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

Choose the correct answer:

1- In order for a system to be in thermal equilibrium, which of the following properties must be the same throughout the system?
A) mass   **C)** temperature
B) pressure   **D)** volume

2- 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 temperature different from the surroundings, is:
A) Mass transfer   **C)** Work transfer
B) Heat transfer   **D)** None of these

3- Which one is NOT part of the total energy of a system?
A) Sensible energy   **C)** Work
B) Chemical energy   **D)** Thermal energy

4- In which region of the property diagram below are liquid-vapor mixture states located?
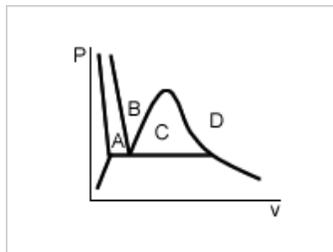
A) A   **C)** C
B) B   **D)** D

5- 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 27°C and 427°C. Is this claim valid?
A) Yes   **B)** No

6- A manufacturer claims that its refrigerator has a COP of 1.4 when cooling food at 7°C using ambient air at 23°C as a heat sink. Is this claim valid
A) Yes   **B)** No

7- According to Clausius, heat will transfer naturally from cold bodies to hot bodies
A) Yes   **B)** No

8- Which of the reversible processes listed below are used to form a Carnot cycle?
A) Isometric, isobaric   **C)** Isobaric, adiabatic
B) Isometric, adiabatic   **D)** Isothermal, reversible adiabatic

9. 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.

10. For a thermodynamic cycle
A) $\Sigma W = \Sigma Q_{added}$ B) $\Sigma W = \Sigma Q$ C) $\Sigma W_{expansion} = \Sigma Q_{added}$

11. For a reversible Carnot engine , which of the following is <u>not true</u>?
 A. The efficiency depends 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.

12. Two Carnot engine have the same minimum temperature while the maximum temperature of the second is double that of the first. Which of the following is true?
A)   The efficiency of the first is half of the second
B)   the net work of the second is twice of the first
C)   both
D)   no enough data

13. "It is impossible for any device that operates on a cycle to receive heat from a single reservoir and produce a net amount of work", this statement represents:
A) First law statement   B) Second law statement   C) Third law statement

14. "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

15. 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

<u>**Solve the following problems:**</u>

1. 10 kg of air at 127 $^{\circ}$C and 2 bar is heated in isothermal process until the volume is doubled. Represent the process on P-V diagram. Determine final pressure and calculate work done and heat added.

2. Reversible heat engine operates on Carnot cycle between two heat reservoir at 127 and 27 $^{\circ}$C. Calculate the thermal efficiency of this engine. If the cycle is reversed find the coefficient of performance of the heat pump.

3. A piston–cylinder device contains 0.1 kg of saturated water vapor that is maintained at a constant pressure of 1 MPa. A resistance heater within the cylinder is turned on until the temperature reaches 300 $^{\circ}$C. Represent process on T-V diagram and determine heat added to the system the final temperature of the steam.

4. The power output of an adiabatic steam turbine is 100 MW, the inlet conditions of steam are 2Mpa and 400°C, and the exit the steam is 15 kPa dry saturated .
(*a*) Determine the work done per unit mass of the steam flowing through the turbine.
(b) Calculate the mass flow rate of the steam

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