

國立中山大學九十學年度碩博士班招生考試試題

科目：工程數學【海環工系碩士班】甲組

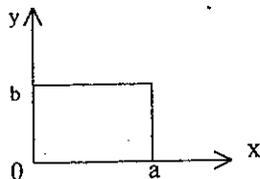
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1. 求解常微分程式 $(x^2 + 1)\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = 6(x^2 + 1)^2$ (20%)

2. 利用座標旋轉標準化二次曲面 $7x^2 - 8y^2 - 8z^2 + 8xy - 8xz - 2yz + 9 = 0$ ，並求出旋轉後的座標軸與原卡氏直角座標 x, y, z 軸的關係式（此題即求特徵值與特徵向量者）。(20%)

3. 導證 Stoke's (Curl) Theorem: $\iint_s (\text{curl } \vec{V}) \cdot \vec{n} dA = \oint_c \vec{V} \cdot \vec{ds}$, $\vec{V}(x, y, z)$ 為可微分的向量函數， s 為 \vec{V} 所在領域的中的一連續曲面，封閉曲線 c 為 s 之一邊界線， \vec{n} 為 s 的法線單位向量， \vec{ds} 為 c 上之弧長基素向量， dA 為 s 上的面積基素；並求 $\vec{V} = y\vec{i} + (x - 2xz)\vec{j} - xy\vec{k}$ 在 xy 平面上之上半球面 $x^2 + y^2 + z^2 = a^2$ ($a > 0$ 為半徑) 上之 $\iint_s (\text{curl } \vec{V}) \cdot \vec{n} dA$ 值。(此題以導證為主) (20%)

4. 求解如下圖所示之長方形領域中的波動方程式 $\frac{\partial^2 u}{\partial t^2} = c^2 \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right)$ 之解 u, c 為波速。(20%)
 起始條件： $u(x, y, 0) = f(x, y)$ ，在開始時間 $t = 0$ 時之起始位移
 $\left. \frac{\partial u}{\partial t} \right|_{t=0} = g(x, y)$ ，在開始時間 $t = 0$ 時之起始速度
 邊界條件： $u = 0$ ，在所有的邊界處（於任何時間 $t \geq 0$ 時）。



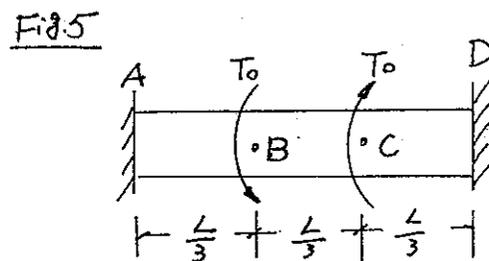
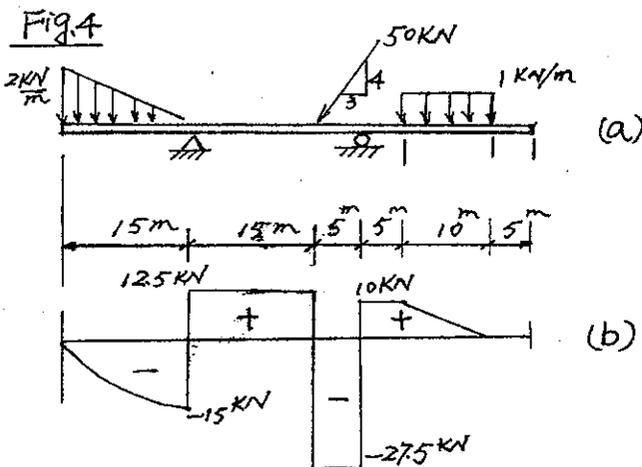
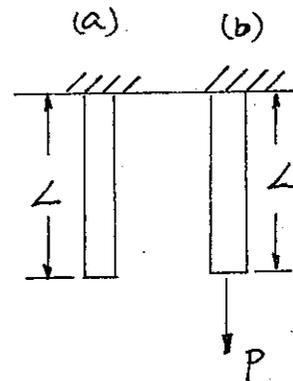
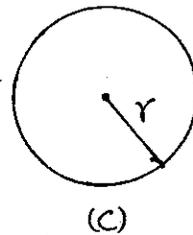
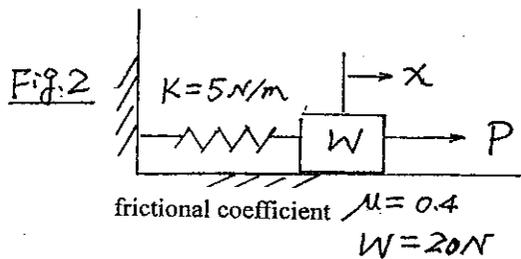
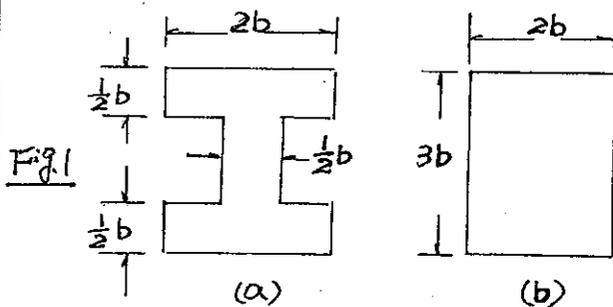
5. 導證複變函數理論中之半平面的 poisson 公式 (poisson formula for the half plane)，並求已知在 x 軸處函數 $f = \cos x$ ，則在半平面中之 $f(x, y) = ?$ (20%)

