

Principles of Physics II (PHY 112)

Practice Exam 1

Question 1 (4 points) Consider the isothermal expansion of an ideal gas. Is heat added to the gas? Does heat transfer from the gas to the surroundings? Does no heat transfer? Or do you need more information? Explain your answer.

Question 2 (4 points) Explain how you can make the temperature of a gas increase without heating it. (In other words, without adding heat to the gas.)

Question 3 (4 points) A gas generally has a heat capacity at constant pressure that is different from its heat capacity at constant volume. Which is bigger? Explain why.

Question 4 (4 points) A mass M_I of ice at a certain initial temperature T_I is combined with a mass M_W of water at a higher initial temperature of T_W . The two are allowed to come to thermal equilibrium without gaining or losing thermal energy to the surroundings. Consider the following energies that would be needed or released *if* the processes described were to occur.

Energy required to heat mass M_I of ice from T_I to 0°C	200,000 J
Energy required to melt mass M_I of ice at 0°C	1,000,000 J
Energy released in freezing mass M_W of water at 0°C	150,000 J
Energy released in cooling mass M_W of water from T_W to 0°C	25,000 J

Will the final state be all water, all ice, or a mixture of ice and water? Explain how you know.

Problem 1 (14 points) The Carnot cycle consists of the following four processes.

- (1) Adiabatic expansion
- (2) Isothermal expansion
- (3) Adiabatic compression
- (4) Isothermal compression back to the initial state

Suppose the initial state of the ideal gas used in this cycle is a temperature of 300 K, a pressure of 150 kPa, and a volume of 2 L. The heat capacity at constant volume for the gas is $C_V = \frac{5}{2}nR$, and has this value at all temperatures. During process (1) (the adiabatic expansion), the gas expands from 2 L to 4 L. During process (2) (the isothermal expansion), the gas expands from 4 L to 6 L. Complete the following tables. Don't forget to include appropriate units (at least at the top of each column).

State	P	V	T	E_{int}
initial				
after process (1)				
after process (2)				
after process (3)				

Process	ΔE_{int}	Q_{in}	W_{on}
(1)			
(2)			
(3)			
(4)			

Problem 2 (8 points) A 500-g chunk of copper at 150°C is placed in a 400-g aluminum cup filled with 600 g of water. Prior to the arrival of the copper, the aluminum and water were happily in equilibrium at 20°C . What is the final temperature of the mix, assuming no heat is lost to the ambient air?