何謂「盒鬚圖」(box-plot)？簡述其定義並繪圖表示。

(b) 若代表某觀測值之依變數 y_i 與其相對的自變數 x_i 有線性迴歸關係 $\hat{y}_i=\hat{\beta}_0+\hat{\beta}_1x_i$，繪圖表示 $\hat{\beta}_0$ 及 $\hat{\beta}_1$。

第二部份：計算題 【50%】

6. (15%)【使用 t 附表】

某考研究所補習班宣稱其甲課程學員在修課後可增加該學科的考試成績。今隨機抽取 6 位學員，得知在修課前後之成績如下：

學　員：	1	2	3	4	5	6	平均數
修課前：	60	50	63	64	53	66	μ_1
修課後：	63	58	65	69	60	70	μ_2

假設上列學員成績屬常態分佈，修課前後之母體平均數各為μ_1及μ_2；

以適當的假設與檢定，求 ($\mu_1-\mu_2$) 在 $\alpha=0.05$ 之信賴區間。

7 (15%)【使用 F 附表】

某大學波浪能量實驗室測定四組不同功率轉換配置的發電量，每組各重複 6 次試驗，結果在計算後填入 ANOVA 表如下（部份缺項）。請以 $\alpha=0.05$ 及適當的假設，檢定所有試驗的發電量是否不同，並作簡要結論。

變異來源	平方和	自由度	均方差	拒絕區(CR)	備註
組間 SSC	382.79			計算值 F_0 = ??	
組內 SSE		20		表列值 F_0 = ??	
總變異 SST	512.96				

8. (20%)【使用 χ^2 附表】(各 10%)

由常態分配中隨機抽取 16 個樣本，得到 $\sum x=36$ 及 $\sum x^2=351$。

(a)求母體變異數在信賴係數95%時之信賴區間；(b)以 $\alpha=0.05$ 檢定該母體變異數是否不等於 28。

國立中山大學100學年度碩士班招生考試試題

科目：統計學【海工系碩士班丙組選考】

$t(\nu)$ 附表

TABLE 2.11 Critical Values of t for ν Degrees of Freedom and Selected Levels of Significance

Number of Degrees of Freedom, ν	Significance Level, α (%)					
	10	5	2.5	1	0.5	0.1
1	3.078	6.314	12.706	31.821	63.657	318.310
2	1.886	2.920	4.303	6.965	9.925	22.327
3	1.638	2.353	3.182	4.541	5.841	10.215
4	1.533	2.132	2.776	3.747	4.604	7.173
5	1.476	2.015	2.571	3.365	4.032	5.893
6	1.440	1.943	2.447	3.143	3.707	5.208
7	1.415	1.895	2.365	2.998	3.499	4.785
8	1.397	1.860	2.306	2.896	3.355	4.501
9	1.383	1.833	2.262	2.821	3.250	4.297
10	1.372	1.812	2.228	2.764	3.169	4.144

$F(\nu_1, \nu_2)$ 附表

TABLE 2.14a Critical Values of F for ν_1 and ν_2 Degrees of Freedom and 5% ($\alpha = 0.05$) Level of Significance

Degrees of Freedom for Denominator, ν_2	Degrees of Freedom for Numerator, ν_1												
	1	2	3	4	5	6	7	8	9	10	12	15	20
1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54	241.88	243.91	245.95	248.01
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.84	2.77
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12

