## Part I – Short Answer

Choose a letter to fill in the blanks. Use choices as many times as you wish. Only one choice is needed per blank. All are 3 points each.

**1.**

**A. ammonia**
**B. CFCs**
**C. HCFCs**
**D. HFCs**
**E. NONE of these**
**F. ALL of these**

_____Which can be used as a **refrigerant gas**?

_____Which has the **longest lifetime** in the atmosphere?

_____Which one is **highly toxic**?

_____Which of these is **highly soluble** in water?

**2.**

**A. 1 mole of ethanol (= ethyl alcohol)**
**B. 1 mole of ethane**
**C. 1 mole of ethene (=ethylene)**
**D. 1 mole of ethyne (=acetylene)**
**E. ALL of these are the same**

____ has the smallest **mass**

____ contains the largest number of **atoms** (these atoms can be part of molecules)

____ contains the smallest number of **molecules**

____ produces the most **moles of $CO_2$** when burned

**3.**

**A. Visible light**
**B. UV radiation**
**C. IR radiation**
**D. ALL of these**
**E. NONE of these**

_____ Provides the energy that green plants use for photosynthesis.

_____ Can cause the oxygen molecule to vibrate (stretch and bend)

_____ Can break the bond in the oxygen molecule.

_____ Is emitted by the Earth as well as the Sun.

**Part II. Gasoline (first part)**

**1.** Hexane is a component of gasoline. The density of hexane is 0.658 g/ml.

**a.** (4 points) Which would weigh more, a milliliter of hexane or a milliliter of water?

hexane Explain your reasoning in 10 words or less:

water

the same

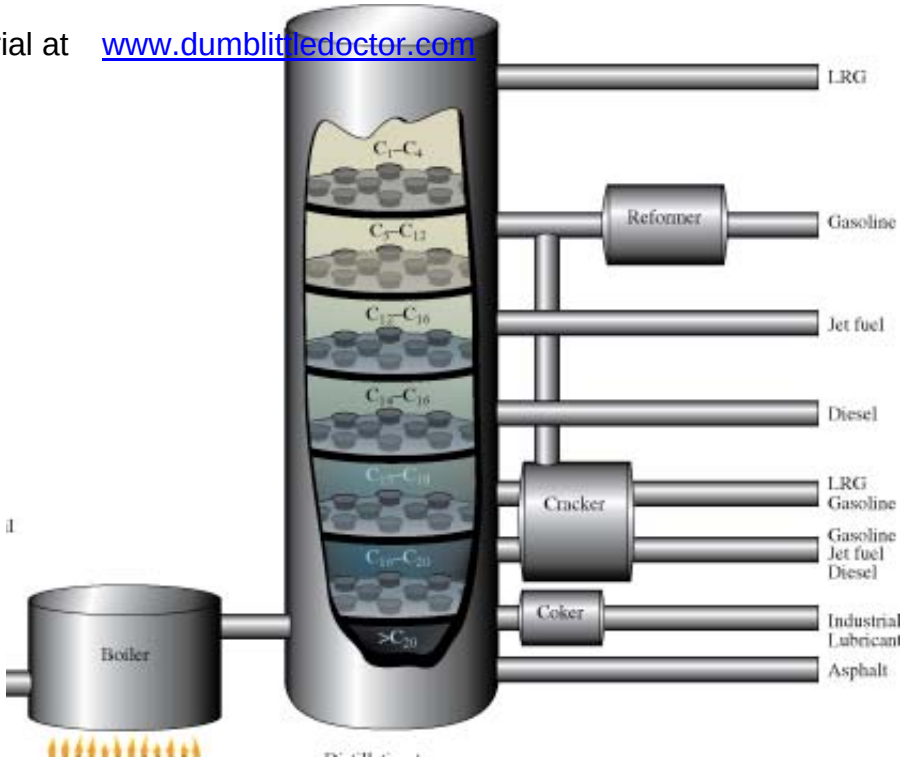
**b.** (3 points) There are _____ milliliters in 4000 grams hexane. SHOW WORK.

**c.** (7 points) If you burn 3,500 grams of hexane (roughly a gallon) in plenty of oxygen, how many grams of carbon dioxide do you get? SHOW WORK.

**2.** (9 points) $C_6H_{12}$ is another component of gasoline. Draw structural formulas for any 3 isomers of $C_6H_{12}$. Show all bonds and all H atoms.

**Part III. Gasoline**
**(second part)**

Yep, here is a refinery tower from your textbook.




**1.** (9 points) Fill in the blanks:

Shown at the bottom left of the figure is a pipe. Through it, _____ is fed into the boiler.

This boiler is necessary because heat is required to

_____.

In the figure, LRG refers to "Liquefied Refinery Gas." Give the name of one of the refinery gases produced that can be liquefied _____.

2. (3 points) In the U.S., the "cracker" shown on the figure is needed. Explain why in 20 words or less why we choose to crack the heavier fractions in the U.S..

