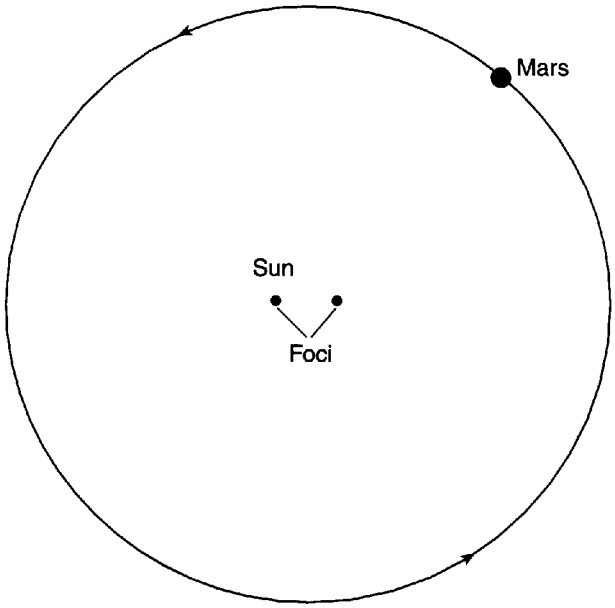
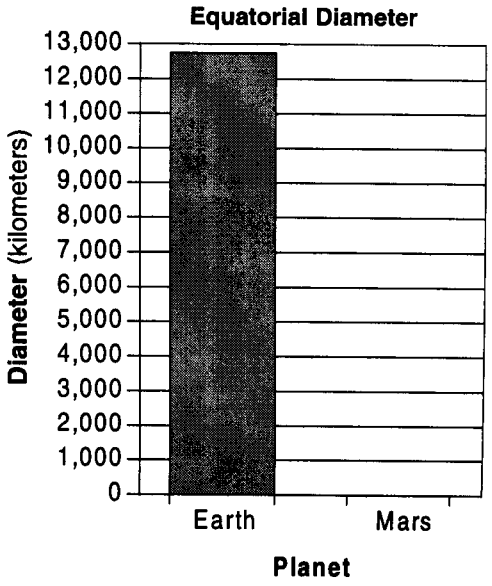
Base your answers to questions **1** through **3** on the diagram below, which represents Mars orbit around the Sun.



(Not drawn to scale)



1. On the diagram above:

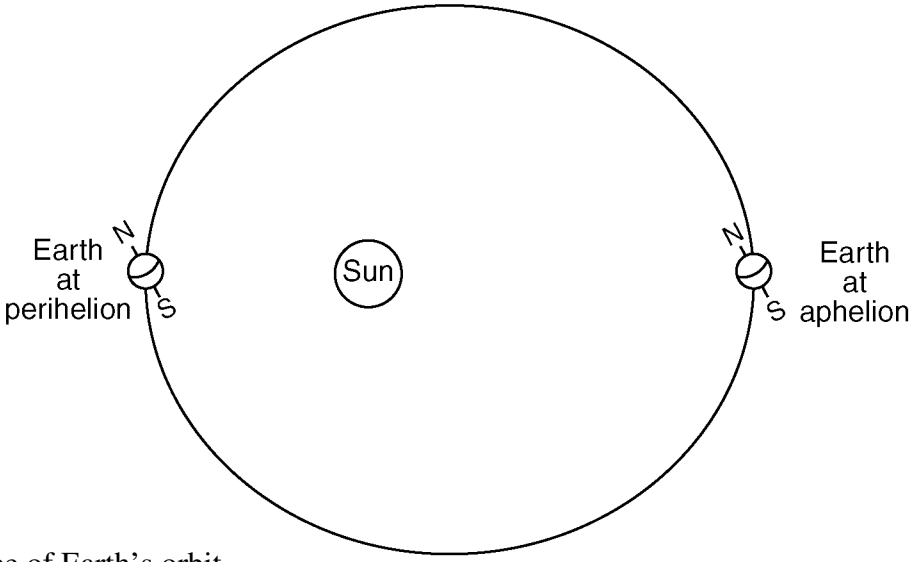
   a Draw and label the major axis of Mars orbit.

   b Place an **X** on the orbit to show the location of Mars greatest orbital velocity.

