AUB
Physics Department

Phys 210
Final exam

Jan. 23, 2006
Time:100 min

Name :_____

ID. NO :_____

Major :_____

INFO:

- No make up of this exam
- All questions are obligatory. Only one answer can be crossed in case of multiple questions. Your answer must be identified uniquely.

Page	Grade	
3)_____	/ 22	4 questions
4)_____	/ 21	4 question
5)_____	/ 35	7 questions
6)_____	/ 12	Problem 1
7) _____	/ 10	problem2

Total:

Physical Constants

$R=8.31$ J/ (Mol .K)	Gas constant
1 atm$=1.01\times10^5$ N/m^2	atmospheric pressure
$c_W=4.19\times10^3$ J(Kg .K)	specific heat of water
$L_{ice}=3.33\times10^5$ J/Kg	Latent heat of fusion
$L_{steam}=2.26\times10^6$ J/Kg	Latent heat of vaporization
$\rho_{steam}=0.598$ kg/m^3	density of steam at 100 °C
$\rho_{water}=1000$ Kg/m^3	density of water

♥ (5 points) Five moles of an ideal gas undergo free expansion from an initial volume of 20 cm ^{3} to a final volume of 100 cm^3. The change in entropy ΔS of this gas (in J / K) is:

a) 191 *b*) 52 *c*) 67
d) 67 *e*) 71

♥ (5 points) Three engines operates between reservoirs separated by 300 K.
Engine A operates between 1000 K and 700 K.
Engine B operates between 800 K and 500 K.
Engine C operates between 600 K and 300 K.

a) All these engines have the same efficiency , because the temperature difference is the same
b) Engine A has the highest efficiency
c) Engine C has the highest efficiency
d) Engine B has the highest efficiency

♥ (6 points)

1) Which of the following is true for the entropy change (ΔS) of a system that undergoes a reversible adiabatic process?

a) $\Delta S < 0$	b) $\Delta S > 0$	c) $\Delta S = 0$

2) What is the answer if the process is adiabatic but irreversible?

a) $\Delta S < 0$	b) $\Delta S > 0$	c) $\Delta S = 0$

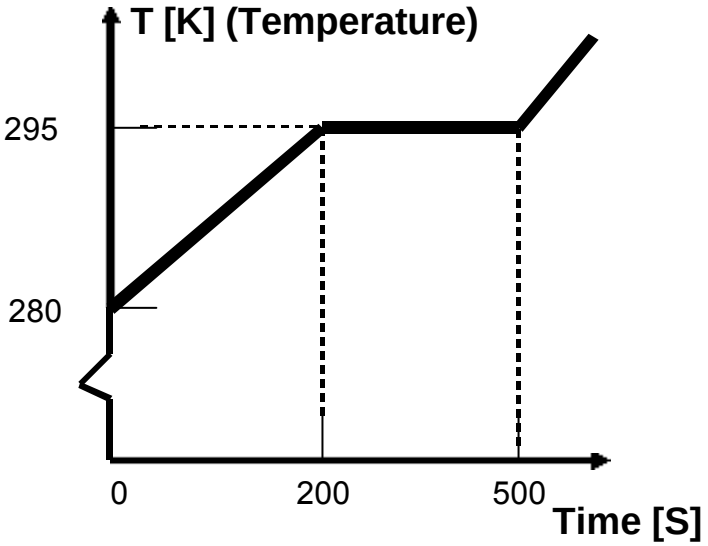
♥ (6 points) Heat is added to 0.25 Kg of a solid substance of yet unknown specific heat (C_S) at a steady (constant rate of **50 J/S** (Joules/second). The temperature T of the substance which is initially solid is shown in the adjacent Figure as a function of time

