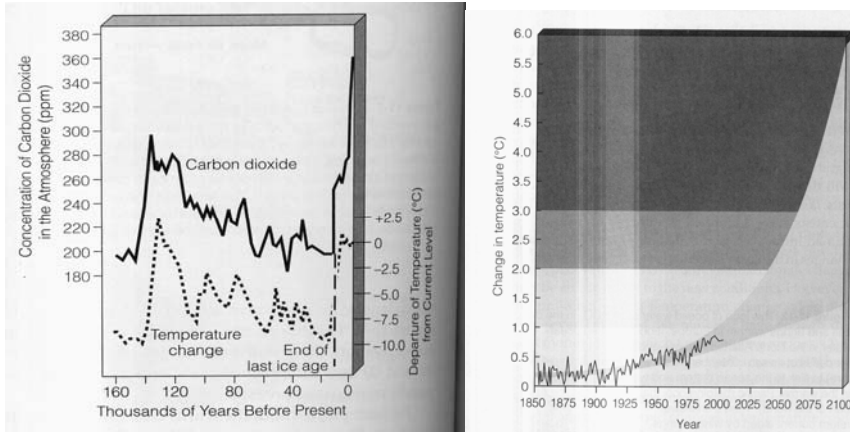


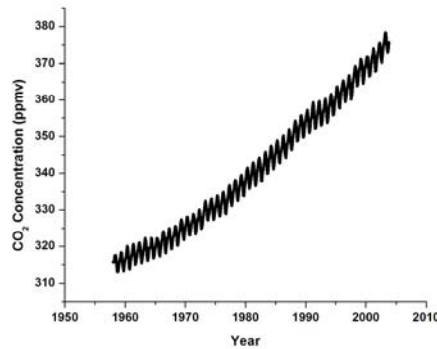
Part I Answer three of the following five questions (60%).



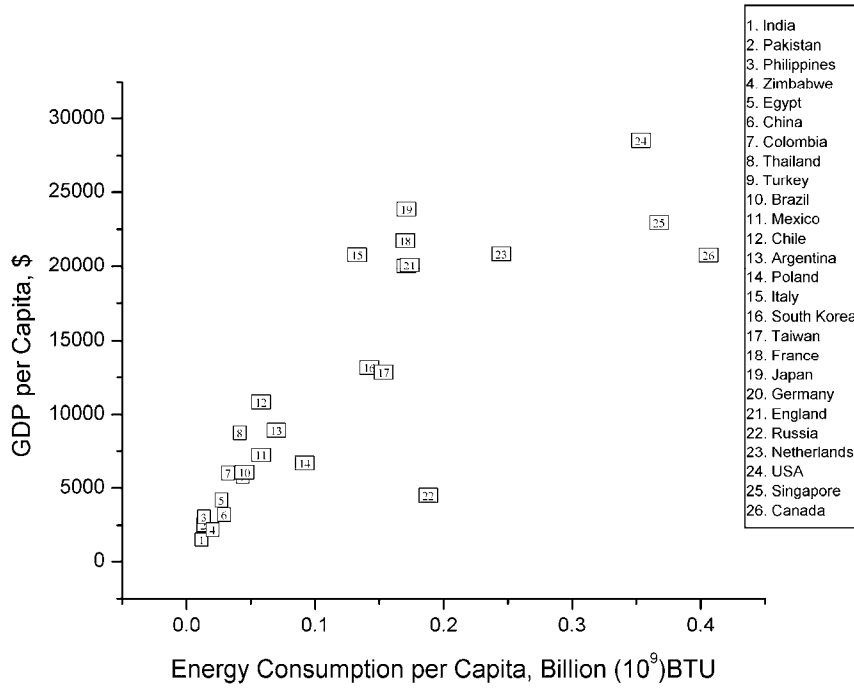
1. The two graphs above represent data on temperature changes and CO₂ atmospheric concentration during the last 160000 years that were measure by analyzing ice cores that were drilled in Antarctica (left figure) and temperature changes during the last 150 years that were measured through direct measurements all over the planet.

Use these data to argue for or against anthropogenic (man induced) contributions to global climate change.

