South Dakota School of Mines and Technology
Department of Materials and Metallurgical Engineering

MET 320 HQ 1 MI 220
9:00 AM Sept 26, 2005

CLOSED BOOK and NOTES
- NO CALCULATORS
- Algebraic Answers Preferred
- Leave R in the equation but write out its value to achieve proper units.

UNITS (Algebraic answers should be left in a form to obtain these units
- q, w, U, and H [=] Joules
- S [=] J/K
- V[=]Liters
- T [=] K
- P [=] atm

SHOW ALL WORK ON THIS SHEET.
- Turn in only the problem sheets with the problems on them.
- Keep or discard all other paper

1. One mole of ideal monatomic gas at 500 K performs 1000 J of work while receiving 300 Joules of heat. What is its final temperature?

2. Ideal diatomic gas in a diesel engine at 1 atm and 300 K is adiabatically compressed to 1/20th of it original volume. What are the final T, P and q, w, ΔU, ΔH, and ΔS for the process?

For problems 3, 4, and 5
One hundred (100) moles of ideal gas at 1000 K and 10 atm are expanded to 10 times its original volume. Find q, w, ΔU, ΔH, final T, and final V if

3. The process is conducted reversibly and isothermally.

4. The process is conducted isothermally but the work of the process is only the work to push back the atmosphere (assumed to be constant at 1 atm).

Cont'd For problems 3, 4, and 5
One hundred (100) moles of ideal gas at 1000 K and 10 atm are expanded to 10 times its original volume. Find q, w, ΔU, ΔH, final T, and final V if

5. The process is conducted isobarically.

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MET 320 HQ 1 MI 220 - 9:00 AM Sept 29, 2004

CLOSED BOOK & NOTES - NO CALCULATORS. SHOW ALL WORK ON THIS SHEET.
Turn in only this sheets with the problems on them. Keep or discard all other paper.

1. Two moles of ideal gas at 500 K and 10 L are isothermally compressed to 500 K and 1 L. Find the q, w, ΔU, ΔH, and ΔS for the process.

2. One mole of ideal monatomic gas performs 400 J of work while receiving 100 Joules of heat. What is its temperature change?

3. Ideal diatomic gas in a diesel engine at 300 K is adiabatically compressed to $1/23^{th}$ of it original volume. Show how to determine the final T, P and q, w, ΔU, ΔH, and ΔS for the process.

4. a) A Carnot-cycle heat engine is operating between two heat sinks at 1027°C and 527°C. What is the maximum theoretical work that can be produced from 100 Joules of heat?
   b) How much work would be required to move 100 Joules of heat from a refrigerator at 275 K into a room at 300 K assuming theoretical efficiency?

South Dakota School of Mines and Technology
Department of Materials and Metallurgical Engineering

Met 320 HQ 1_Makeup 3:00 PM, Oct 8, 2002
MI 220

CLOSED BOOK & NOTES - NO CALCULATORS. SHOW ALL WORK ON THIS SHEET.
Turn in only this sheets with the problems on them. Keep or discard all other paper.

1. Ten moles of ideal gas at 1000 K and 2 L are reversibly expanded to 500 K and 10 L along a straight-line path on a P-V plot. Find the final T, V and q, w, ΔU, ΔH, and ΔS for the process.

2. Three moles of ideal gas at 1000 K are reversibly adiabatically expanded from 4 L to 12 L. Find the final T, P and q, w, ΔU, ΔH, and ΔS for the process.

3. One mole of ideal monatomic gas at 2 atm and 300 K undergoes an adiabatic compression to 10 atm. Find the final T and q, ΔU, ΔH, and ΔS for the process?

4. Heat Pump and Engine questions:
   a) What is the theoretical efficiency of a Carnot Cycle engine in terms of absolute temperature?
   b) How much energy would be required to move 1000 BTU's of heat into a home at 70 F from a temperature sink at 35 F assuming theoretical efficiency?

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY
DEPARTMENT OF MATERIALS & METALLURGICAL ENGINEERING

MET 320 HQ 1 Oct 5, 2001

Constants: R = 1.987 cal/K•gmole = 8.31 J/K•gmole

1. One mole of ideal monatomic gas at 2 atm and 500 K undergoes a reversible, straight-line transition on a P-V plot to 10 atm and 1000 K. Find the amount of heat exchanged with the surroundings and described the direction (if any) of the heat exchange.

2. Three moles of ideal gas at 300 K and 1 atm are isochorically pressurized to 3 atm while exchanging heat with a heat sink at 1000 K. Find the final ΔS for the
   a) gas and
   b) heat sink.

3. Ten moles of an ideal gas at 2 atm and 500 K are adiabatically compressed to 10 atm.
   a) What is the final temperature?
   b) How much heat was required?
   c) How much work was required?

4. What is the theoretical efficiency for a Carnot-cycle heat engine operating between a boiler at 1000 K and a cold sink at 300 K?

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY
DEPARTMENT OF METALLURGICAL ENGINEERING

Met 320 HQ 1 Oct 4, 2000

CLOSED BOOK & NOTES - NO CALCULATORS. SHOW ALL WORK ON THIS SHEET. DISCARD ALL OTHER WORK SHEETS. (WORK MAY BE SHOWN ON THE BACK)

1. Three moles of ideal monatomic gas at 600 K are isothermally and reversibly expanded from 10 atm to 2 atm. Find the final T, V and q, w, ΔU, and ΔH for the process.

2. One mole of ideal, monatomic gas at 500 K and 8 atm undergoes the following reversible process:
   a) a straight-line expansion to 400 K and 2 atm followed by
   b) reversible, adiabatic expansion to 1 atm
   Find w_{NET} for the process?

3. Three moles of ideal **diatomic** gas at 300 K are adiabatically compressed from 23 liters to 1 liter. Find the final T, P and q, w, ΔU, and ΔH for the process.

4. One mole of ideal monatomic gas at 1 atm and 300 K undergoes a reversible, straight-line transition on a P-V plot to 10 atm and 1000 K.
   Find the amount of heat exchanged with the surroundings and say if the heat is added to surroundings, withdrawn from the surroundings, or is no heat exchanged?