Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ number:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Q (15 point): During an industrial facility audit, you collected the following boiler data:

Stack temperature = 670 oF

Ambient temperature = 70 oF

Fuel type: oil #2

Fuel cost = $1.6 per liter

Fuel calorific value = 36 MJ/L

Daily boiler demand (load) = 1.25 GJ/day (as steam at boiler output, before distribution system)

# of working days = 250 per year

Current O2% level = 9%

Auxiliary systems energy consumption = 20 kWh/day

Distribution system losses = 200 MJ/day

1. Calculate the combustion, gross and net efficiencies.
2. If O2% level is reduced to 4%, calculate the new combustion, gross, and net efficiencies.
3. Calculate the estimated annual **energy** saving due to combustion efficiency (only) improvement.
4. Calculate the estimated annual **cost** saving due to combustion efficiency (only) improvement.
5. If the distribution losses can be lowered to 50MJ/day, which efficiency will be affected? And what is the new value?