2. State the difference between the shape (not the size) of Earth's orbit and the shape of Mars orbit.

3. The bar graph above shows the equatorial diameter of Earth. On the bar graph, construct the bar that represents the equatorial diameter of Mars.

Base your answers to questions **4** and **5** on the diagram below, which represents an exaggerated model of Earth's orbital shape. Earth is closest to the Sun at one time of year (perihelion) and farthest from the Sun at another time of year (aphelion).

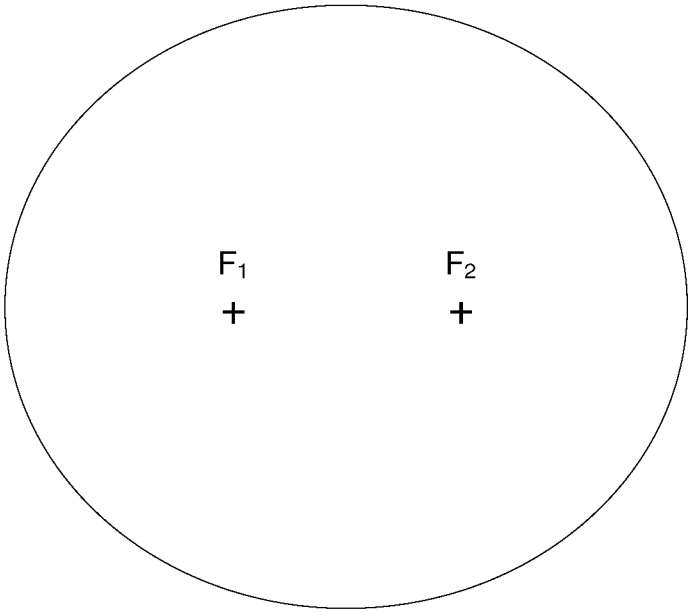


(Not drawn to scale)

4. State the actual geometric shape of Earth's orbit.

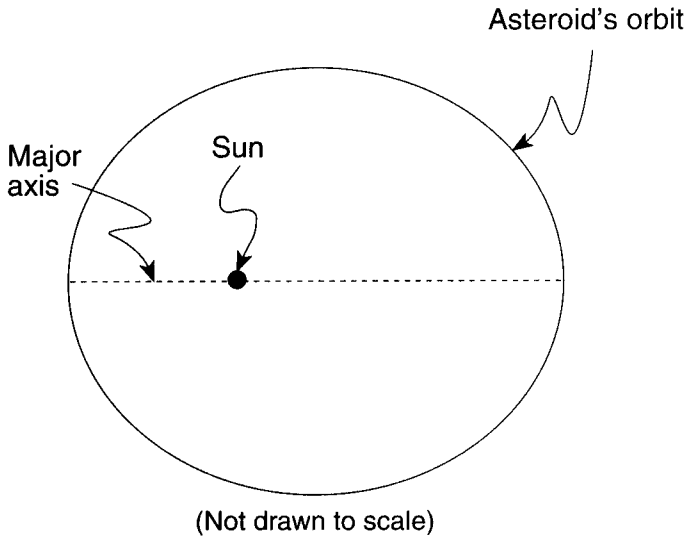
5. State the relationship between Earth's distance from the Sun and Earth's orbital velocity.

6. Base your answer to the following question on the diagram of the ellipse below.



a. Calculate the eccentricity of the ellipse to the *nearest thousandth*.
b. State how the eccentricity of the given ellipse compares to the eccentricity of the orbit of Mars.

Base your answers to questions **7** and **8** on the diagram below, which represents an asteroid's elliptical orbit around the Sun. The dashed line is the major axis of the ellipse.

