國立臺灣師範大學 104 學年度碩士班招生考試試題

科目：**普通物理**　　適用系所：**地球科學系**

注意：1.本試題共 1 頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則不予計分。

1. (a) Write down the 0^{th}, 1^{st}, and 2^{nd} law of Thermodynamics. Explain the physical meaning of the laws. (10 points)
   (b) Use the 1^{st} law to calculate the work "**ΔW**" done by **N** mole of ideal gas while expanding its volume from **V** to **5V** at a constant temperature **T**? (i.e. calculate "ΔW" by using N, V, T, and the ideal gas constant R.) (5 points)
   (c) What is the physical meaning of "entropy" in the 2^{nd} law? (5 points)

2. (a) There is a train of a speed $\mathbf{V_t}$ sending out a sound of the frequency **f**. An observer A is standing still and facing the train; i.e. the train is approaching observer A. The sound speed = $\mathbf{V_s}$. What is the frequency $\mathbf{f_1}$ of the sound from the train observed by observer A? (10 points)
   (b) If observer A starts to move with a constant speed of $\mathbf{V_A}$ with the direction facing the train, what is the frequency $\mathbf{f_2}$ observed by observer A? (10 points)

3. What is "Hall Effect"? How to use it for the determination of charge carrier density? (10 points)

4. There is a metallic and cylindrical rod with the radius = **r** and the length = **L**.
   (a) The electric conductivity of this metal = **σ**. When an electric voltage **V** is applied to the two ends of this rod, calculate the current I flowing through the rod; i.e. calculate I by using **σ**, **V**, **L**, and **r**. (10 points)
   (b) The thermal conductivity of the metal = **k**. When the temperature difference between the two ends of the rod is fixed at **ΔT**, calculate the heat transfer **Q** through the rod in a time interval **Δt**. (i.e. calculate **Q** by using k, ΔT, Δt, L, and r) (10 points)

5. There is a thick plastic (insulating) spherical shell with the inner radius = $\mathbf{R_i}$ and outer radius = $\mathbf{R_o}$. The shell is uniformly charged with **+Q**; i.e. the volume charge density is uniform.
   (a) Calculate the volume charge density in the shell. (5 points)
   (b) Calculate and plot the electric field **E(r)** for r=0 ~ ∞. (Note: r is the distance to the center of this spherical shell.) (10 points)
   (c) Calculate and plot the electrical potential **Φ(r)** for r=0 ~ ∞. (5 points)

6. (a)What is "**Thermal Radiation**"? Explain it quantitatively. (5 points)
   (b)What is the "**Greenhouse Effect**"? Can you use the thermal radiation to explain the "Greenhouse Effect"? (5 points)