國立中山大學九十學年度碩博士班招生考試試題

科目：工程力學【海環工系碩士班】甲組

共 / 頁 第 / 頁

1. As shown in figure 1 are three cross sections of a beam, knowing that the areas are the same for all sections, please compare the flexural capacities in terms of the moment of inertia of an area for these three cross sections. (25%)
2. Figure 2 shows a block of weight W connected to a spring of stiffness K . Please (a) find the minimum force P required to move this block if the previous extension on the spring is 2 m, and (b) draw a curve for the P - X for P up to 20 N when the initial displacement of the block is 0. (25%)
3. Shown in figure 3 is a prismatic bar supported from its end. Please determine the strain energy considering the following loads: (a) the weight of the bar itself, and (b) the weight of the bar plus a load P at the lower end (Assume linearly elastic behavior, the weight density of the material is γ and A is the cross sectional area of the bar) (15%)
4. Please construct the bending moment diagrams for loaded beam shown in figure 4(a) with the aid of the integration process. The shear-force diagram is shown in figure 4(b) (15%)
5. A solid circular bar with fixed ends is acted upon by two oppositely directed torques T_0 , as shown in figure 5. Please determine the reactive torque T_A and T_D , the maximum angle of twist ϕ_{max} , and the angle of twist ϕ_0 at the mid-section of the bar. (20%)



國立中山大學九十學年度碩博士班招生考試試題

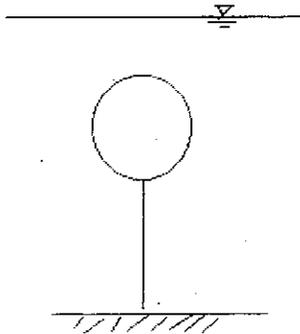
科目：流體力學【海環工系碩士班】甲組

共 / 頁 第 / 頁

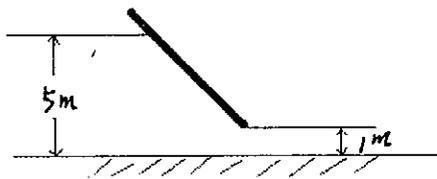
1. 定義或解釋名詞 (4% x 10 = 40%)

- | | |
|---------------------------|------------------------|
| (1). Laminar flow | (2). Turbulent flow |
| (3). Surface force | (4). Irrotational flow |
| (5). Doublet | (6). Cavity in liquids |
| (7). Dynamical similarity | (8). Reynolds number |
| (9). Supersonic flow | (10). Fluid Density |

2. A spherical buoy has a diameter of 1.5m, mass 100kg and is anchored to the sea floor with a cable as is shown in the figure. For this condition what is the tension of the anchor. (15%)



3. Water flows under the inclined sluice gate shown in the figure. Determine the flowrate if the gate is 2m. The upstream water depth is 5m while the down stream water depth is 1m. Neglect the energy loss during flowing through the gate. (15%)



4. 推導 Lagrangian 方式描述下之質量守衡方程式，即所謂的 Lagrange's continuity equation. (15%)

5. 在非旋轉流 (irrotational flow) 的理想流体流場中，其固定不透水平底床在 $y=-h$ 常數而在 x 軸處之流函數 (stream function) $\psi(x,0) = a \cos mx$ ， a 與 m 皆為常數，求 $\psi(x,y)$. (15%)

