

國立臺北科技大學九十六學年度碩士班招生考試

系所組別：3210 環境工程與管理研究所甲組

第二節 工程數學 試題

第一頁 共一頁

注意事項：

1. 本試題共 4 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Find the complete solution of the ordinary differential equation:

$$\frac{d^2 y}{(dx)^2} - 3 \frac{dy}{dx} + 2y = \sin(e^{-x}) \quad (20 \text{ 分})$$

2. For the incineration (thermal oxidation) of benzene, the activation energy of benzene oxidation is 95.9 (kcal/mol). The Arrhenius Equation is

$$k = A \cdot \exp\left(\frac{-E}{RT}\right), \text{ the frequency factor of benzene oxidation is } 7.43 \cdot 10^{21} \text{ (s}^{-1}\text{), the universal gas constant is } 8.3143 \text{ J/mol-K or } 1.987 \text{ cal/mol-K}$$

- (a) what is the kinetic rate constant of benzene oxidation at 760°C? (5 分)
- (b) If the thermal oxidation of benzene is a first-order reaction. Write an ordinary differential equation for the benzene concentration C(t). (5 分)
- (c) Define the destruction efficiency $\eta(t)$ as $[C(0)-C(t)]/C(0)$. Solve (b) and the destruction efficiency $\eta(t)$ of benzene. (10 分)
- (d) Estimate the time of incineration required to destroy 99.9% of benzene at 760°C? (5 分)

3. Find the complete solution of the ordinary differential equation:

$$2\left(\frac{dy}{dx}\right)^2 + x \frac{dy}{dx} - y = 0 \quad (25 \text{ 分})$$

4. Model the growth and decay of population "X" (for example: human, animals, insects, bacteria...). The population level at time t is x(t). The reproduction rate of this species is at an average per-capita rate r.
- (a) Write an ordinary differential equation for the population x(t). (5 分)
 - (b) Solve the ordinary differential equation (a) if the initial population is x_0 . (5 分)
 - (c) If the habitat can support a maximum population level "k" (Carrying Capacity). Re-Write the ordinary differential equation for the population x(t). (10 分)
 - (d) Solve the ordinary differential equation (c) if the initial population is x_0 . (10 分)

-The end-