## Practice Problems

1. High-performance aircraft and rockets are two examples of things that consume fuel at ludicrous rates. This means that if you define your system as the plane or rocket, the rate of mass leaving the system shouldn’t be neglected.   
     
   For this problem you are going to calculate the net energy transport rate [Btu/sec] of an aircraft that has a constant specific internal energy (plane isn’t changing temperature) of 3500 Btu/lbm, a mass of 32,000 lbm, and is flying horizontally (inverted, if you’re a Top Gun fan) at 30,000 ft, and at a constant speed of 500 ft/sec. While doing this, the aircraft is consuming fuel at a rate of 50.0 lbm­/min. Because of this unusually high rate of mass being ejected, use equation 4.10 to solve for the net energy transport rate.
2. You’ve got a large (but still portable) generator being powered by a combustion engine. The engine is sending 300 hp of shaft power to the generator. The generator is producing 200 kW of electricity. Under these conditions, what rate of heat transfer [Btu/hr] must be provided to the generator to keep it from overheating?
3. You have a sealed, rigid container with a volume of 0.566 m3. It is filled with steam that is at 0.800 MPa and 250 °C. You want to turn this superheated steam in to a saturated vapor. Calculate the following:
   1. How much mass of water [kg] is inside your container?
   2. What is the temperature [°C] when it reaches saturated vapor?
   3. How much heat energy [kJ] needs to be removed?

## Preparatory Reading Questions

1. Write the expression for work performed by an ideal gas during isothermal expansion/compression. Define all terms in this expression. Give the SI and English units for each term.
2. Write the expression for work performed by an ideal gas during a polytropic (but not isothermal) expansion/compression. Define all terms in this expression. Give the SI and English units for each term.
3. What is the special thermodynamic meaning of the words adiabatic and aergonic? Give an example of a physical system/process where each of these applies.
4. Reflect on the amount of time you spent outside of class per class session in this class. What are two tips for your fellow classmates to that could make for greater efficiency or effectiveness?

## Answers to Practice Problems

1. Net energy transport rate is around -2,953 [Btu/sec]
2. Heat transfer rate will need to be -80,900 [Btu/hr]
3. Heat transfer for this process will be -280.7 [kJ]