Recommendations for the exam:

1. Review the modules as you put your notebook together.
2. Rework the homework questions.
3. Review your notes from the lectures in class.
4. Make sure that you understand the following topics:

- how one determines the direction and the speed of the wind using an isobaric weather map
- how does the air move around low and high pressure regions?
- light—reflection, emission and absorption. What happened to the UV energy when it hit the fluorescent minerals in the display case? Can you explain in precise language what was happening? Why did we see light coming from the rock when the incoming energy was UV?
- you should expect to see questions related to the greenhouse effect and how it warms the atmosphere. Can you compare and contrast a real greenhouse to the Earth’s greenhouse?
- what is the relationship between ozone depletion and greenhouse effect?
- why is it warmer in the northern hemisphere in the summer? You might expect variations on the planet Ajay/Steve theme.
- you should expect questions about the phase of the Moon and the positions of the Sun, Earth, and Moon
- what is the difference between the advancing (or retreating) of a glacier? How can we predict whether a glacier is advancing or retreating?
- radioactive decay—you should be able to determine the 1/2-life of a material from either the decay of the parent or the accumulation of the daughter.
- you should be able to predict the number of protons, electrons, and neutrons in an isotope from the atomic number and the atomic mass.
- how do we use oxygen-isotopes to identify periods of warmer and colder climate in the past?
- the Milankovitch cycles and how they help us understand past climate

Practice Questions:

1. Crater Lake, in southern Oregon Cascades, sits inside a volcano called Mt. Mazama. This volcano erupted catastrophically about 7000 years ago and then collapsed forming the depression. Since this eruption, snow and rain have filled the depression with water forming Crater Lake. Since there is no river flowing into Crater Lake, the water in the lake is very clear. You can see to a depth of 60-70 feet where the bottom of the lake is shallow. (Crater Lake is the deepest lake in North America at more than 1900 feet deep). (To see the color version of these photos go to the web site).
Lake Louise is a popular tourist location in the Canadian Rockies. An alpine glacier occupied the valley during the last ice advance. The water in the lake comes from runoff from the surrounding mountains, including small alpine glaciers. The greenish color of the water in Lake Louise is due to fine rock “flour” (it is actually silt) created by glacial abrasion in the mountains above Lake Louise.

For each of these lakes draw a graph of the relative absorption of various colors of light (assume the light source is the Sun and that sunlight is “white light”). For example for Crater Lake, is the water absorbing most of the blue light that is shining on it?

![Graphs of relative absorption of various colors of light for Crater Lake and Lake Louise](image)

1b. Imagine that you could shine a yellow light on the water of Lake Louise, what color would it appear? Explain your thinking.

Yellow light consists of red and green light. The water in Lake Louise absorbs the red part of the yellow light, but does not absorb the greenish light. This means that the greenish light will reflect to our eyes making the lake look green.

2a. Why is the sky blue when the light from the sun is “white”?

The white light from the sun includes all wavelengths (blue, blue-green, orange, magenta, violet...) but we can simplify things by thinking of it as being made up of red, green, and blue. The “blue” sky is the part of the sky that is away from the sun on a clear day (the sky near the sun is impossible to make out because the sun is so bright but if we could see it clearly it would look “whiter” than the bluest part of the sky. The light that comes to us from areas away from the sun must have bounced (reflected) off of small dust particles in the atmosphere. Blue and violet light “bounces” the most and green light not quite as much so the only thing that we see in appreciable amounts is light blue (which includes some green in it). The color we call “sky blue” is mostly blue, with less green, and even less red.

2b. If we see color photographs of the moon’s surface taken by the astronauts who walked on the moon, we see that the sky is black. Why is the sky black on the Moon?

The moon doesn’t have an atmosphere with dust particles to reflect the blue light that we see in our own sky. The only sunlight that reaches a point on the surface of the moon is light that comes directly from the sun (or reflects off of rocks or maybe the Earth).
3. Compare and contrast the physical processes that create seasons on the Earth versus the physical processes that cause longer-term climate changes as described by Milankovitch.

The season on Earth are created by the tilt of the rotational axis. In the summer, sunlight is more perpendicular to the Earth’s surface creating a greater intensity of light. In the winter the sunlight is spread out so there is less intensity of light.

Longer-term climatic variations may be due to changes in the distance of the Earth from the sun, variations in the tilt of the Earth and the precession of the season (when the northern hemisphere winter is farther from the sun, the planet will be colder).

4. The map on the next page is of atmospheric pressure (corrected to sea level pressure) on Friday, February 17, 2006. Draw on the map the direction of the winds with vectors. Vectors are straight lines that should direction and by their length show the velocity of the wind.

Take one spot near the low pressure area in the SW United States and one spot near the high pressure in northern Nebraska and discuss how you drew the wind vectors.
5. The tornado over North Dakota shown in the picture below is typical of the tornadoes that race across the central part of North America each year. These storms are intense low pressure regions with wind speeds of 110 to 200 mph.

   a) Explain how the air moves around a tornado in words and then illustrate the motion by drawing vectors on the picture.

