"Okay, Houston, we've had a problem here."

-Jack Swigert

Apollo 13 is currently 320,000 km from Earth. The crew has just reported hearing a "pretty large bang" and, looking out the window, they're seeing the craft vent "a gas of some sort" into space. Oxygen tank 2 immediately reads a quantity of zero.

…130 minutes later

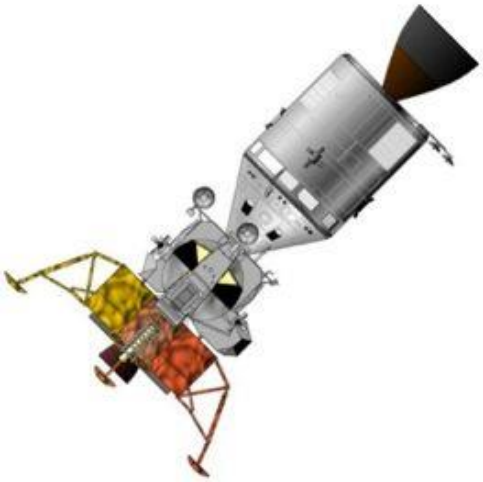
Oxygen tank 1 is now empty after stored O_2 quantity gradually decreased. The command module now has no remaining oxygen. Minutes beforehand, the crew was ordered to enter the lunar module. This craft is attached to the command module.

…3 minutes later

The #1 and #3 fuel cells have now failed. Houston has ordered the crew to shut down the remaining fuel cells in order to conserve power for Earth re-entry. The mission to land astronauts Jim Lovell, Jack Swigert, and Fred Haise on the lunar surface has officially been aborted. The new mission is to return Apollo 13 to Earth before oxygen and energy supplies fail.

…A few moments later

Carbon dioxide levels are building up in the lunar module due to the astronauts breathing. The CO_2 absorbers in the spacecraft, some of which remain in the command module, contain lithium hydroxide and are designed to capture CO_2 from astronauts breathing at a normal rate.



http://www.astronautix.com/a/apollocsm.html

Student Instructions

You are a NASA engineer and your superiors have instructed you to analyze the situation. The space craft consists of a command module and a lunar module. The command module is intended to house the three astronauts for most of the duration of the mission and enter lunar orbit, while the lunar module was designed only for the short trip from lunar orbit to the Moon's surface and back to the command module. The lunar module is only built to support two people, with the third remaining on the command module during a lunar excursion.

You have the following information:

There are enough CO_2 absorbers on the command module to last more than 10 days, but the LiOH cannisters are not easily compatible with the containment units on the lunar module.

Each CO_2 absorber on the command module contains 600g of lithium hydroxide.

Each CO_2 absorber on the lunar module contains 365g of lithium hydroxide.

The lunar module is expected to reach Earth 3 days from now and has more than enough oxygen supply for the trip.

The lunar lander is equipped with six CO_2 absorbers.

Each astronaut uses approximately 2500 kilocalories per day, and there are 4 kilocalories per gram of glucose.

You can assume that metabolism of the astronauts can be approximated by the (***unbalanced***) equation for glucose metabolism given below:

$$\_C_6H_{12}O_6 + \_O_2 \rightarrow \_CO_2 + \_H_2O$$

You need to determine:

Can the three astronauts safely make the trip back to Earth with only the CO_2 absorbers contained in the lunar module?

If not, how many additional CO_2 absorbers need to be retrieved from the command module?

Write out all calculations and relevant reactions equations that you used to come to this conclusion.

Could these calculations be done without using the mole?

P.S. The Apollo 13 astronauts did make it back to Earth safely.