1) A heat engine has a thermal efficiency of 20%. It runs 2 revolutions per second and delivers 80 W. For each cycle find the heat discharged to the cold reservoir. \( A: 160 \text{ W} \).

2) Two moles of an ideal gas undergo an adiabatic free expansion from an initial volume of 0.6 L to 1.3 L. Calculate the change in entropy of gas. \( A: 12.9 \text{ J/K} \).

3) System A (one kilogram of ice at zero degrees Celsius) is added to system B (one kilogram of water at 100 degrees Celsius) in an insulator container. Calculate the total change in entropy of system A. \( A: 1.37 \text{ kJ/K} \).

Major T-031

Five moles of an ideal gas undergo a reversible isothermal compression from volume \( V \) to volume \( V/2 \) at temperature 30 degrees C. What is the change in the entropy of the gas? \( A: -29 \text{ J/K} \).

(2) An automobile engine operates with an overall efficiency of 20%. How many gallons of gasoline is wasted for each 10 gallons burned? \( A: 8 \).

(3) A heat engine operates between 600 K and 300 K. In each cycle it takes 100 J from the hot reservoir, loses 25 J to the cold reservoir, and does 75 J of work. This heat engine violates:
A1 The second law but not the first law of thermodynamics. A2 Both, the first law and the second law of thermodynamics. A3 The first law but not the second law of the thermodynamics. A4 Neither the first law nor the second law. A5 Conservation of energy.

Major T-032

1) One mole of a monatomic ideal gas is taken from an initial state (i) to a final state (f) as shown in figure 1. The curved line is an isotherm. Calculate the increase in entropy of the gas for this process. \( A: 36.5 \text{ J/K} \).

2) One mole of a diatomic ideal gas is taken through the cycle shown in Figure 1. Process b->c is adiabatic, \( P_a = 0.3 \text{ atm}, V_b = 1.0*10^{-3} \text{ m}^3, V_c = 4.0*V_b \). What is the efficiency of the cycle? \( A: 53\% \).

3) You mix two samples of water, A and B. Sample A is 100 g at 20 degree-C and sample B is also 100 g but at 80 degree-C. Calculate the change in the entropy of sample B. \( A: -8.9 \text{ cal/K} \).

4) What mass of water at 0 degrees-C can a freezer make into ice cubes in one hour, if the coefficient of performance of the refrigerator is 3.0 and the power input is 0.2 Kilowatt? \( A: 6.5 \text{ kg} \).

Major T-011

1) An ideal monatomic gas is confined to a cylinder by a piston. The piston is slowly pushed in so that the gas temperature remains at 27 degree C. During the compression, 750 J of work is done on the gas. The change in the entropy of the gas is:
A. \(-3.0 \text{ J/K}\).

2) An ideal engine, whose low-temperature reservoir is at 27 degrees Celsius, has an efficiency of 20 %. By how much should the temperature of the high-temperature reservoir be increased to increase the efficiency to 50 % ? A: 20k

Major T-002

One mole of an ideal gas undergoes the thermodynamic process shown in figure (2). If the process BC is an isothermal, how much work is done by the gas in this isothermal process? \( A: 0.56*10^{**3} \text{ J} \).

Major T-001

Two moles of helium (monatomic) gas are heated from 100 degree Celsius to 250 degree Celsius. How much heat is transferred to the gas if the process is isobaric? \( A: 6.23*10^{**3} \text{ J} \).

(2) What is the coefficient of performance of a refrigerator that absorbs 40 cal/cycle at low temperature and expels cal/cycle at high temperature? \( A: 3.6 \).

(3) A heat engine absorbs 8.71*10**3 J per cycle from a hot reservoir with an efficiency of 25% and executes 3.15 cycles per second. What is the power output of the heat engine? \( A: 6.86*10^{**3} \text{ w} \).

Major T-099

1) A 10 kg piece of ice at 0 degree Celsius is changed slowly and reversibly to water at 70 degrees Celsius. What is the change in entropy of the Ice? \( A: 2.2*10^{**4} \text{ J/K} \).

(2) What is the coefficient of performance of a refrigerator that absorbs 40 cal/cycle at low temperature and expels 51 cal/cycle at high temperature? \( A: 3.6 \).

(3) A heat engine absorbs 8.71*10**3 J per cycle from a hot reservoir with an efficiency of 25% and executes 3.15 cycles per second. What is the power output of the heat engine? \( A: 6.86*10^{**3} \text{ w} \).