1) (3 points) The specific heat of this solid is **(in J/(Kg .K):**

a) 130	b) 750
c) 2700	d) 4000

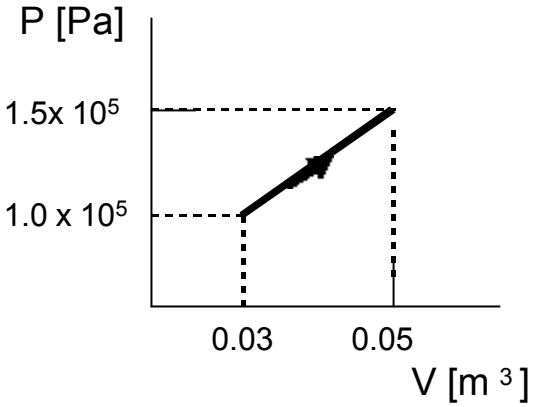
2) (3 points)The latent heat of fusion is **(in J/Kg):**

a) 3.35 x10^2	b) 6 x10^4
c) 4 x10^4	d) 200



Score: 22

♥ (6 points) An **ideal monatomic gas** of 1.8 moles undergoes the process shown in the Figure



1) The temperature change is: (3 points)

a) 200 → 300 K b) 200 → 333 K

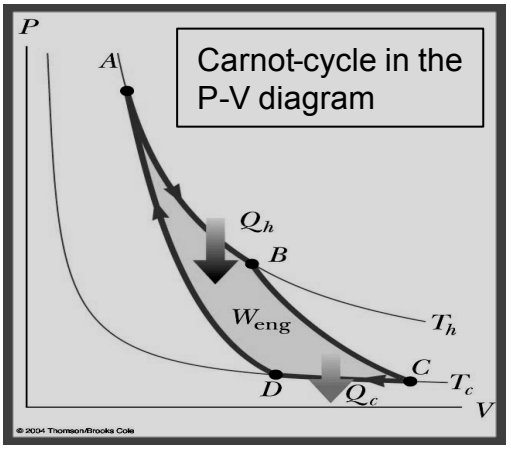
b) 300 → 500 K c) 200 → 500 K

2) The internal energy change is about (in J): (3 Points)

a) 4900 b) 6731 c) 3030 d) 4487

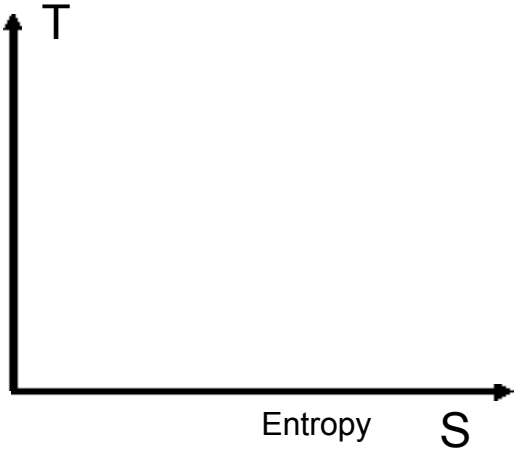
e) None of the above, my answer is:_____

♥ (4 points) A Carnot cycle operating as heat engine is shown in the adjacent Figure. It can be represented on a T-S diagram (T=Temperature, S=Entropy).



Question

Draw the Carnot Cycle in the T-S Diagram: start at A →B→C →D →A



♥ (6 points) An amount of 5.0 Kg of water at T=288 K is mixed with 3.0 Kg of water at T=348 K in an insulated container. What is the change of entropy (ΔS) of the system in **(J /K)**?

a) 1.05 x 10^5 b) 138 c) 142 d) 3000

e) none of the above, my answer is:_____

♥ (5 points) In a Carnot cycle, the entropy change is 2.57 (J/K) for the reversible isothermal expansion at T_h =500 K. What is the change in entropy for the reversible isothermal compression at T_c =300 K?

a) +2.57 J/K b) 0.0 J/K c) -2.57 J/K d) 1.54 J/K e) +1.54 J/K

Score: 21

♥ (4 points) You see two helium balloons floating close to each other (distance between them is about 2.0 cm). The balloons are fixed by strings to a table. You blow through the small apace between the balloons. What will happen to them?

a) They move away from each other b) They are not affected at all

c) They move toward each other

♥ (5 points) A beam of unpolarized light in air is incident at an angle of 58.6° (with respect to the normal) on a plane glass surface of unknown refraction index. The reflected beam is completely polarized. The refraction index of the glass is:

a) 1.60 b) 1.64 c) 1.33 d) 1.50

♥ (4 points) Suppose a **Michelson interferometer** is adjusted such that the monochromatic light beam produces a maximum in intensity at the detector. If the movable mirror is moved a distance ΔL and during this motion the intensity decreases to minimum. What is the wavelength of the light?

