系所組別： 工程科學系在職專班乙組

考試科目： 熱傳學（專班）

考試日期：0219，節次：3

※ 考生請注意：本試題 □可 ☑不可 使用計算機

I. The energy equation can be written as

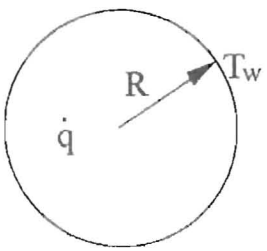
$$\rho C\frac{\partial T}{\partial t}+\rho C\left(\vec{v}\cdot\nabla T\right)=k\frac{\partial^2 T}{\partial x^2}+q'''$$

(1) In the three terms, $\rho C\frac{\partial T}{\partial t}$, $\rho C\left(\vec{v}\cdot\nabla T\right)$ and $k\frac{\partial^2 T}{\partial x^2}$, which one is the convective term? (3%)

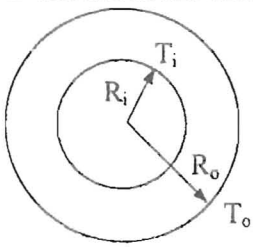
(2) In what conditions is there no convective effect? (Hint: "no convective effect" means that the convective term does not have any effects on the heat transfer.) (6%)

(3) What is q''' ? What is its unit? (4%)

II. A one-dimensional steady heat transfer problem of a cylinder with a uniform heat source $\dot{q}$ is shown in the following figure. What is the heat flux on the cylinder surface (i.e., at r = R)? (8%)



III. Consider one-dimensional steady heat flow thruogh a hollow sphere (without heat source), as shown in the following figure.



Derive the expression of the thermal resistance for the heat flow from R_i to R_o. (10%)

IV. Explain the following terms: (24%)

(1) Heat Transfer (4%)

(2) Boussineq Approximation (4%)

(3) Steady State (4%)

(4) Biot Number (4%)

(5) The zeroth law of thermodynamics (4%)

(6) Fourier's law (4%)

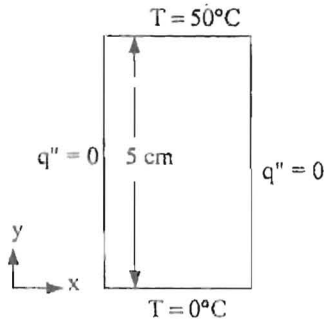
V. Answer the following questions: (20%)

(1) 自然對流與強制對流各有何優缺點？(10%)

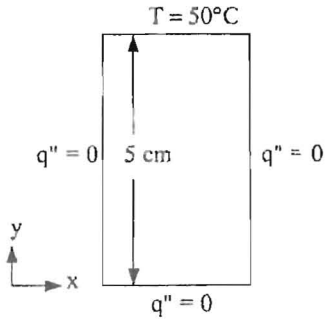
(2) 鑽石與銅，那一個熱傳導係數較高？這兩種材料之熱傳導機制有何不同？(5%)

(3) 冰箱要除霜，是將冷凍庫之結冰去除，冷凍庫之結冰不是可幫助維持冰箱之冷度？爲何冰箱要除霜？(5%)

VI. According to the following boundary conditions, draw the isotherms for the steady solutions or write down the solutions. (No calculation required) (12%)

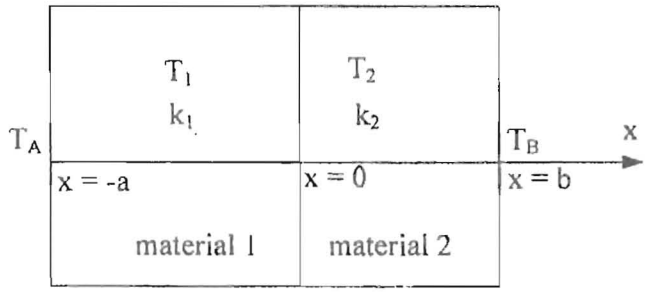


(a)



(b)

VII. In the following figure, two materials with k_1 and k_2 thermal conductivities have perfect contact and their corresponding temperatures are T_1 and T_2.



(i) Write down the boundary conditions at x=0, x=a and x=b. (6%)

(ii) Solve the T_1 and T_2 under the assumptions of 1-D steady state with no heat source and constant k_1 and k_2. (7%)