MAE 119 Winter 2018
Quiz 1 Prof. G.R. Tynan
Closed Book/Closed Notes/No electronic devices

1. Name at least 4 primary energy sources in use today. (4 pts)

2. Describe 4 human quality of life measures that are correlated with access to energy resources (4 pts)

3. What are the three main end uses of energy today? (3 pts).

4. Suppose the world has a population of 10 billion people, each of whom has access to 1000 kW-hr of energy per year. This energy is produced by the combustion of natural gas which has a carbon intensity of 0.05 kG-C per MJ of energy release.
    a. In this scenario, what is the annual C emission rate? Note: 1kW-hr = 3.6 MJ. An answer to one significant figure is sufficient. (10 pts).

    b. How does the emission rate in problem 3 above compare to present day global C emission rates? (5 pts).

5. Suppose you wish to store enough energy to power a region the size of San Diego, which consumes an average power of 2 GW, for 10 hours. You have two water reservoirs available to use in a pumped storage system in which water is pumped up hill, thereby storing energy in the gravitational potential energy of the water in the higher reservoir; this water can then be discharged thru a turbine into the lower reservoir, thereby releasing the stored potential energy. If the two reservoirs are separated by an elevation of 200m, what is the volume of water that must be accommodated in the higher reservoir? You may take Earth's gravitational acceleration to be equal to 10 m/s^2. The density of water is $1000 kG/m^3$. (10 pts).

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1) Oil, Gas, Coal, Nuclear

2) Child mortality, Life expectancy, Literacy rate, HDI(Human Development Index), The Income

3) Electric utilities, Transportation, Industrial, Residential /commercial

4/a) $E_{\text{total use}} = 10 \times 10^9 \times 1000 = 10^{13} \left(\frac{kWhr}{year}\right)$ 1 Gigatonne $= 10^{12}$ kg

$E = 10^{13} \times 3,6 = 3,6 \times 10^{13} \left(\frac{MJ}{year}\right)$

$C_{\text{emission}} = 0,05 \times 3,6 \times 10^{13} = 0,18 \times 10^{13} \left(\frac{kgC}{year}\right) = 1,8 \left(\frac{\text{Billion tone}}{year}\right)$

$= 1,8 \left(\frac{\text{Gigatonne C}}{year}\right)$

b) Present day global C emission rates are close to 10 billion of tones per year, So it is much less than the current total C emissions.

5) $E = 26W \times 10 \times 60 \times 60 = 72000\,(GJ)$

$72000(GJ) = \Delta P = mgh = Vegh$

$72000 \times 10^9\,(J) = V \times 1000 \times 10 \times 200$

$V = 36 \times 10^6\,(m^3)$