國立中山大學九十學年度碩博士班招生考試試題

科目：基礎環境科學【海環工系碩士班】乙組

共 0 / 頁 第 0 / 頁

一、解釋名詞：(30%)

1. biosphere
2. biomagnification
3. The population, resources, and pollution model (PRP model)
4. population histograms
5. dust storm
6. keystone species
7. green energy
8. streambed channelization
9. weathered oil
10. contingency plan

二、問答題：(70%)

1. 請對「污染物」下一個較完整之定義。(10%)
2. 酸雨應如何定義？為什麼？(10%)
3. 試述石灰岩(limestone)洞形成原因與機制，並探討細菌活動(bacterial action)在這當中扮演的角色。(10%)
4. 氣候變化的主要原因為何？全球氣候變遷對於台灣地區的主要衝擊可能是什麼？何謂「京都議定書(Kyoto Protocol)」？為何有些國家不願遵守之？(10%)
5. 何謂有害廢棄物(hazardous waste)？去年我國曾發生不肖廠商亂倒有毒廢液於高屏溪水源地之事件。試述我國對有害廢棄物的管理方式為何？而我國政府環保部門對管理有害廢棄物問題之癥結所在又為何？(15%)
6. 今年(民國九十年)元月十四日在墾丁龍坑外海所發生的「阿瑪斯號(Amorgos)」溢油事件，試述海洋及海岸溢油污染的清除處理技術。我國政府針對此次洩油事件，其所採取的油污清除方式你是否贊同？不論是否贊同，試分別陳述其理由。如不贊同，亦請對我政府所應採行的方式及步驟提出你的建議。(15%)

國立中山大學九十學年度碩博士班招生考試試題

科目：環境微生物學與環境化學【海環工系碩士班】乙組

共 2 頁 第 1 頁

1. 請寫出（或畫出）多氯聯苯之化學式（或結構式）(5%)，並討論其可能的污染源、對環境與人類之危害。(7%) 如何分析土壤中多氯聯苯之濃度（原理與分析儀器）？(7%)
2. 何謂緩衝強度？應用時，緩衝強度的高低意義何在？(6%)
3. 土壤對非極性有機污染物的吸附決定於土壤的特性與污染物本身之性質，請分別討論。(8%)
4. 請分別計算(1) $10^{-3}M$ 與 (2) $10^{-7}M$ 的 HA 水溶液的 pH 值（如有需要，請列明解題所需之假設， Given: $pK_a = 0$ for HA ）(12%)
5. 何謂鹼度(alkalinity)？在廢水處理時量測鹼度意義何在？試舉一例說明鹼度較高 pH 值不一定較高。(10%)
6. A COD analysis is to be performed using 0.25N $K_2Cr_2O_7$. How many grams of $K_2Cr_2O_7$ must be added to 1 liter of water to prepare this solution? The product of oxidation is Cr^{+3} and the reaction takes place in acid solution. (The formula weight of $K_2Cr_2O_7$ is 294.2) (10%)
7. How does chelation influence corrosion? (5%)

國立中山大學九十學年度碩博士班招生考試試題

科目：環境微生物學與環境化學【海環工系碩士班】乙組

共 2 頁 第 2 頁

8. 解釋名詞：(20%)

- (1) co-enzyme
- (2) anaerobic respiration
- (3) oxidative phosphorylation
- (4) co-metabolism
- (5) Gram stain
- (6) *Nocardia*
- (7) Purple Sulfur Bacteria
- (8) Diversity Index
- (9) red tide
- (10) bioaugmentation

9. 試述三階段厭氧分解有機物之步驟。其中產酸菌、甲烷菌、及 obligate proton acetogenic bacteria (OPAB) 分別出現在何分解之步驟中？(5%)