a) $\Delta L/4$ b) $\Delta L/2$ c) ΔL d) $2\,\Delta L$ e) $4\,\Delta L$

♥ (5 points) Monochromatic light from a He-Ne laser (λ= 632.8 nm) is incident on a diffraction grating containing 5000 lines/cm. The angle of the first-order maximum is:

a) 18.4° b) 39.2° c) 14.6° d) 27.7° e) 13.9°

♥ (5 points) A length of organ pipe is closed at one end. If the speed of sound is 344 m /s. What length of pipe (in cm) is needed to obtain a fundamental frequency of 50 Hz?

a) 1.72 b) 86 c) 344 d) 172 e) 688

♥ (6 points) A string is stretched and fixed at both ends, 200 cm apart. If the density of the string is 0.015 g/cm, and its tension is 600 N, what is the wavelength (in cm) of the fundamental harmonic?

a) 600 b) 400 c) 800 d) 200

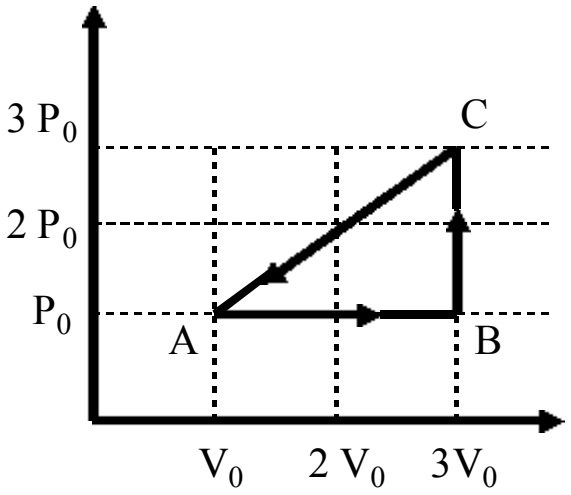
♥ (6 points) A thin film of a refraction index n_f =1.29 is to be placed on a glass plate of n=1.50. The minimum thickness for the film such that the reflection of normally incident light with λ=600 nm is minimized is (1 nm= 1 nanometer=10^{-9} m):

a) 232 nm b)58 nm c) 116 nm d) 465

Score: 35

P1) (12 points)

A substance is taken through the Cycle shown in Figure.



Given:

P_0 [pa]	V_0 [m^3]	Q_{AB} [J]	Q_{BC} [J]
10^5	10^{-3}	450	200

Q_{AB}= heat absorbed by the system from A→B,
Q_{BC}= heat absorbed by the system from B→C

a) (4 points) What is the work done on the gas during the cycle?

b) (4 points) If the internal energy in the state B is $(E_{int})_B$ =200 J, what is the $(E_{int})_C$?

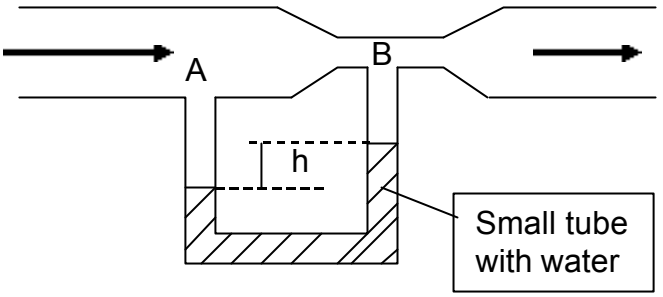
c) (4 points) What is the amount of heat used during the process C→A.
Is this heat absorbed or rejected by the system?

P2) (10 points)

In the Figure, air moves the horizontal tube. At point A the air speed is v_A =2.0 m /s and the radius is of the tube is r_A = 0.05 m. At point B the radius is r_B = 0.02 m. The small tube contains some water.

The density of the air is ρ_a =1.29 Kg/m^3.

Take gravitational acceleration g=10 m/s^2



a) Calculate the speed at point B, v_B.

b) Find the height h indicated in the Figure between the water level in the small tube