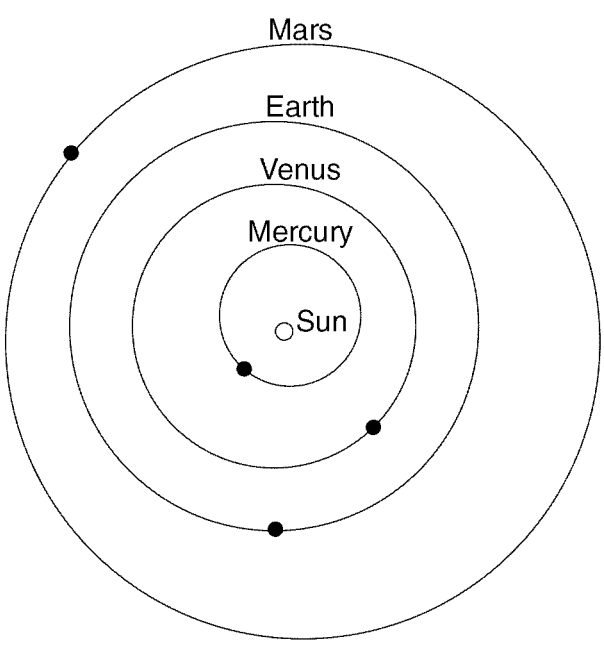


7. Place a circle, **0**, on the orbital path where the velocity of the asteroid would be the least.

8. The Sun is located at one focal point of the orbit. Place an **X** on the diagram at the location of the second focal point.

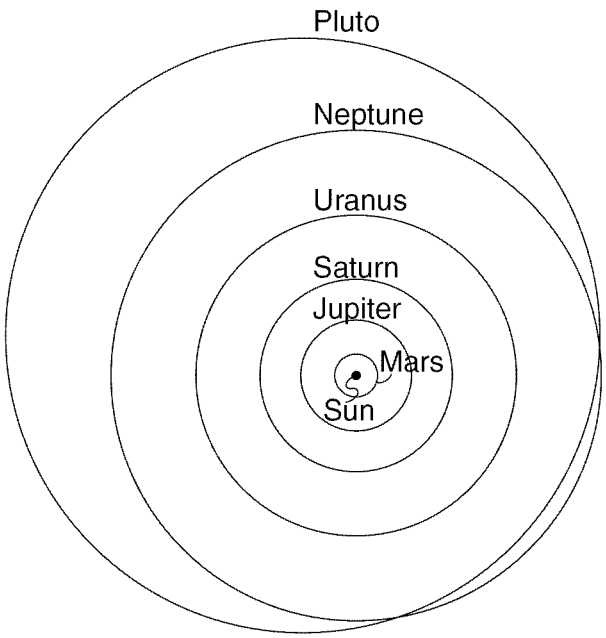
Base your answers to questions **9** through **11** on the two diagrams. Diagram I shows the orbits of the four inner planets. Black dots in diagram I show the positions of the orbits where each planet is closest to the Sun. Diagram II shows the orbits of the six planets that are farthest from the Sun. The distance scale in diagram II is different that the distance scale in diagram I.

Diagram I



(Not drawn to scale)

Diagram II



(Not drawn to scale)

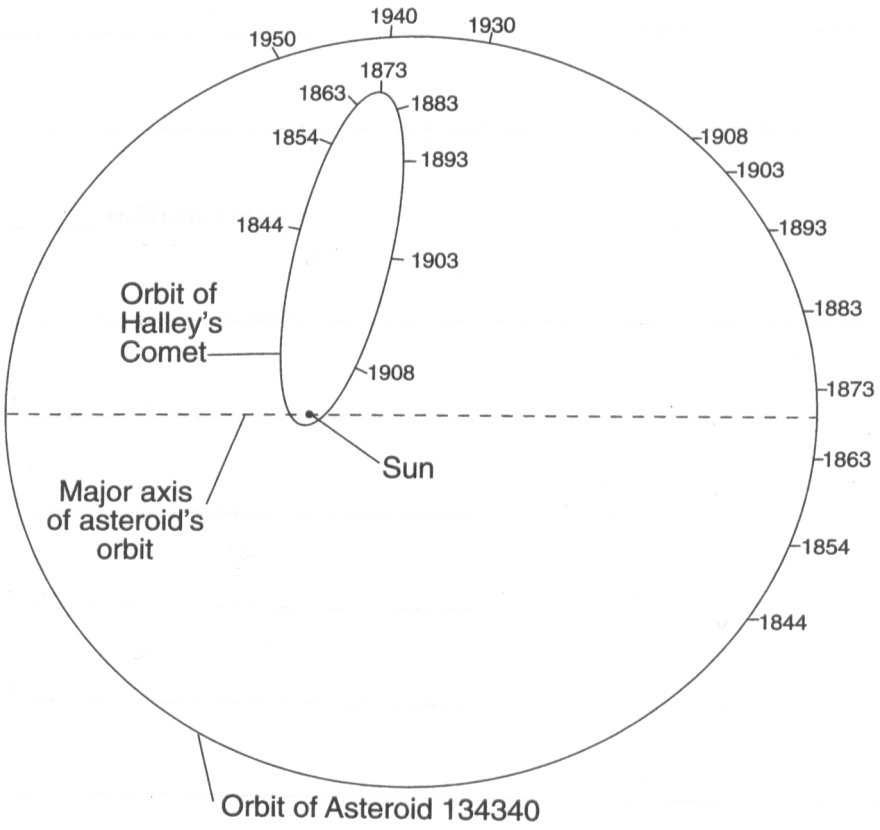
9. On diagram I, place the letter W on Mars' orbit to represent the position of Mars where the Sun's gravitational force on Mars would be *weakest.*

