Name _____ Date _____ Period _____

Biochemistry PAP Extension

An analysis of Martian Molecules

April 27, 2032
Johnson Space Center
Houston, TX

5:53am

In the parking lot at Johnson Space Center, the morning dew is just beginning to evaporate into a misty haze that envelops you as you step out of your car. The campus is quiet, except for the baying of the longhorn cows in the pasture nearby.

You make your way to Building C, say hello to the security guards who are nearing the end of their shift, and walk through the double glass doors into the research wing. Once through the doors, the quiet disappears. The hallways are abuzz with energy and chatter about what the day will hold. In a few minutes, a very special delivery will be made and the most important work of your life will begin. This is the day you have been waiting for since elementary school.

You head into the clean room entry area, put on your sterile white suit, shoe covers, and gloves, and step through the revolving door into the clean room. Sheila and Marcus are already inside, getting the gas chromatograph ready and speculating about what they will find. You double-check that all of the equipment you will need is set out and ready for use, then pull your laboratory notebook from the shelf. Turning to a new page, you write a title across the top of the blank sheet: *Sample Analysis—Materials Returned to Earth by Mars Curiosity Mission 5.*

6:21am

The revolving door spins open and Alexa bursts into the room holding a clear glass cylinder. "It's here!" she exclaims. "Are you guys ready?" The cylinder appears to be empty, but in fact it holds a precious sample of the Martian atmosphere, collected by the Mars Curiosity 5 rover from an area within the Gale Crater. You and your team have been given the task of analyzing the molecular makeup of the air inside the cylinder using GC-MS (gas chromatography-mass spectrometry). Gas chromatography will allow you to separate the compounds in the sample, and mass spectrometry will detect the molecular weight of each individual molecule. You inject some of the gas sample into the GC-MS instrument and wait anxiously for the results.

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The results are show below in Figure 1:

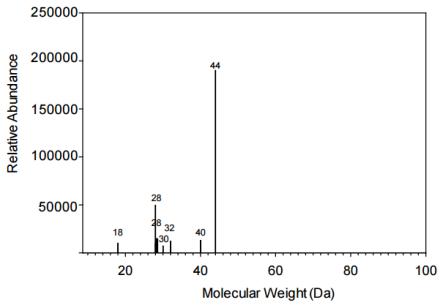

Figure 1: Results from the gas chromatography-mass spectrometry analysis of the Gale Crater atmospheric sample. (Note that there are two peaks at 28 Da. How do you interpret those seemingly redundant data?)

Based on the gas chromatography results, you conclude that the seven peaks on the graph represent the following 7 molecules:

Figure 2: Molecules and molecular weight from sample

Atom/Molecule	***Molecular Formula***	***Molecular Weight (daltons)***
Carbon dioxide	CO_2	*44 Da*
Argon	*Ar*	*40 Da*
Oxygen	O_2	*32 Da*
Nitric oxide	*NO*	*30 Da*
Nitrogen	N_2	*28 Da*
Carbon monoxide	*CO*	*28 Da*
Water	H_2O	*18 Da*

Assignment 1: Based on the atomic content of the molecules you identified in the Mars atmospheric sample, predict whether the following molecules that exist on Earth could be produced. List the molecules in the Martian atmosphere that contain the necessary atoms to build them, or if you predict that they could not be constructed, list the atoms that are missing from what you found in the atmospheric molecules.

A. DNA

B. Glucose

C. Valine (amino acid)

D. Cysteine (amino acid)

E. Fatty acid

F. Phospholipid

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Assignment 2: Look at the list of molecules that are present in the Martian atmosphere. Compare this list with the predicted components that were present in the atmosphere of ancient Earth.

Martian atmosphere:

Ancient Earth atmosphere:

Assignment 3: Based on your predictions on which of the molecules that exist on Earth could be produced from the atmospheric contents of Mars, do you think that life on Mars could exist? If so, which of the Mars atmospheric molecules or conditions would be important for creating the necessary molecules for life? If not, what additional molecules or conditions would be required to make life possible? Explain your reasoning.