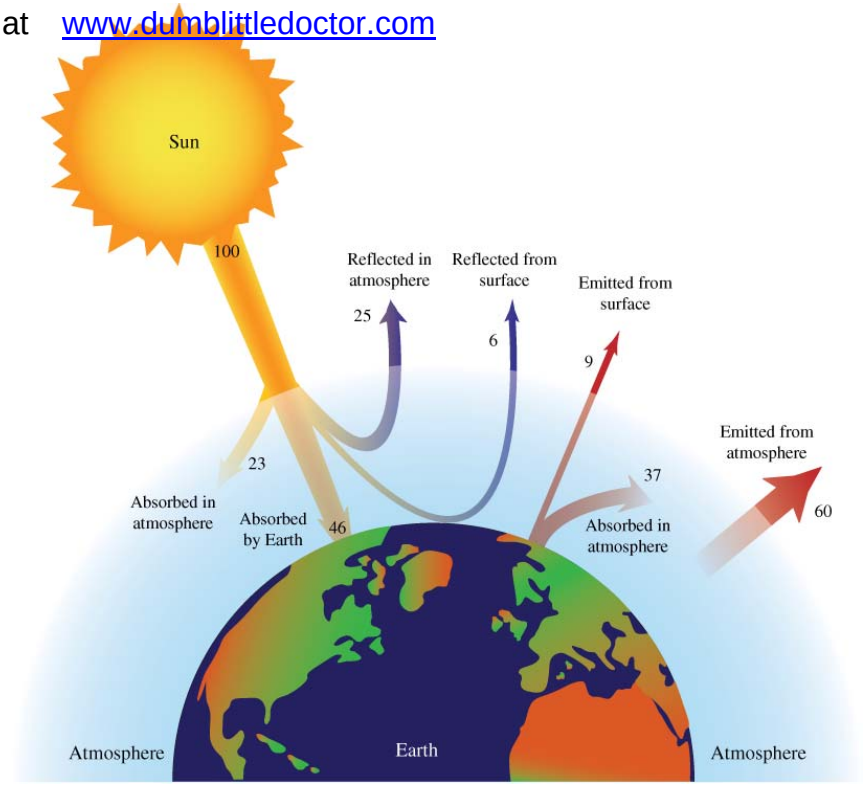
3. (5 points) Speaking of cracking, write a chemical equation that shows how a saturated hydrocarbon molecule containing 16 carbon atoms can be thermally cracked to produce two molecules each with 8 carbon atoms.
Note: Chemical formulas are fine – you don't have to draw out the structures.

4. (3 points) Give one reason that catalytic cracking was an improvement over thermal cracking.

5. (5 points) Hydro-cracking uses the process of hydrogenation to get rid of the alkenes that can gum up your engine. To save you drawing the big structural formulas for the molecules in gasoline, let's deal with propene, a smaller alkene. Use structural formulas (show bonds and atoms) to show the chemical equation for the hydrogenation of **propene**.

## Part IV – The Earth as a Greenhouse

The Sun emits UV, visible, and IR radiation. Four arrows on the figure relate to the Sun's emission.




**1.** (3 points) Explain why much of the UV light emitted by the Sun does not reach the surface of the Earth.
(15 words or less)

**2.** (3 points) Other than absorption, explain why a significant amount of the visible light emitted by the Sun does not reach the surface of the Earth. (15 words or less)

**3.** (6 points) Which of these wavelengths does the Earth (= rock, dirt, ground, pavement) emit? Circle those that apply.

**UV visible IR**

**4.** The Greenhouse effect.

**a.** (3 points) One of the arrows on the figure is primarily responsible for the greenhouse effect. Write the text label that goes with this arrow here:

**b.** (3 points) Use the numerical value on this arrow to explain the term "enhanced greenhouse effect".

**5.** (4 points) In the atmosphere, CFCs are present only at the parts per trillion level. Even so, they have a large potential to cause global warming. Explain why.

**Part V – The Carbon Cycle**

1. (5 points) Limestone can contain **calcium carbonate**. Write the balanced chemical equation for the action of hydrochloric acid on limestone to release carbon dioxide as one of the products.

2. Assume the carbon dioxide released from the limestone is now in the atmosphere.

**a.** (3 points) The process of **photosynthesis** can **remove** this $CO_2$ from the atmosphere. The levels of $CO_2$ decrease in April and May. Why isn't this decrease balanced by an increase in $CO_2$ from the southern hemisphere (where it is fall, not spring)?

**b.** (3 points) Starting in the springtime, plants store carbon by making **cellulose**. Describe the cellulose molecule (not its uses, but the molecule itself).

**c.** (3 points) Name one way other than photosynthesis that $CO_2$ is **removed** from the air.

4. (4 points) **Respiration** is another process that releases $CO_2$ into the atmosphere.
Write <u>one sentence</u> describing **respiration** that uses these 4 terms: **glucose $CO_2$ $O_2$ energy**

5. This photo from your text relates to another way that a carbon compound (<u>not</u> $CO_2$) can be released back into our atmosphere.

**a.** (2 points) What is pictured and where is it from?

**b.** (3 points) What carbon compound gets released when it melts?

**c.** (3 points) When it melts, a feedback loop is set in motion … one that has severe implications for global climate change. <u>Describe the loop</u>.

**Part VI – Global climate change**

**1. People agree that we are seeing ice loss in the Arctic, both land ice and sea ice.**

**a.** (3 points) People sometimes use the metaphor "the canary in the mine" to make a point. Why is the canary taken into the mine? What is significant about how the canary behaves once there?

**b.** (6 points) Gore points out that the Arctic is "the canary in the mine" when it comes to global climate change. What is significant about how the Arctic behaves? Check the ones that are true.

____ The Arctic is showing larger changes in average temperature than occur in mid-latitudes.

____ The Arctic ice packs are reflecting sunlight to a greater extent than other ice packs on the planet.

____ The Arctic is showing larger changes in ecosystems than is occurring at the mid-latitudes.

**2. People agree that $CO_2$ levels are rising in our atmosphere.**

**a.** (3 points) How do we measure $CO_2$ levels in the atmosphere today?

**b.** (3 points) How did we measure $CO_2$ levels in the atmosphere thousands of years ago?

**c.** (3 points) $CO_2$ levels are rising today because of a combination of two reasons. First, we humans are adding $CO_2$ to the atmosphere by _____. Second, the processes that remove $CO_2$ from the atmosphere _____ _____.