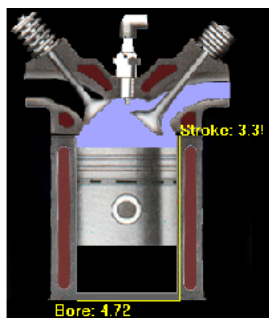


## Lecture Notes I: Thermo Problems

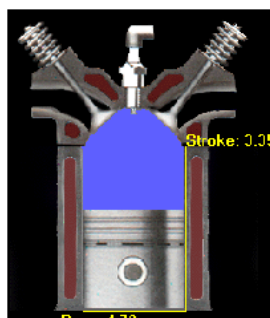
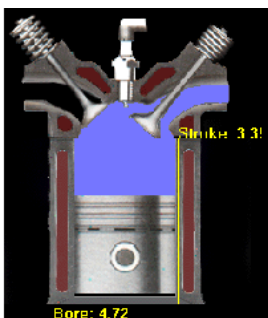
### *Problem*

10.0 g of  $\text{CaCl}_2$  are added to 100.0g of water. If the initial temperature of both the salt and the water is  $25.0^\circ\text{C}$ , what is the final temperature of the solution after the salt dissolves?

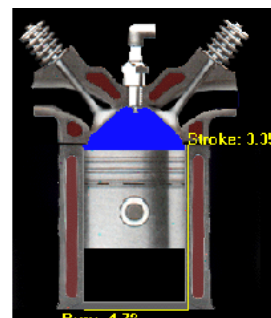
### 1) Basic operation of a four stroke engine



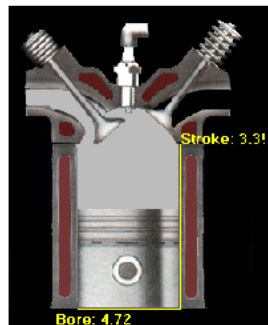
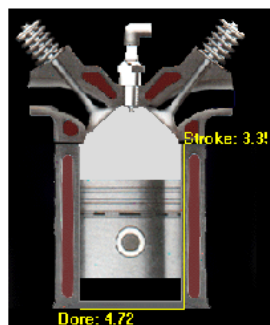
Stroke 1: The intake valve opens, and the piston moves down. This brings a mixture of air and fuel into the chamber.



Stroke 2: The piston moves up, compressing the gas.



Stroke 3: The spark plug then initiates the combustion of the gas. The explosion pushes the piston down. The piston is connected to a crankshaft that delivers power to the drive train and the wheels.



Stroke 4: The exhaust valve opens, and the piston moves up, pushing the exhaust fumes out of the chamber.



**Problem**

We'll assume the engine is using hexane ( $\text{C}_6\text{H}_{14}$ ) as a fuel, and assume that all of the hexane is consumed to form  $\text{CO}_2(\text{g})$  and  $\text{H}_2\text{O}(\text{g})$  (water vapor). The heat of combustion of  $\text{C}_6\text{H}_{14}$  is  $-3886.7\text{kJ/mol}$

The fuel injector of a car creates a mixture of fuel and air. This mixture is injected into the cylinder in Stroke 1. We'll assume the fuel injector is creating a 0.75% mixture of hexane in air. In stroke 2, the gas is compressed. The volume of the chamber before compression is 0.80 liter, and the compression ratio is 5. After the compression, the spark plug initiates the combustion. We'll assume that the temperature of the air-fuel mixture is  $30^\circ\text{C}$  when it is brought into the chamber, and that it remains fixed at  $30^\circ\text{C}$  until the spark plug initiates the explosion.

a) How much heat is generated by the explosion (in kJ)?

b) What is the temperature of the gas after the explosion?

c) What is the pressure of the gas in the chamber after the explosion. (Assume that the piston remains at the top of the chamber.)?