

國立高雄大學九十四學年度轉學招生考試試題

系所組別：化學工程與材料工程學系

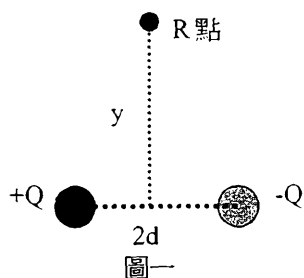
科目：普通物理

考試時間：90 分鐘

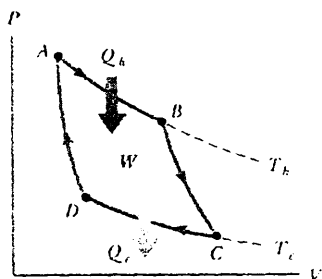
本科原始成績滿分 100 分

問答計算題：(共五題)

1. 今有一電偶極(electric dipole, 如圖一所示), 請求出在 R 點處($y \gg d$)的電場, 並說明該處電場與電偶極矩 \vec{p} (electric dipole moment)的關係。(20 分)

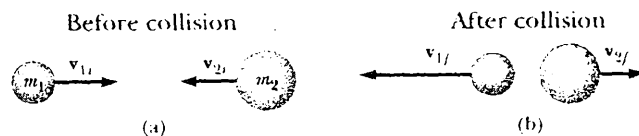


2. 卡諾引擎(Carnot engine)是 1824 年法國工程師 Sadi Carnot 所設計的一個理想的可逆式熱機(heat engine)。今有一卡諾引擎它利用兩個不同溫度(T_H 與 T_C)的熱庫並以氦氣作為工作介質, 如圖二所示。請回答下列的問題：(30 分)
- 請詳細說明此卡諾引擎的運轉循環(亦即卡諾循環)圖。
 - 請計算此卡諾引擎由點 B 到點 C 所做的功為何?
 - 請計算點 B 與點 A 的體積比(V_B/V_A)為何?



圖二

3. 請回答下列關於碰撞的問題：(20 分)
- 彈性碰撞(elastic collision)與非彈性碰撞(inelastic collision)的異同為何?
 - 關於圖三的一維彈性碰撞問題,請推導出 V_{1f} 與 V_{2f} 。



圖三

4. 關於固體的形變(deformation),可定義出楊氏(Young)、切變(Shear)與塊體(Bulk)等三種彈性係數(elastic modulus), 請分別繪圖並加以說明其定義。(15 分)
5. 對於一串聯的 RLC 交流電路(電源 $v = V \sin \omega t$ 、電阻 R、電感 L、電容 C)：(15 分)
- 此交流電路的阻抗值為何?
 - 此交流電路在何種情況下稱之為共振(resonance)? 共振頻率為何?

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Part I. 選擇題 (80%) 答對每題 10 分，未作答不記分，答錯每題倒扣 5 分。

- In the reaction $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$, N_2 is
 - oxidized.
 - reduced.
 - electron donor.
 - reducing agent.
 - two of these
- Which conditions of P , T , and n , respectively, are most ideal?
 - high P , high T , high n
 - low P , low T , low n
 - high P , low T , high n
 - low P , high T , high n
 - low P , high T , low n
- Given the equation $\text{S}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{SO}_2(\text{g})$, $\Delta H = -296 \text{ kJ}$, which of the following statement(s) is (are) true?
 - The reaction is exothermic.
 - When 0.500 mole sulfur is reacted, 148 kJ of energy is released.
 - When 32.0 g of sulfur are burned, $2.96 \times 10^5 \text{ J}$ of energy is released.
 - All are true.
 - None is true.
 - I and II are true.
 - I and III are true.
 - Only II is true.
- In Bohr's atomic theory, when an electron moves from one energy level to another energy level more distant from the nucleus
 - energy is emitted.
 - energy is absorbed.
 - no change in energy occurs.
 - light is emitted.
 - none of these
- Consider the following rate law: $\text{Rate} = k[\text{A}]^n[\text{B}]^m$. How are the exponents n and m determined?
 - By balancing chemical equation
 - By using the subscripts of the chemical formulas
 - By using the coefficients of the chemical formulas
 - By educated guess
 - By experiment
- For a certain process at 355 K, $\Delta G = -12.4 \text{ kJ}$ and $\Delta H = -9.2 \text{ kJ}$. The ΔS for the process is
 - 0
 - 9.0 J/K·mol
 - 9.0 J/K·mol
 - 21.6 J/K·mol
 - 21.6 J/K·mol
- Which one of the following decreases as the strength of the attractive intermolecular forces increases?
 - The heat of vaporization.
 - The normal boiling temperature.
 - The deviations from the ideal gas law.
 - The sublimation temperature of a solid.
 - The vapor pressure of a liquid.
- Atoms having greatly differing electronegativities are expected to form:
 - no bonds
 - polar covalent bonds
 - nonpolar covalent bonds
 - ionic bonds
 - covalent bonds

Part II. 簡答題 (20%) 每題 10 分，請詳細寫出過程並標示出答案。

- Give the Lewis structures, predict the molecular structures, and describe the bonding (in terms of hybrid orbitals for the central atom) of the following molecules: a) XeO_4 and b) CO_2
- Calculate the root mean square velocity (in meter/sec) for the atoms in a sample of helium gas at 25°C . (gas constant $R = 8.3145 \text{ J/K}\cdot\text{mol}$, atomic mass of Helium 4.0 g/mol).

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You need to show all your work.

1. (10 pts) Show that $f(x) = \int_1^{2x} \sqrt{16+t^4} dt$ has an inverse and find $(f^{-1})'(0)$.

2. Find the limit.

(a) (10 pts) $\lim_{x \rightarrow 0} \left(\frac{\sin x}{x} \right)^{1/x^2}$

(b) (10 pts) $\lim_{(x,y) \rightarrow (0,0)} \frac{x^9 y}{(x^6 + y^2)^2}$

3. (15 pts) A rectangle is inscribed in a circle of radius 5 inches. If the length of the rectangle is decreasing at the rate of 2 inches per second, how fast is the area changing at the instant when the length is 6 inches?

4. Find or evaluate the integral.

(a) (10 pts) $\int \frac{1}{5+3\sin x} dx$

(b) (10 pts) $\int_0^1 x \ln x dx$

(c) (10 pts) $\int_0^1 \int_0^{\cos^{-1} y} e^{\sin x} dx dy$

5. (15 pts) Find the area of the surface generated by revolving $y = \cos x$, $x \in [0, \frac{\pi}{2}]$ about the x -axis.

6. (10 pts) Find the values of p for which the series $\sum_{n=2}^{\infty} \frac{\ln n}{n^p}$ converges.