Name: LRR Grade: ______________

FSC 401

Quiz #4

Read the following statements carefully and indicate whether they are true (T) or false (F).

Note: For partial credit (if an answer is incorrect), summarize the procedure you used to obtain the answer and show the relevant calculations. If necessary, make the most convenient (and hopefully reasonable) assumptions.

F (33%) If we switch from a 20 mpg car to one whose efficiency is 30 mpg, and the car is driven 15,000 miles per year, the annual CO_2 savings exceed 10^3 kg of carbon per car.

$$\text{C-footprint of gasoline} = \frac{8\times12 \text{ kg C}}{(8\times12+18) \text{ kg gas}} \frac{0.8 \text{ kg gas}}{1 \text{ L}} \frac{3.8 \text{ L}}{1 \text{ gal}} = 2.56 \frac{\text{kg C}}{\text{gal}}$$

$$\left.\begin{matrix} \text{gal/yr \#1} = 750 \\ \text{gal/yr \#2} = 500 \end{matrix}\right\} \Rightarrow \text{Savings} = \left(250 \frac{\text{gal}}{\text{yr}}\right)\left(2.56 \frac{\text{kg C}}{\text{gal}}\right) = 640 \frac{\text{kg C}}{\text{yr}} < 10^3$$

F (33%) If the efficiency of a 1000-MW power plant (10,000 BTU/lb coal at 85% CUF) increases from 33 to 35%, the annual CO_2 savings exceed 10^9 kg of carbon.

$$\text{Coal input \#1} = 7.7\times10^9 \frac{\text{lb}}{\text{yr}} \Rightarrow \text{C emissions \#1} = 2.62\times10^9 \frac{\text{kg C}}{\text{yr}}$$

$$\text{〃 \#2} = 7.26\times10^9 \text{〃} \qquad \text{〃 \#2} = 2.47\times10^9 \text{〃}$$

$$\Rightarrow \text{C-savings} \cong 1.5\times10^8 \frac{\text{kg C}}{\text{yr}} < 10^9$$

F (34%) If natural-gas-based electricity requires an investment of 500 million dollars for a 500 MW plant, and if the cost of gas is \$5/10^6 BTU and the other annual operating costs add up to 10% of the investment, a crudely estimated payback period (without taking into account the time value of money) exceeds 10 years if the price of electricity is 10 cents/kWh.

$$\frac{\text{kWh}}{\text{yr}} = 3.72\times10^9 \Rightarrow \frac{\$}{\text{yr}} = 3.72\times10^8/\text{yr} \quad \text{(revenues)}$$

$$\text{Expenses} = \underbrace{1.59\times10^8}_{\text{fuel}} + \underbrace{5.0\times10^7}_{\text{other}} = 2.09\times10^8 \$/\text{yr}$$

$$\Rightarrow \text{Annual profit} = 1.64\times10^8 \text{ (\$)}$$

$$\text{Payback} = \frac{\$\, 5\times10^8}{1.64\times10^8 \frac{\$}{\text{yr}}} \cong 3.1 \text{ yrs} < 10$$