10. Describe how the orbits of each of the nine planets are similar in shape.

11. Pluto's orbital speed is usually slower than Neptune's orbital speed. Based on diagram II**,** explain why Pluto's orbital speed is sometimes faster than Neptune's orbital speed.

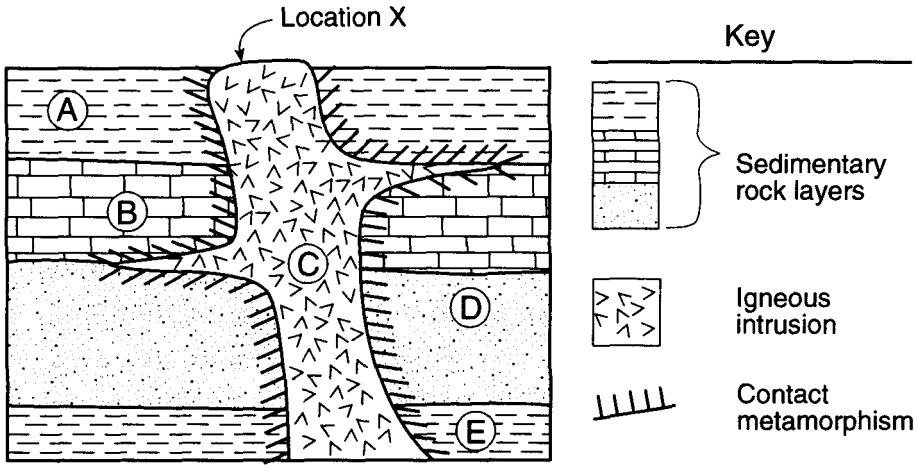
_____

12. Base your answer to the following question on the diagram below. The diagram shows the positions of Halley's Comet and Asteroid 134340 at various times in their orbits. Specific orbital positions are shown for certain years.



Determine which was traveling faster, Halley's Comet or the asteroid, between the years 1903 and 1908. State one reason for your choice.