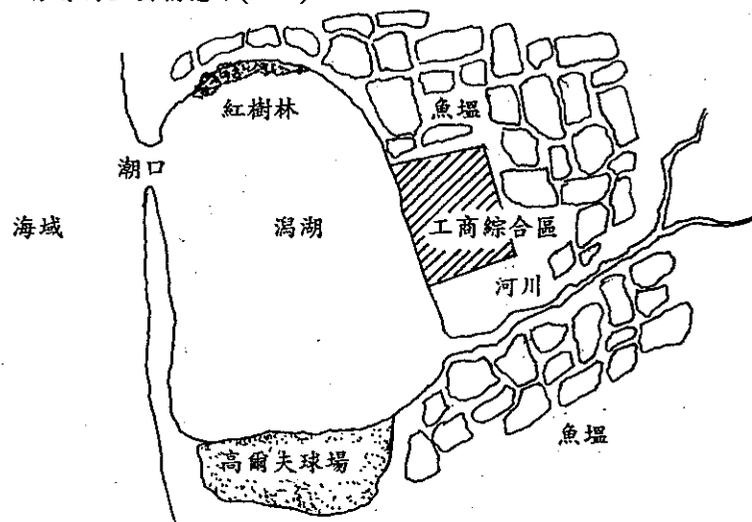
10. 今年元月十四日在墾丁龍坑外海所發生的「阿瑪斯號洩油事件」，你是否建議在第二階段清除海岸殘留油污時採用生物處理技術？如果建議，試述理由及採用何種生物處理方法，如果不建議，其原因又為何？(5%)

國立中山大學九十學年度碩博士班招生考試試題

科目：環境保護概論【海環工系碩士班】丙組選考

共 / 頁 第 / 頁

1. 氣候變化的主要原因是什麼？全球氣候變遷對於台灣地區主要的可能衝擊是什麼？何謂 FCCC？何謂「京都議定書 (Kyoto Protocol)」，其目的和主要措施何在？為什麼有些國家不願配合？(20%)
2. 何謂有害廢棄物 (Hazardous waste)？去 (八十九) 年我國曾發生不肖廠商亂倒有毒廢液於高屏溪上游水源地之事件，試述我國對於有害廢棄物的管理方式為何？你認為有害廢棄物管理的癥結何在，應如何改善？(15%)
3. 今 (九十) 年元月在墾丁國家公園龍坑保護區外海發生「阿瑪斯 (AMORGOS)」號貨輪擱淺溢油事件，請問油污染可能造成之影響為何？我國「海洋污染防治法」大要？請依據該法及政府現有機制評述此一事件之應變與改進之道？(20%)
4. 最近丹大林場發生台灣水鹿遭獵殺事件，請問一個物種消失對於人類和生態系統有何關係？我國野生動物有何管理制度？你對於目前野生動物保育、開放狩獵和人工飼養有何看法？(20%)
5. 如圖，某處瀉湖 (lagoon) 周遭為魚塭，有河川經由都市地區匯入湖中，該一瀉湖目前生產牡蠣，未來擬發展為水域遊憩區，毗鄰之陸岸部分地區 (參見下圖) 擬開發一處高爾夫球場，以及一處工商綜合區。請問：(1) 紅樹林生長的區位要件？(2) 以瀉湖的水文動態，評述目前與未來的水質有何可能之問題？(3) 從土地使用配置而言，高爾夫球場及工商綜合區有何問題？應如何改善？(4) 如果你受聘規劃未來水域遊憩的發展，從陸岸、瀉湖或鄰近海域，你有何主要構想？(25%)



國立中山大學九十學年度碩博士班招生考試試題

科目：計算機概論【海環工系碩士班】丙組選考

共 | 頁 第 | 頁

共計 100 分，請儘量陳述，空白為零分，請注意時間。

1. 試說明電腦資料傳輸的方式及如何避免資料傳輸過程中可能產生之錯誤。(10分)
2. 試說明何謂電腦動畫(Computer Animation)及虛擬實境(Virtual Reality)，並比較說明兩者之差異。(10分)
3. 試說明何謂網際網路(Internet)，其功能及未來可能之發展。(15分)
4. 試比較說明試算表(例如：Microsoft Excel 等軟體)與資料庫(例如：Microsoft Access 等軟體)功能上之一般之差異。(15分)
5. 試說明一個環境資料庫之建立流程、方法與資料庫應具備之功能。(15分)
6. 目前許多汽車廠商已為其所出廠之汽車安裝或選配汽車導航系統，試說明汽車導航系統可能達成的功能。若今提供給你一部電腦(或 Notebook)及一台 GPS 衛星定位接收儀(Global Positioning System Receiver)，試說明你如何進行汽車導航系統之軟體設計，並說明汽車導航系統中電子地圖(Electronic Map)之地圖資料，若有修正時應如何處理。(15分)
7. 在一個檔案中有許多以空格來間隔的實數(例如：50.2 35.5 44.8 78.9.....等)，試以 Basic、Fortran、Pascal、C 或其他電腦語言(請註明)，寫出一程式(Program)來讀出上述檔案中之所有實數，並將之排序(sorting)後，輸出至另一新檔案。(20分)

