

九十二學年度 動力機械工程學系(所) 甲 組碩士班研究生招生考試

科目 熱流學(工) 科號 1302 共 二 頁第 一 頁 \*請在試卷【答案卷】內作答

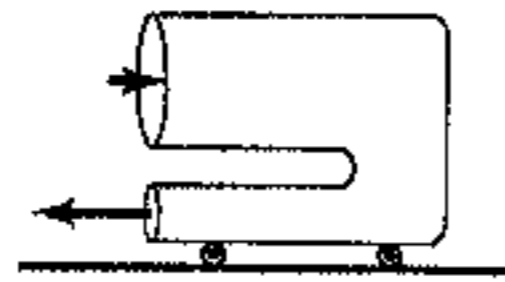
1. A 5-m x 6-m x 8-m room is to be heated by an electric resistance heater placed in a duct in the room. Initially, the room is at 15 °C, and the local atmospheric pressure is 98 kPa. The room is losing heat steadily to the outside at a rate of 200 kJ/min. A 200-W fan circulates the air steadily through the duct and the electric heater at an average mass flow rate of 50 kg/min. The duct can be assumed to be adiabatic, and there is no air leaking in or out of the room. If it takes 15 min for the room air to reach an average temperature of 25 °C, find the following:
  - (1) the power rating of the electric heater. (8%)
  - (2) the temperature rise that the air experiences each time it passes through the heater. (5%)  
( $C_p=1.005$  kJ/kg•K,  $C_v=0.718$  kJ/kg•K,  $R=0.287$  kPa•m<sup>3</sup>/kg•K)
2. A Carnot heat engine receives heat at 750 K and rejects the waste heat to the environment at 300 K. The entire work output of the heat engine is used to drive a Carnot refrigerator that removes heat from the cooled space at -15 °C at a rate of 400 kJ/min and rejects it to the same environment at 300 K. Determine the following:
  - (1) the rate of heat supplied to the heat engine. (8%)
  - (2) the total rate of heat rejection to the environment. (5%)
3. Air is compressed in a piston-cylinder device from 100 kPa and 17 °C to 800 kPa in a reversible, adiabatic process. Assuming constant specific heats for air, determine the following:
  - (1) final temperature. (6%)
  - (2) work done during this process. (3%)  
( $C_{v,ave}=0.727$  kJ/kg•K,  $k=1.4$ ,  $R=0.287$  kPa•m<sup>3</sup>/kg•K)
4.
  - (1) What is the dry-bulb temperature in a psychrometer (溼度計)? (2%)
  - (2) What is the difference between the wet-bulb temperature and the dew-point temperature on the T-s diagram? (2%)
  - (3) What is the definition of the relative humidity? (3%)
  - (4) How about the definition of the humidity ratio (or specific humidity)? (3%)
  - (5) Please design a psychrometer and shows what parameters you need to measure. Also derive the mathematical expression of the relative humidity as a function of those measurable parameters. (5%)
5.
  - (1) What is an ideal Brayton Cycle (in  $P-v$  and  $T-s$  diagrams) and what are its basic components? (5%)
  - (2) How to promote the standard Brayton Cycle to achieve its maximum efficiency? (10%)

Hints: Which cycle is its target to convert to and what components needed to add on its basic configuration? What is the maximum efficiency theoretically it can achieve? Please explain the methods in  $P-v$  and  $T-s$  diagrams.

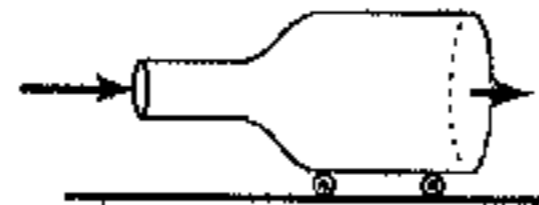
九十二學年度 動力機械工程學 系(所) 甲 組碩士班研究生招生考試

科目 熱流學(工) 科號 1302 共 二 頁第 二 頁 \*請在試卷【答案卷】內作答

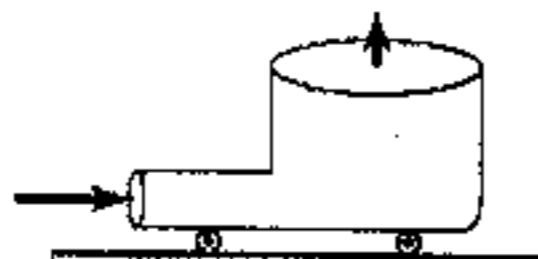
6. (1) Define the streamline (3%) and stream function (3%).  
 (2) Please state the situation(s) that the streamlines intersect with each other. (3%)  
 (3) Please explain the basic assumption(s) of boundary layer equations? (3%)  
 (4) Explain briefly why the adverse pressure gradient usually enhance flow separation. (3%)
7. A bubble is rising with a velocity  $V$  through a liquid. The rise velocity is a function of liquid density,  $\rho_b$ , bubble diameter,  $D$ , the viscosity of the liquid,  $\mu$ , the surface tension,  $\sigma$ , and the acceleration due to gravity,  $g$ . By dimensionless analysis, find the dimensionless parameters for this problem. Please interpret the physical meaning of all parameters. (10%)
8. The four devices shown in the following figure rest on frictionless wheels are restricted to move in the  $x$ -direction only and are initially held stationary. The pressure at the inlets and outlets of each is atmospheric, and the flow is incompressible. The content of each device is not known. When released, which device will move to the right and which to the left? Why? Please derive the continuity equation and momentum equation for this problem before discussion. (10%)



(a)



(b)



(c)



(d)