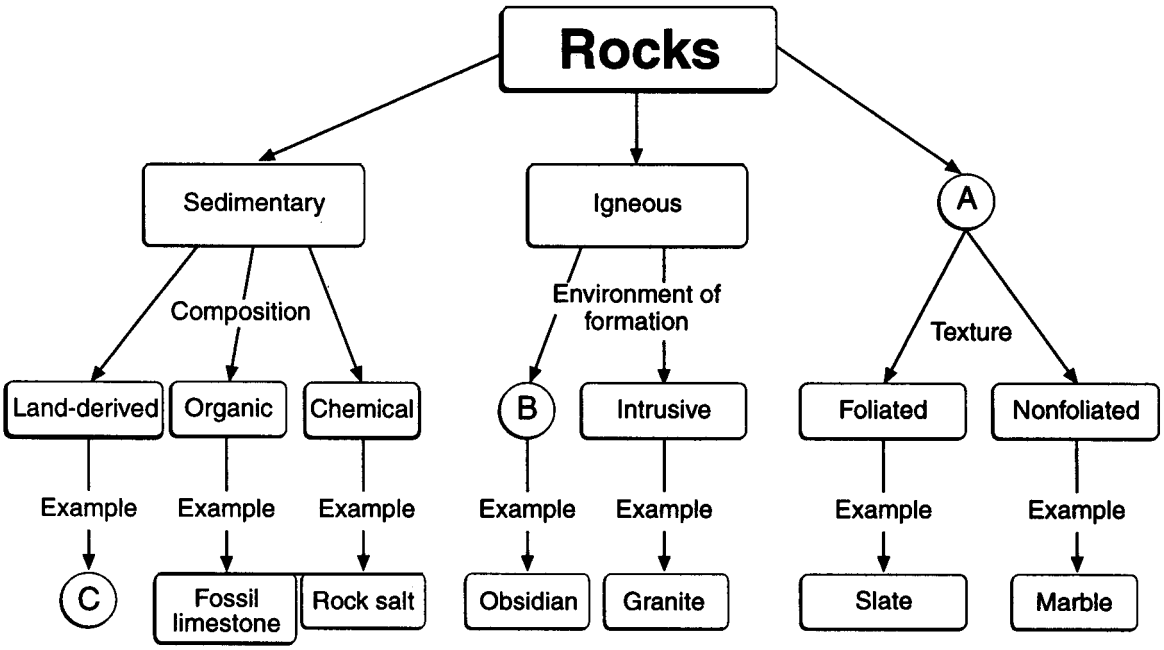
Base your answers to questions **13** and **14** on the geologic cross section below. The cross section shows an outcrop in which the layers have not been overturned. Rock units are labeled *A* through *E*.



13. State the name of the sediment that was compacted to form rock unit *A*.

14. State one observation about the crystals at location *X* that would provide evidence that igneous rock unit *C* was formed by very slow cooling of magma.

15. The chart below shows the different rock families and their subdivisions. The circled letters, *A, B,* and *C,* indicate parts of the chart that have not been completed.

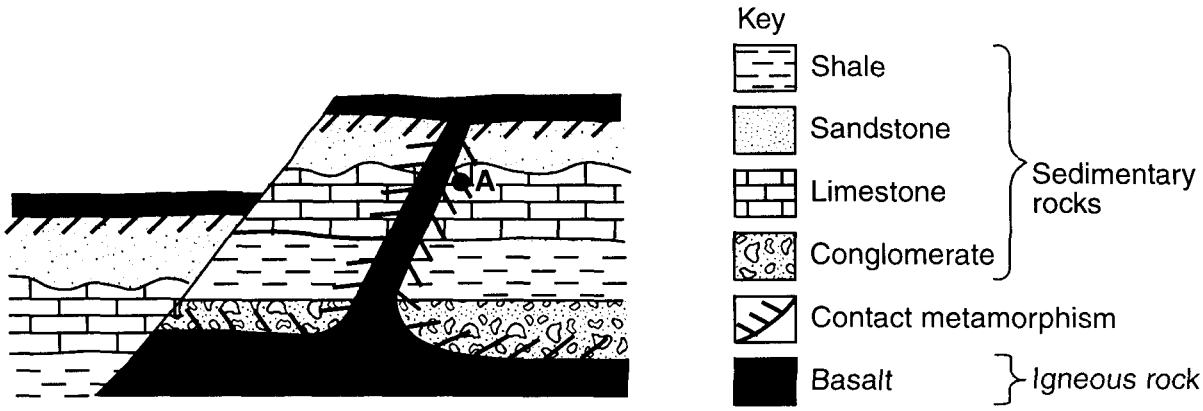


Complete the chart by writing the missing terms in the spaces labeled *A, B,* and *C* below

A _____
B _____
C _____

Base your answers to questions **16** through **18** on the diagram and information below.

The diagram shows a cross section of a portion of Earth's crust that has undergone geological processes. Overturning of rock layers has not occurred. Point *A* represents one location of metamorphic rock.