$\chi^2(\nu, \alpha)$ 附表

ν \ α	.995	.990	.975	.950	.900	.500	.100	.050	.025	.010	.005
1	.00+	.00+	.00+	.00+	.02	.45	2.71	3.84	5.02	6.63	7.88
2	.01	.02	.05	.10	.21	1.39	4.61	5.99	7.38	9.21	10.60
3	.07	.11	.22	.35	.58	2.37	6.25	7.81	9.35	11.34	12.84
4	.21	.30	.48	.71	1.06	3.36	7.78	9.49	11.14	13.28	14.86
5	.41	.55	.83	1.15	1.61	4.35	9.24	11.07	12.83	15.09	16.75
6	.68	.87	1.24	1.64	2.20	5.35	10.65	12.59	14.45	16.81	18.55
7	.99	1.24	1.69	2.17	2.83	6.35	12.02	14.07	16.01	18.48	20.28
8	1.34	1.65	2.18	2.73	3.49	7.34	13.36	15.51	17.53	20.09	21.96
9	1.73	2.09	2.70	3.33	4.17	8.34	14.68	16.92	19.02	21.67	23.59
10	2.16	2.56	3.25	3.94	4.87	9.34	15.99	18.31	20.48	23.21	25.19
11	2.60	3.05	3.82	4.57	5.58	10.34	17.28	19.68	21.92	24.72	26.76
12	3.07	3.57	4.40	5.23	6.30	11.34	18.55	21.03	23.34	26.22	28.30
13	3.57	4.11	5.01	5.89	7.04	12.34	19.81	22.36	24.74	27.69	29.82
14	4.07	4.66	5.63	6.57	7.79	13.34	21.06	23.68	26.12	29.14	31.32
15	4.60	5.23	6.27	7.26	8.55	14.34	22.31	25.00	27.49	30.58	32.80
16	5.14	5.81	6.91	7.96	9.31	15.34	23.54	26.30	28.85	32.00	34.27
17	5.70	6.41	7.56	8.67	10.09	16.34	24.77	27.59	30.19	33.41	35.72
18	6.26	7.01	8.23	9.39	10.87	17.34	25.99	28.87	31.53	34.81	37.16

國立中山大學100學年度碩士班招生考試試題

科目：微積分【海工系碩士班丙組選考】

Part 1: Differentiation and limits (50%)

1. (20%) Find the limit for each of the following questions **(5% each)**:

(a) $\lim_{x\to 2+}\frac{\ln(2x-3)}{x^2-4}$; (b) $\lim_{x\to\infty}\frac{2x-1}{\sqrt{3x^2+x+1}}$;

(c) $\lim_{x\to\infty}x^{1/x}$; (d) $\lim_{x\to 0+}\frac{\sin x}{x}$;

2. (10%) Find $\frac{du}{dt}$, given $u=x^2+2xy+y^2$ where $x=t\cos t$ and $y=t\sin t$.

3. (10%) Assume $u=f(x)$ and $v=f(x)$, and are differentiable at $x=0$, together with boundary conditions $u(0)=4$, $u'(0)=-3$, $v(0)=-2$ and $v'(0)=1$. Find:

(a) A complete mathematical expression for u and v; **(5%)**

(b) The numerical value of $\frac{d}{dx}\left(\frac{v}{u}\right)$. **(5%)**

[Note: The primes (') denote differentiation with respect to x.]

4. (10%) Sand is falling into a conical pile at the constant rate of 1.25×10^{-3} m^3 per second. If the height of the pile is always twice the radius of the base, determine the rate of increase in height when the pile is 0.3 m high?

[Note: The volume of the cone (pile) at any time can be expressed as

$V=\frac{1}{3}\pi R^2 h$, where R is the radius and h is vertical height.]

Part 2: Integration (50%)

5. (10%) Evaluate $\int\left(x^2\sqrt{x^3+4}\right)dx$

6. (10%) Evaluate $\int_0^1\left(x\tan^{-1}x\right)dx$

7. (10%) Evaluate $\int\left(x^{1/3}+x^{1/2}\right)^{-1}dx$

8. (10%) Evaluate $\frac{d}{dx}\int_{2x}^{x^2}u(1+u^2)^3\,du$

9. (10%) Find the area of the region bounded by the graph of

$y(x)=\frac{2x}{\sqrt{x^2+9}}$, with $y=0$, $x=0$ and $x=4$.