RR#3 - Free Response

Base your answers to questions 1 and 2 on the passage and diagram below and on your knowledge of Earth science. The diagram represents a house located in New York State.

Solar Heating

Solar collectors in solar heating systems harness the power of the Sun to provide thermal energy for heating hot water and house interiors. There are several types of solar heating systems. The best system will depend on the geographic location and the intensity of the Sun. A solar heating system saves energy, reduces utility costs, and produces clean energy. The efficiency and reliability of solar heating systems have increased dramatically in recent years.



- 1. State *one* advantage of using solar energy instead of burning fossil fuels to produce thermal energy for your home.
- 2. Explain why solar energy can still be collected on cloudy days.

Base your answers to questions **3** and **4** on the diagram below, which shows incoming solar radiation passing through the glass of a greenhouse and then striking the floor.



- 3. Describe *one* way the glass in the greenhouse acts like the greenhouse gases in Earth's atmosphere.
- 4. Some of the incoming solar radiation is absorbed by the floor. Identify the type of electromagnetic energy reradiated by the floor.

5. The diagram below represents a beaker of water that is being heated. As the colored dye pellet dissolves, the dye will show the movement of water in the beaker. On the diagram, draw arrows in the water to show the direction the colored dye will move when the water is heated as shown.



Base your answers to questions 6 through 8 on the passage below.

Ozone in Earth's Atmosphere

Ozone is a special form of oxygen. Unlike the oxygen we breathe, which is composed of two atoms of oxygen, ozone is composed of three atoms of oxygen. A concentrated ozone layer between 10 and 30 miles above Earth's surface absorbs some of the harmful ultraviolet radiation coming from the Sun. The amount of ultraviolet light reaching Earth's surface is directly related to the angle of incoming solar radiation. The greater the Sun's angle of insolation, the greater the amount of ultraviolet light that reaches Earth's surface. If the ozone layer were completely destroyed, the ultraviolet light reaching Earth's surface would most likely increase human health problems, such as skin cancer and eye damage.

- 6. Assuming clear atmospheric conditions, on what day of the year do people in New York State most likely receive the most ultraviolet radiation from the Sun?
- 7. Explain how the concentrated ozone layer above Earth's surface is beneficial to humans.
- 8. State the name of the temperature zone of Earth's atmosphere where the concentrated layer of ozone gas exists.

Base your answers to questions 9 through 11 on the data table below. A student recorded the hours of daylight and the altitude of the Sun at noon on the twenty-first day of every month for one year in Buffalo, New York.



9. On the same sky model above, place an asterisk (*) at the apparent position of the North Star as seen from Buffalo.

- 10. The sky model diagram above shows the apparent path of the Sun on March 21 for an observer in Buffalo, New York. Draw a line to represent the apparent path of the Sun from sunrise to sunset at Buffalo on May 21. Be sure your path indicates the correct altitude of the noon Sun and begins and ends at the correct positions on the horizon.
- 11. On the graph below, draw a line to represent the general relationship between the altitude of the Sun at noon and the number of hours of daylight throughout the year at Buffalo.



Altitude of the Noontime Sun

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Base your answers to questions **12** through **15** on the model and data table shown below. A student constructed a model to demonstrate how water is recycled by natural processes on Earth. The model consisted of a clear plastic tent over a pan containing a bowl of water. The model was sealed so no air could enter or leave the tent. The data table shows the observations recorded when the model was placed in direct sunlight for 60 minutes.



Data Table

Time (min)	Observations
0	Water level in bowl = 10 cm Inside walls of the plastic tent are dry. Inside air temperature = $20^{\circ}C$
30	Water level in bowl = 9.9 cm Small drops of water form on the inside walls of the tent. Inside air temperature = 23° C
60	Water level in bowl = 9.8 cm Large drops of water form on the inside walls of the tent. Inside air temperature = 26° C

12. A student glues a Y-shaped piece of plastic, as shown below, near the top of the inside of the tent and repeats the demonstration. Drops of water are seen dripping from the bottom of the Y after 60 minutes. Which process of the water cycle is represented by the dripping water?



- 13. If the model is changed and the bowl of water is replaced with a green plant, by which process would the plant supply water vapor to the air inside the tent?
- 14. How much heat energy, in joules per gram, is released as water droplets are formed on the inside walls of the tent?
- 15. Identify the process that caused the water level in the bowl to decrease.