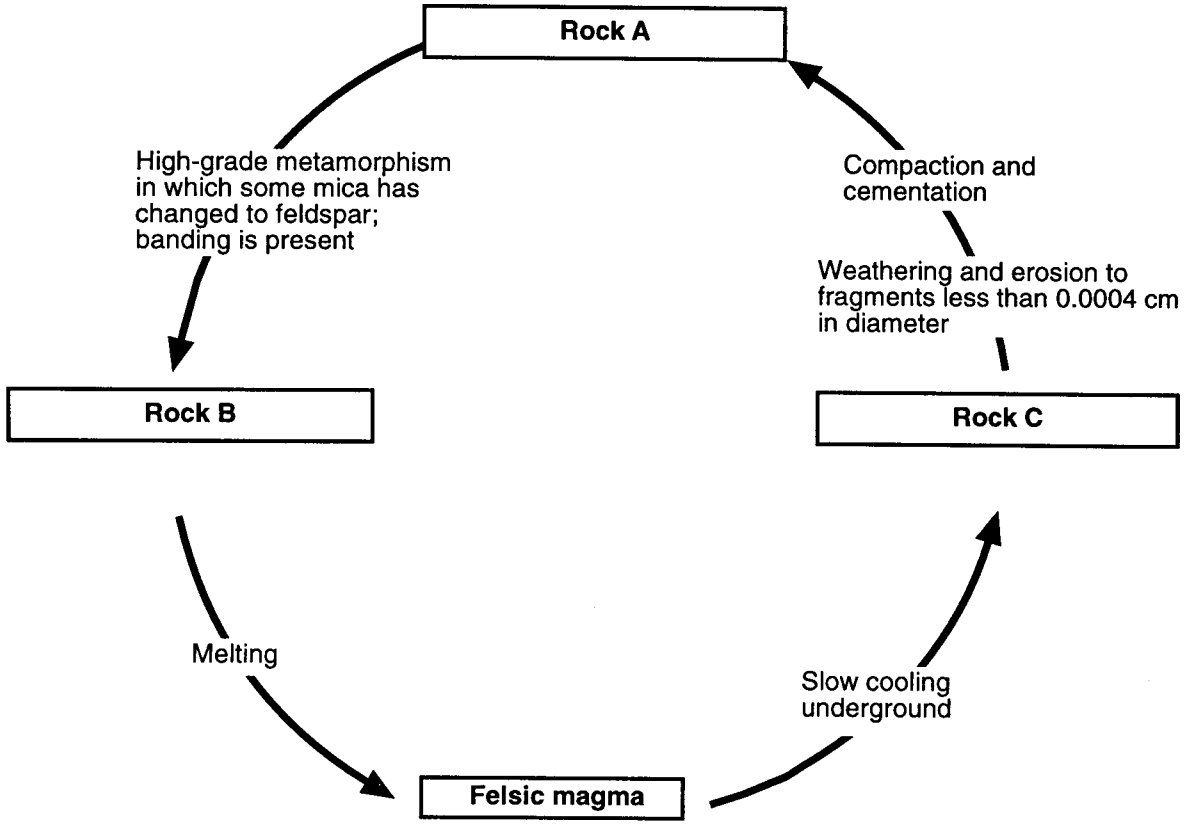


16. As magma cools, what process changes it into basalt?

17. State the name of the inorganic sedimentary rock shown in the cross section that is composed of sediment with the greatest range in particle size.

18. State the name of the rock, formed by contact metamorphism, located at *A*.

Base your answers to questions **19** and **20** on the rock cycle diagram below.



