MAE 119 WINTER 2017
PROFESSOR G.R. TYNAN

QUIZ 1 CLOSED BOOK CLOSED NOTES

1. List three non-economic human quality-of-life metrics that are correlated with energy access which were discussed in the readings. (5 points each, 15 points total)

2. What are the top three primary energy sources in use globally today? (5 points each, 15 POINTS TOTAL)

3. Suppose a typical US resident consumes 4000 kW-hr of electrical energy per year. If this energy is produced by burning coal, how much carbon emission results from this energy consumption? Assume coal releases 30 MJ/kg, and that coal is 100% carbon, and that the coal is converted into electrical energy with an efficiency of 30%. An answer to one significant figure is sufficient. 15 points.

4. A particular machine maintains horizontal motion across Earth's surface by exerting a force of 1000 N over a distance of 100km in 5000 seconds. (15 PTS Total)

    a. How much energy is dissipated in doing this? (5 points)
    b. What is the mechanical power that the machine must be able to develop? (5 points)
    c. If the work done here is produced by burning fuel with an energy content of 100 MJ/kG and converting this heat to mechanical work with an efficiency of 10%, how much fuel will be consumed? (5 points)

Solution to Quiz 1

Jan 18, 2017

Problem 1

- Oil
- Gas
- Coal

Problem 2

$$Etot = 4000 \times 10^3 * 60 \times 60;$$
$$EC = 30 \times 10^6;$$
$$mC = \frac{Etot}{0.3\ EC};$$
$$mCO2 = ScientificForm\left[\frac{44\ mC}{12}\right]$$

$$"5.86667" \times 10^{"3"}\ (kg)$$

Problem 3

a.

$$Force = 1000;\ Dist = 100 \times 10^3;$$
$$Work = Dist * Force$$

$$100\,000\,000\ (Joule)$$

$$"1.00000000" \times 10^{"8"}\ (Joule)$$

b.

$$Time = 5000;$$
$$Power = \frac{Work}{Time}$$

$$20\,000\ (W)$$

c.

$$\text{Fuel} = \frac{\text{Work}}{0.1 \times 100 \times 10^6}$$

10. (kg)

Problem 4

As the access to energy increase,

- literacy rates increase
- child mortality decreases
- life expantancy increases
- Human Development Index (HDI) increases

It might be concluded that the increase in energy access, e.g. the energy use per person, increases economic activities other than agriculture and thus the income per person, which can improve the quality of life.