Homework #3 **Geology 1020** **FULL Name (clearly):_____KEY_______**

1. (0.5 pts.) Which major component of the Earth system is the fundamental driving force for the Earth's H_2O cycle? (circle one)
   A. Oceanic circulation
   B. Rising water vapors and the jet stream
   C. Tropical rain forests
   D. Solar energy
   E. Glacial and river discharge

2. (2 pts.) Briefly list at least two key observations, or lines of evidence, that were used by early plate-tectonic advocates (*e.g.* Alfred Wegener, Alexander Du Toit) to demonstrate that the separate continents had once originated from a single landmass (use the back of this sheet to answer this question; please just make a list, a long commentary is not needed).

For this question, I was looking for evidence from comparative stratigraphy between South America and southern Africa, paleontological evidence (e.g. Mosasaurus), plate reconstructions linking continents using glacial striations, mountain ranges and so on.

3. (0.5 pts.) In a balanced (pre-Industrial!) "equilibrated" Earth system, subsequent **increases** in the global deposition of marine organic matter on the continental shelves or in deep marine sedimentary basins would result in the following atmospheric effects (circle one):
   A. An **increase** in the Earth's N_2 and a **decrease** in O_2 levels
   B. A **reduction** in the Earth's O_2 and an **increase** in CO_2 levels
   C. A reduction in the Earth's CO_2 and an increase in O_2 levels
   D. A **reduction** in the Earth's CO_2 and a **reduction** in O_2 levels
   E. An **increase** in the Earth's CO_2 and an **increase** in O_2 levels

4. (0.5 pts.) When the rate of burial of isotopically **light** (*i.e.* **low** $^{13}C/^{12}C$ values) organic material (C_{org}) **decreases** in marine sediments, the Earth's **atmospheric and oceanic CO_2 reservoir** – i.e. the CO_2 that is dissolved in water and in air and upon which phytoplankton and reef builders depend for photosynthesis – becomes (circle one)

A. Isotopically heavier or enriched in ^{13}C

B. Steady and unchanging with time because it's always in equilibrium

C. Isotopically heavier or enriched in ^{14}N

D. Isotopically lighter or enriched in ^{16}O

E. Isotopically lighter or enriched in ^{12}C

5. (1.5 pts.) The carbon isotope ratios of $^{13}C/^{12}C$ in sedimentary rocks provide geologists with information about
    1. *Ancient atmospheric oxygen concentrations*
    2. *Paleoclimates ("ancient climates") linked with past greenhouse gas levels*
    3. *Rates of burial of organic matter*

Briefly discuss how these isotopes are used to assess changes in the ancient environmental factors listed above. (Use the back of this sheet**)**

Question #5.

1. **Ancient oxygen can be deduced in much the same fashion as Question #4 lays the problem out. When isotopically light carbon is buried, it leaves behind isotopically heavy CO2 in the atmosphere. This CO2 is used by plants leading to progressively heavy organic matter. Under these conditions, oxygen concentrations in the atmosphere are on the increase. So, changes in organic matter 13C/12C ratios from lower to higher values means atmospheric O2 is on the rise. The reverse is also true. As organic matter 13C/12C ratios go DOWN, it means more organic matter is being oxidized and returned to the atmosphere at CO2. This results in more 12C in the atmosphere and a draw down of O2.**

2. **If CO2 goes up, it tends to heat the atmosphere. When CO2 levels drop, the atmosphere cools. Warming or cooling of the atmosphere has profound effect on the climate and habitats for life.**

3. **If rates of organic matter burial are on the increase, it means that less oxygen is being consumed for respiration-oxidation-decomposition of the organic matter. O2 then builds up in the atmosphere, CO2 levels drop and the CO2 that's left over becomes progressively enriched in 13C.**