   Since tornadoes are intense low pressure systems, the air moves in a counter-clockwise direction if seen from above. The air spirals upward, like a corkscrew.

   b) If you could observe this storm from above, illustrate the motion of the air.
6. From the two graphs below:

a) Which location Corpus Christi (CRP) or Oakland (OAK) has the higher humidity? Explain your reasoning.

Notice that the temperature is higher than the dew point at CRP, while the temperature and dew point are the same at OAK. When the dew point is the same as the temperature, the humidity must be 100%. The closer the temperature and dew point lines are to each other, the higher the relative humidity.

At which location is the water vapor content of the atmosphere greater? Explain your reasoning.

The dew point is higher in CRP than in OAK. Therefore, the vapor pressure of the water is high in CRP.

Height (M) Versus Temperature (C) and Dew Point at CRP on 7-1-2000
7. Imagine two individuals seated at point A and B on a merry-go-round, as shown below. The merry-go-round is rotating counterclockwise.

a) Who is moving faster, person A or person B? How do you know?

Person A is covering more distance in the same amount of time, therefore, person A is going faster.

b) If person A rolls a ball towards person B, what track will the ball follow, as seen by a stationary observer above the merry-go-round? Draw the path of the ball on a sketch below, then explain your reasoning.

The ball will go in a nearly straight line.
c) If person A rolls a ball towards person B, what track will the ball follow, as seen by an observer riding on the merry-go-round? Draw the path of the ball on a sketch below, then explain your reasoning.

The ball will appear to curve to the right, just like objects moving in the northern hemisphere of the Earth.

8. Planet Steve has an orbit in which the northern hemisphere is always pointed toward the sun, but the axis of rotation is tilted at 23.5 degrees from vertical. See the diagram below. (Ignore the N and S dots!)

Will Planet Steve have seasons? Explain your logic. Due to the fact that the axis of rotation is always pointed at the sun, planet Steve will not have seasons. There would be not variation in the angle of the sunlight.

Will Planet Steve have day and night? Explain your logic. Yes, as the planet rotates, there will be times when the planet faces the sun and times when it faces away from the sun.
9. Phases of the moon:

d) The picture on the left shows the Moon as it appeared to a person standing on the north pole. The picture on the right shows the positions of the Earth and the Sun as they would appear if looking "down" on the north pole, but the moon is not in the diagram. Sketch in the position of the moon in the diagram on the right. Explain your reasoning.

![Diagram](image)

*The right side of the moon is illuminated. This means that it must be a waxing moon. The phase of the Moon is a waxing crescent, so the Moon on the “sun” side of the Earth as seen from above.*

e) In the diagram below, sketch the moon as it would appear to an observer standing on the north pole two weeks after it appeared as it did in the diagram on the left above. Explain your reasoning.

![Diagram](image)

f) Again referring to the diagram on the left in part a, roughly how many nights after the moon appeared as it did in this diagram would the observer have seen the next full moon? You don’t need to be exact, but you can probably get it within a couple of days. Explain your reasoning.

*Each quarter of the Moon’s cycle is about 7 days. In part a, the moon is about ½ way through the first quarter cycle. This means that in about 3-4 days the Moon will be at first quarter phase. About a week after the first quarter moon, is the full moon. Therefore it will be about 10-12 days.*
10. The half-life of a certain sample of a radioactive element is 3.0 days. At noon on May 10 the amount of the parent isotope was 400 milligrams (mg.).

A. When will the amount of the parent isotope be equal to 100 mg? **May 16**

<table>
<thead>
<tr>
<th>Date</th>
<th>Parent</th>
<th>Daughter</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 1</td>
<td>3200 mg</td>
<td>0 mg</td>
</tr>
<tr>
<td>May 4</td>
<td>1600 mg</td>
<td>1600 mg</td>
</tr>
<tr>
<td>May 7</td>
<td>800 mg</td>
<td>2400 mg</td>
</tr>
<tr>
<td>May 10</td>
<td>400 mg</td>
<td>2800 mg</td>
</tr>
<tr>
<td>May 13</td>
<td>200 mg</td>
<td>3000 mg</td>
</tr>
<tr>
<td>May 16</td>
<td>100 mg</td>
<td>3100 mg</td>
</tr>
<tr>
<td>May 19</td>
<td>50 mg</td>
<td>3150 mg</td>
</tr>
<tr>
<td>May 22</td>
<td>25 mg</td>
<td>3175 mg</td>
</tr>
</tbody>
</table>

B. What was the amount of parent isotope on May 1st? **3200 mg**

C. Using a solid line on the graph below, show the amount of the parent isotope in the sample as time passes.

D. Use a dashed line to show how the amount of the daughter product changes at the same time.