

科目：物理化學

適用：應化系

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答；試題須隨卷繳回。

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1. In a thermally insulated kitchen, an ordinary refrigerator is turned on and its door is left open. The temperature of the room: (a) remains constant by first law (b) increases by first law (c) decreases by first law (d) remains constant by second law (e) increases by second law. (10 pts)
2. The net work done during one Carnot cycle is on a p-V diagram: (a) the area under the upper isothermal curve (b) the area under the lower isothermal curve (c) the area under the right hand adiabatic curve (d) the area under the left hand adiabatic curve (e) the area enclosed. (10 pts)
3. By the second law of thermodynamics: (a) all heat engines have the same efficiency (b) all reversible heat engines have the same efficiency (c) the efficiency of any heat engine is independent of its working substance (d) the efficiency of a Carnot engine depends only on the temperatures of the two reservoirs (e) all Carnot engines theoretically have 100% efficiency. (10 pts)
4. An ideal diatomic gas has a molar heat capacity at constant pressure,  $C_p$ , of: (a) R (b)  $3R/2$  (c)  $5R/2$  (d)  $7R/2$  (e)  $9R/2$ . (10 pts)
5. If the molecules in a tank of hydrogen have the same rms speed as the molecules in a tank of oxygen, we may be sure that: (a) the pressures are the same (b) the hydrogen is at the higher temperature (c) the tanks will burst (d) the temperatures are the same (e) the oxygen is at the higher temperature. (10 pts)
6. The "heat capacity" of an object is: (a) the amount of heat energy to raise its temperature by  $1^\circ\text{C}$  (b) the amount of heat energy to change its state without changing its temperature (c) the amount of heat energy per kilogram to raise its temperature by  $1^\circ\text{C}$  (d) the ratio of its specific heat to that of water (e) the change in its temperature caused by adding 1 J of heat energy. (10 pts)
7. Please show the energy of free particle in a one-dimensional box of length  $l$  from the time-independent Schrödinger equation? (20 pts)
8. If  $U = U(V, T)$  and  $p = p(V, T)$  are functions of  $V$  and  $T$  and if  $H = U + pV$ , show that

$$\left(\frac{\partial H}{\partial T}\right)_p - \left(\frac{\partial U}{\partial T}\right)_V = \left[\left(\frac{\partial U}{\partial V}\right)_T + p\right] \left(\frac{\partial V}{\partial T}\right)_p \quad (20 \text{ pts})$$

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