PART I: Focus on:

- the use of graphs of sea-level changes to determine if the land near the gauging station is subsiding, stable, or uplifting and explanations of the logic you use.
- characteristics of basaltic, andesitic, and rhyolitic lavas and their viscosities
- the factors which control the viscosity of lavas/magmas. You should be able to apply those factors to help explain the characteristics of volcanic eruptions.
- interaction between the viscosity of a magma and the release of volcanic gases.
- relationship between the amount of silica in a magma and the tendency to form lava and/or pyroclastics
- connections between the types of volcanic rocks and the types of volcanoes
- similarities/differences between magma and lava
- the rock types in the volcanic (extrusive) group and the rock types of the plutonic (intrusive) group. For example, you should be able to recognize that basalt and gabbro originate from the same magma, but differ in the way they crystallize.

PART II: Sample questions

1. How does viscosity affect the nature of a volcanic eruption?

   The explosiveness of an eruption is determined primarily by the viscosity of the magma and the amount of gas in the magma. If the viscosity of the magma is high (due to high silica levels in the magma and/or low magma temperature) it is more difficult for the gases in the magma to escape and the eruption will be more violent.

2. What is the role of the gases in magma as that magma approaches the earth’s surface?

   The gases are the primary reason that volcanoes are violent. If magma has little or no gases, the magma flows out with little tephra erupted, but if the gas content of the magma is high (due to initial composition of the magma or added water from the surrounding rock as the magma comes to the surface) the eruption will be more explosive.

3. In class we observed a movie on the 1973 Heimaey eruption in Iceland and a videotape of a 1983 Hawaiian eruption. The Icelandic eruption had much more tephra and was more explosive than the Hawaiian eruption. Both of these eruptions were basaltic. Explain how two basaltic eruptions could be so different.

   To answer this question think of the three factors that control volcanic eruptions: silica content, magma temperature, and gas content. The question states that both eruptions are basaltic, so silica content is not helpful in explaining why the Icelandic volcano is more explosive. (It is possible that the two basaltic magmas were different in silica content and behave differently, but it would require very careful explanation.)

   If the Icelandic magma had spent more time sitting in a shallow crustal position (near the surface), the magma would have cooled and the viscosity of the magma would have increased, making the eruption more violent. It is possible (and likely) that water could have been added to the magma as it came to the surface. We term these phreatic eruptions.

4. In class, we made the generalization that basaltic magmas normally form low viscosity lava flows and only minor amounts of tephra. However, most cinder cones are built of basaltic tephra. Explain the conditions under which basalt can erupt enough tephra to form cinder cones. (There should be two answers to this question.)

   The answer to this question is the same as for #3 above—lower magma temperature that creates higher viscosity or higher gas content in the magma.
5. Complete the following chart:

<table>
<thead>
<tr>
<th>Name</th>
<th>Silica content</th>
<th>Color</th>
<th>Viscosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>rhyolite</td>
<td>high</td>
<td>Light</td>
<td>Highest</td>
</tr>
<tr>
<td>Andesite</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Intermediate</td>
</tr>
<tr>
<td>basalt</td>
<td>Lowest</td>
<td>darkest</td>
<td>lowest</td>
</tr>
</tbody>
</table>

6. The diagram below is an igneous rock. If the groundmass or matrix (the fine-grained part between the crystals) of the rock is gray, what type of rocks is this? What does this texture tell you about the cooling history of this rock?

![An igneous rock diagram]

the rock type would be a andesite or dacite (normally rhyolite is lighter tan to pink) if the groundmass is gray in color

The mixture of crystals and fine grained groundmass means that the rock would have cooled slowly, forming the crystals and then cooled rapidly forming the gray groundmass

7. Explain how you can determine whether an igneous rock cooled deep within the Earth or whether the rock cooled at or near the Earth’s surface.

Igneous rocks that cool at or near the Earth’s surface have a fine-grained texture because the crystals did not have time to form. If magma is trapped underground, the magma cools slowly and crystals form, producing a coarse-grained igneous rock.

8. Why is it somewhat uncommon to find the plutonic equivalent of a mafic (dark colored) magma?

If it is dark, it is probably going to be low in silica, so the magma will be low in viscosity. If the magma is low in viscosity, it will more likely reach the Earth’s surface and erupt producing a volcanic or extrusive rock. If most of the magma is reaching the Earth’s surface, there will less chance for magma to be trapped under the surface and form an intrusive rock.

9. You are on a vacation trip. In the distance you see a steep-sided conical hill which is about 600-800 feet higher than the land around it. You suspect this to be a volcano. What type of volcano do you think it is? Since you cannot go up to it and take a sample of the rock, what features could you look at through your binoculars to confirm that the hill is a volcano? (You should also be able to answer the same type of question using a topographic map!)

We can eliminate shield volcano and composite cones because they are too large for the 600-800 feet height given. We can eliminate a fissure because there is nothing about a linear feature, such as a fracture. We can eliminate a volcanic dome based on the conical shape of the volcano (domes may be steep sided and this height, but are normally more irregular in shape). The remaining type is a cinder cone.

You should be able to defend your choice of volcano type by using the characteristics.

10. The graph below is the change in sea level for Los Angeles from 1923 to 2000. Is Los Angeles subsiding, stable, or uplifting according to this graph? Explain your reasoning.
The rate of global sea level rise is between 1mm/yr and 2.3 mm/yr. The sea level rise in LA is smaller than this global rate. This means that there is some minor amount of uplift happening in the LA area. In the 1940’s, in some places in the LA basin, oil was withdrawn from the ground and creating subsidence of the land. This is not shown on this graph.

11. A map of volcano X is below. The lines are rivers running from the mountain. Cross sections were taken at stations A through J. Answer the following questions from the cross-sections and the map: (the numbers in the parentheses on the cross sections are the ages of the layers)

1) Using the information from the cross-sections, what type of volcano is illustrated? What makes you think this?

Volcano X is a composite volcano. 
Logic: There are too many eruptions for it to be a cinder cone. Volcanic domes do not normally have lava flows as we see from volcano X. It is unlikely to be a shield or a fissure due to higher (intermediate) silica contents of the lava and the presence of nuee ardentes that normally happen with higher silica volcanoes.

2) Some of the eruptions left layers of tephra or other deposits in multiple locations. From the various cross sections, construct a single list of the dates that this volcano has erupted.

9630, 7210, 6600, 6000, 3400, 2120, 1100, 190, and 100
Notice we omitted 6800. There is only a lahar deposit and it is possible that a lahar could be created by an earthquake or large storm and does not require an eruption to happen.

3) Which of these eruptions would have been the "biggest" (most explosive/most devastating- you define what “biggest” means)?

Geologists normally define “biggest” as the eruption that deposited the greatest volume of tephra. This is the 6600 year eruption.

4) For the 6600-year eruption, determine the direction the wind was blowing at the time of the eruption. 

SW to NE determined by the depth of the tephra layers on the NE side of the mountain.

5) When will the volcano erupt next?

There is no way to tell. We can state the chance of it erupting, but one can reliably predict the date of the next eruption of a dormant volcano.