2nd Mid Term Exam	**Thermodynamics 1**	**2nd term 2007/2008**
KSU University	**ME371**	**Name:**
College of Engineering	**Time: 90 min**	**Group:**
Mech. Eng. Dept.		**No.:**

Choose the correct answer:

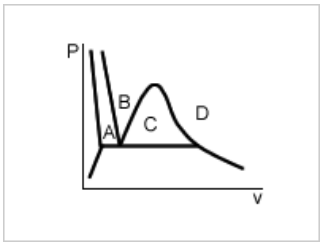
1- The interaction that occurs between a system and its surroundings as the system executes a process, which is the result of the system being at a pressure different from the surroundings, is:

A) Mass transfer
B) Heat transfer
C) Work transfer
D) None of these

2- Which one is a part of the total energy of a system?

A) Internal energy
B) Heat
C) Work

3- In which region of the property diagram below are superheated vapor states located?



A) A
B) B
C) C
D) D

4- An inventor claims to have created a heat engine which produces 10 kW of power for a 15 kW heat input while operating between energy reservoirs at 300 K and 600 K. Is this claim valid?

A) Yes
B) No ($\eta_{carnot} = 1 - T_L/T_H = 50\%$, $\eta_{th} = 10/15 = 66.6\%$)

5- A manufacturer claims that its refrigerator has a COP of 14 when cooling food at 270 K using ambient air at 300 K as a heat sink. Is this claim valid ?

A) Yes
B) No

6. Which of the following is NOT a correct statement due to the second law of thermodynamics?

A. It is impossible for a machine unaided by an external agency to transfer heat from one body to another at higher temperature.

B. It is impossible to construct a machine that operates in a cycle and produces no effect but work and the cooling of a hot reservoir.

C. A reversible series of processes in which the final result is only the transformation of heat into work.

7. For a thermodynamic cycle

A) $\Sigma W = \Sigma Q_{added}$ B) $\Sigma W = \Sigma Q$ C) $\Sigma W_{expansion} = \Sigma Q_{added}$

8. For a reversible Carnot engine, which of the followings is true?

A. The efficiency does not depend on the maximum and minimum temperatures.
B. The Carnot efficiency is the upper efficiency limit.
C. The efficiency depends on the working medium which converts the heat into works.

9. "It is impossible to construct a device that operates in a cycle and produces no effect other than the transfer of heat from a lower-temperature body to a higher-temperature body", this statement represents:

A) Clausius statement of the second law
B) Kelvin-Planck statement of the second law
C) none

10. Somebody claims to have developed a new reversible heat-engine cycle that has a higher theoretical efficiency than the Carnot cycle operating between the same temperature limits. This statement violates:

A) zeroth law B) Carnot principles C) second law

Solve the following problems:

1. Air at 7°C and 80 kPa enters an adiabatic diffuser of a jet engine steadily with a velocity of 200 m/s. The inlet area of the diffuser is 0.5 m^2. The air leaves the diffuser with a velocity that is very small compared with the inlet velocity.
Determine (*a*) the mass flow rate of the air and (*b*) the temperature of the air leaving the diffuser. (c) the exit pressure.

For air: C_p = 1.005 kJ/kg K, C_v = 0.718 kJ/kg K

```
T1=7+273
P1=80
Q=0
W=0
Vel1=200
Vel2=0
A1=0.5
R=0.287
v1=R*T1/P1
mass=A1*Vel1/v1
h1=Cp*T1
h2-h1+(Vel2^2-Vel1^1)/2000=0
Cv=0.718
Cp=R+Cv
h2-h1=Cp*(T2-T1)
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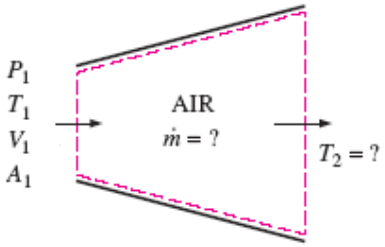

A1=0.5

Cp=1.005

Cv=0.718

h1=281.4

h2=301.4

mass=99.55

P1=80

Q=0

R=0.287

T1=280

T2=299.9

v1=1.005

Vel1=200

Vel2=0

W=0

2. The power output of a steam turbine is 100 MW. If steam expands in a reversible adiabatic (isentropic) in the turbine from the inlet conditions of 5MPa and 400°C to the exit the steam pressure of 20 kPa.

(*a*) Represent process on T-S diagram

(b) Exit entropy and enthalpy

(c) Determine the work done per unit mass of the steam flowing through the turbine.

(e) Calculate the mass flow rate of the steam

T1=400
P1=5000
Q=0
W=100000
P2=20
x2=0.95
h1=Enthalpy(Steam_NBS,T=T1,P=P1)
hf=Enthalpy(Steam_NBS,x=0,P=P2)
hg=Enthalpy(Steam_NBS,x=1,P=P2)
h2=hf+x2*(hg-hf)
Wt=h1-h2
mass=W/Wt

h1=3196
h2=2491
hf=251.3
hg=2609
mass=141.9
P1=5000
P2=20
Q=0
T1=400
W=100000
Wt=704.5
x2=0.95