國立中山大學九十學年度碩博士班招生考試試題

科目：線性代數【海環工系碩士班】丙組選考

共 1 頁 第 1 頁

1. (20%) Let A be the matrix
$$\begin{bmatrix} 1 & 2 & 1 & 2 & 3 \\ 2 & 4 & 3 & 1 & 0 \\ 1 & 2 & 3 & -4 & -9 \\ 0 & 0 & 1 & -3 & -6 \end{bmatrix}$$

- Find a basis for the row space $\text{row}(A)$ of A . (5%)
 - Find a basis for the column space $\text{col}(A)$ of A . (5%)
 - Find a basis for the null space $N(A)$ of A . (5%)
 - Find a homogeneous system of linear equations such that $\text{col}(A^T)$ is the solution space (5%)
2. (15%) Find an orthonormal basis for the subspace $W = \{(x_1, x_2, x_3, x_4) \mid x_1 + x_2 + x_3 + x_4 = 0\}$
3. (15%) Find the least square fitting of a straight line for $(1, -1)$, $(2, 4)$, $(3, 2)$, and $(4, 3)$.
4. (25%) Given a matrix $A = \begin{bmatrix} -2 & 4 \\ 1 & 1 \end{bmatrix}$.
- Find an invertible matrix P and a diagonal matrix D such that $A = PDP^{-1}$ (8%)
 - Compute A^{100} . You don't have to calculate the actual values of each component in the matrix A^{100} . (10%)
 - Find a square matrix B such that $B^5 = A$. (7%)
5. (15%) Let A be an orthogonal matrix with determinant $\det A = -1$. Show that $I + P$ is not invertible.
6. (10%) Find the value of k so that the vectors $(3, 1, k+1, 9)$, $(2, k, 1, 6)$, and $(1, -3, 4, 3)$ are linearly dependent.

國立中山大學九十學年度碩博士班招生考試試題

科目：統計學【海環工系碩士班】丙組選考

共 2 頁 第 / 頁

- 一. Suppose that A and B are independent events, with $\Pr(A) = .6$ and $\Pr(B) = .2$. What is:
- $\Pr(A|B)$?
 - $\Pr(A \text{ and } B)$?
 - $\Pr(A \text{ or } B)$?
- (10分)

- 二. Given: The probabilities of three events, $A, B,$ and $C,$ occurring are $P(A) = 0.35, P(B) = 0.45,$ and $P(C) = 0.2.$ Assuming the $A, B,$ or C has occurred, the probabilities of another event, $X,$ occurring are $P(X|A) = 0.8, P(X|B) = 0.65,$ and $P(X|C) = 0.3.$ Find $P(A|X); P(B|X);$ and $P(C|X).$
- (15分)

- 三. Suppose X and Y are two random variables such that the correlation coefficient $\rho(X, Y) = \frac{1}{2}, \text{Var}(X) = 1,$ and $\text{Var}(Y) = 2,$ compute $\text{Var}(X - 2Y).$
- (15分)

- 四. To see what difference class attendance made, a professor sampled grades from his large statistics class of 530 students. From the 220 students who attended class less than half the time (the "irregulars"), he took a random sample of 5 grades. From the remaining 310 students who attended at least half the time (the "regulars"), he took an independent random sample of 5 other grades:

($t_{0.025} = 2.78$)

irregulars	regulars
41	69
81	56
52	83
69	70
62	92

- Construct a 95% confidence interval for the mean difference between the two groups of students.
 - To what extent does this support the contention that "it is worth 18 marks to come to class regularly"?
- (15分)

- 五. A statistician reported to a car insurance company a confidence interval for the proportion (p) of convertible cars that had been involved in major accidents during the past year. The 95% confidence interval for p was reported to be the interval from 0.12 to 0.48.

- What is the statistician's estimate of p ?
- Approximately what sample size did the statistician use?