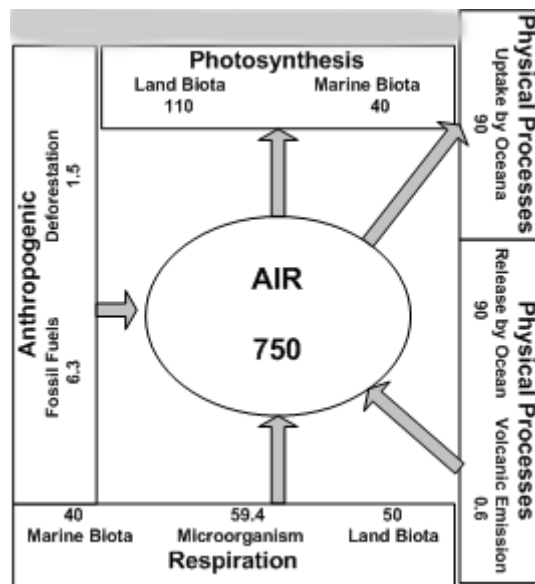
- 2.



The graph above shows Carbon Dioxide Concentrations as observed at Mauna Loa. (Source : C.D. Keeling and T.P. Whort in the Carbon Dioxide Information Analysis Center (CDIAC) – Oak Ridge National Laboratories – 2004). It was referred by many as measuring the breathing of planet earth – **explain!**



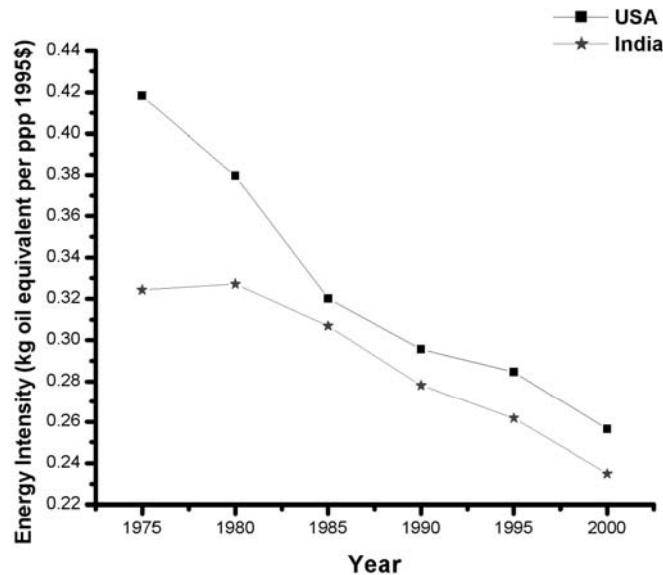
3. The graph above, depicts GDP/Capita of various countries. It is being argued that it quantifies the conflict between developing and developed countries in trying to coordinate a global response to anthropogenic climate change. **Explain.**



4. The schematic above describes the atmospheric carbon budget. (Fluxes are in Gt-C/year; air quantity in Gt-C). Describe the processes that take place.

5. The IPAT equation given below tries to separate the various factors that contribute to the anthropogenic atmospheric release of carbon dioxide.

$$\frac{CO_2}{Year} = Population \left(\frac{GDP}{Population} \right) \left(\frac{Energy}{GDP} \right) \left(\frac{FossilFuels}{Energy} \right) \left(\frac{CO_2}{FossilFuels} \right)$$



The recent trend in energy intensity both in India and the US is shown in the graph above. Try to account for the decline in both countries and the apparent convergence in trend. Why such a decline is so important for the establishment of a sustainable planet?

Part II Answer two of the following four questions (40%).

1. Assume that your food intake constitute only of glucose – $C_6H_{12}O_6$. The digestion of glucose follows the following chemical reaction:



The molecular weights of these compounds are: Glucose – 180, Oxygen – 32, CO_2 – 44, H_2O – 18.

Your average caloric intake is 2000 kCal. Estimate your daily exchange of CO_2 .

2. Assume that we have 1000 trees on campus and that each tree weigh's 10 metric tons (1 metric ton = 1000kg). Assume that the trees are made of glucose and take the details of burning (oxidation) of glucose from problem 1. Estimate the amount of carbon dioxide stored in the trees on campus.

3. I use 15 therms/month of natural gas and 230kwh of electricity. I drive 25miles/day in a car that is rated at 25miles/gallon. What is my average energy use per day. Use the following energy conversions:
1Btu = 0.25kcal; 1therm = 25,000 kcal; 1 kwh = 850 kcal; Burning of 1 gallon of gasoline produces 31, 470 kcal.

4. The 2000 GDP/Capita of India is \$500 with a growth rate of 4.1% in inflation adjusted dollars. The GDP/Capita of the US is \$36,000 with a growth rate of 1.9%. If we neglect population growth and assume constant growth rates, when will India catch up with the US?