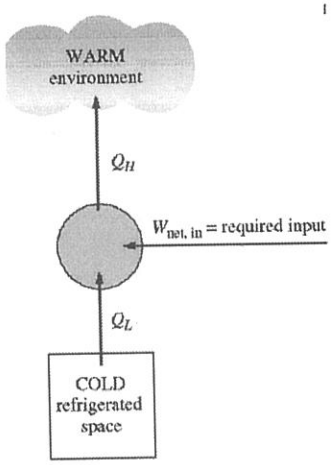
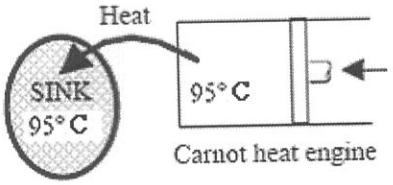
1001 熱力學資格考

1. Refrigerator or Heat Pump are shown as below
   (a) **R**efrigerator 與 **H**eat **P**ump 之效率定義 COP_R and COP_{HP}。(5%)
   (b) Prove $COP_{HP} = COP_R + 1$ (10%)

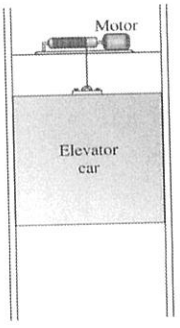


2. During the isothermal heat rejection process of a Carnot heat engine, the working fluid experiences an entropy change （ΔS） of -0.8 kJ/K. If the heat sink is 95 ℃, determine (a) the amount of heat transfer (5%), (b) entropy change of the sink (5%), (c) the total entropy change for this process. (5%)



3. Make use of equation $\Delta S_{sys} = S_2 - S_1 = \int_1^2 \frac{\delta Q}{T} + S_{gen}$ and demonstrate
   (a) a reversible adiabatic process **is necessarily** isentropic process ($s_1 = s_2$) (5%)
   but (b) a isentropic process ($s_1 = s_2$) **isn't necessarily** a a reversible adiabatic process (5%)

4、 Determine the power required to raise a 500-kg elevator car from initial position of 20 m to 100 m in 20 s ($g = 9.8\ m/s^2$). (10%)



1001 機械系博士班資格考試題目

考試科目	方式	
熱力熱傳學	Closed Book,可使用計算機	Part II

1. (15%) (a). Please describe **the physical mechanisms** of conduction, convection and radiation, and then also **write their rate equations**.
(b). What is heat transfer defined ?
(c) What is a thermal contact resistance ? How is it defined in plane wall condition?
(d) Please **write heat equation** in Cartesian coordinates, with three dimensions, heat generation and unsteady.

2. (15 %) A thin walled copper tubes of radius r_i is used to transport a low temperature refrigerant and is at a temperature T_i that is less than that of the ambient air at T_∞ around the tube. Is there an optimum thickness associated with application of insulation to the tube. Please construct the thermal circuit of heat flow resistance. And prove the optimal insulation radius is $r_{cr} = k/h$.

3. (20%) For flow of a liquid metal through a circular tube, the velocity and temperature profile at a particular axial location may be approximated as being uniform and parabolic, respectively. That is, $\mathbf{u(r) = C_1}$ and $\mathbf{T(r) - T_S = C_2\,[\,1-(r/r_0)^2]}$, where C_1 and C_2 are constants. What is the values of the Nusselt number Nu_D at this location ?