($Z_{0.025} = 1.96$)

(15分)

國立中山大學九十學年度碩博士班招生考試試題

科目：統計學【海環工系碩士班】丙組選考

共 2 頁 第 2 頁

- 六. The following scores represent the performance in a beer drinking contest between reporters from three different news papers

	"Scores" (measured in liters)
Newspaper 1	1, 3, 4
Newspaper 2	4, 5, 6, 7, 8, 9, 6
Newspaper 3	2, 3, 3, 4

- (1) Set up an analysis of variance table.
 - (2) Test the hypothesis that newspaper affiliation has no effect on the ability to drink beer. ($\alpha = 0.05$) (15分)
- $(f_{0.05}(2, 11) = 3.278)$

- 七. Assume a multiple regression equation to describe "y" as a function of three "X" variables is: $\hat{Y} = 12.6 + 17.3X_1 + 0.21X_2 + 74.7X_3$ and the associated standard errors are $S_{\hat{\beta}_0} = 4.2$, $S_{\hat{\beta}_1} = 3.1$, $S_{\hat{\beta}_2} = 0.02$, $S_{\hat{\beta}_3} = 67.1$.

- (1) If you tested both of the hypothesis, $H_0: \beta_2 = 0$ and $H'_0: \beta_3 = 0$, you would reject $H'_0: \beta_3 = 0$ and not reject $H_0: \beta_2 = 0$. Explain this since $\hat{\beta}_2$ is so much closer to 0 than $\hat{\beta}_3$.
 - (2) Would the regression equation to describe y with X_3 be $\hat{Y} = 12.6 + 74.7X_3$? Explain why or why not. (15分)
- $(t_{1/2} = 2.04)$

國立中山大學九十學年度碩博士班招生考試試題

科目：微積分【海環工系碩士班】丙組選考

共 2 頁 第 1 頁

1. (10%) About Continuity.

a) (5%) Find the value of constant a and b so that the given function will be continuous for all x .

$$f(x) = \begin{cases} \sqrt{x} - a & \text{if } x > 0, x \neq 1 \\ \frac{x-1}{b} & \text{if } x = 1 \end{cases}$$

b) (5%) Show that if two functions f and g are continuous at $x = x_0$, then $f + g$ is also continuous at $x = x_0$.

2. (10%) About Limit.

a) (5%) Explain what is the general concept of limit and its relationship with calculus.

b) (5%) Evaluate the limit or explain why it does not exist. $\lim_{x \rightarrow 0} \left(\frac{1}{x} - \frac{1}{x^2} \right)$

3. (30%) About Differentiation.

a) (10%) Find $\frac{d}{dx} f[f(x)]$, and $\frac{d}{dx} f[f'(x)]$ assuming these derivatives exist.

b) (10%) Given $x \sin^{-1} y + y \tan^{-1} x = x$, evaluate $\frac{dy}{dx}$.

c) (10%) Find $\frac{dy}{dx}$ where $y = \frac{e^{2x}}{(x^2 - 3)^2 \ln \sqrt{x}}$.

4. (30%) About Integration.

a) (10%) Evaluate $\int_2^1 4x \, dx$ using the definition of the definite integral.

b) (10%) Evaluate $\int [\sin 2x \ln(\cos x)] \, dx$

c) (10%) Find the length of the curve defined by $9x^2 = 4y^3$ between the points $(0, 0)$ and $(2\sqrt{3}, 3)$.

5. (8%) About Infinite Series.

a) (4%) Is the sequence $\sqrt[n]{n}$ convergent or divergent? If it converges, find its limit.

b) (4%) Find the interval of convergence for the power series $\sum_{k=1}^{\infty} \frac{k(k+1)x^k}{k+2}$

國立中山大學九十學年度碩博士班招生考試試題

科目：微積分【海環工系碩士班】丙組選考

共 2 頁 第 2 頁

6. (12%) Modeling Problem: As more and more industrial parks are constructed, there is a growing need for standard ensuring control of pollutants released into the air. Suppose that the pollution at a particular location is based on the distance from the source of the pollution according to the principle that for distance greater than or equal to 1 kilometer (km), the concentration of particular matter (in parts per million, ppm) decreases as the reciprocal of the distance from the source. This means that if you live 3 km from the plant emitting 60 ppm, the pollution at your home is $60/3=20$ ppm. Suppose that two plants 10 km apart are releasing 60 ppm and 240 ppm, respectively (shown as the following figure). At what point between the plants is the pollution minimum? Where is it a maximum?