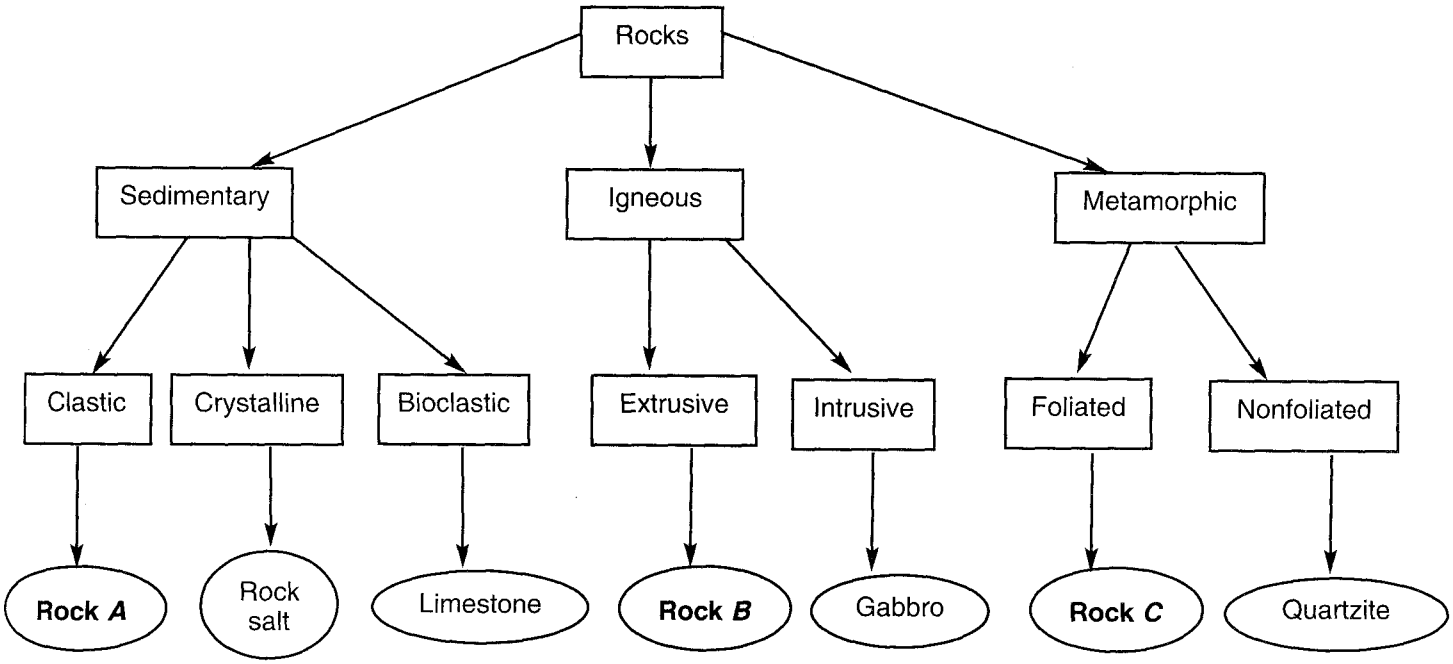
19. State the specific names of rocks *A*, *B*, and *C* in the diagram. Do *not* write the terms "sedimentary," "igneous," and "metamorphic."

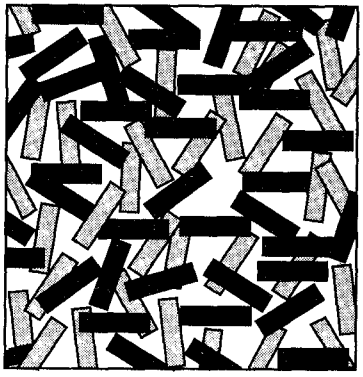
20. State *one* condition or process that would cause the high-grade metamorphism of rock *A*.

_____

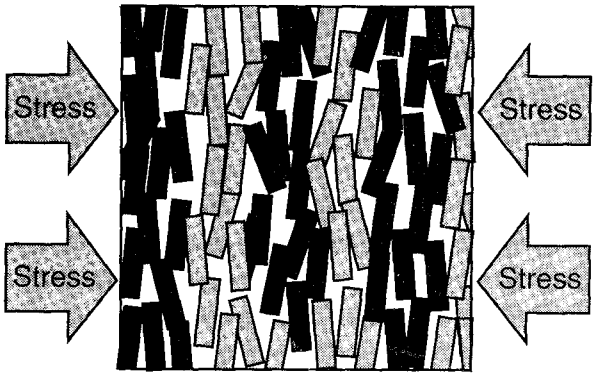
Base your answers to questions **21** through **24** on the Rock Classification Flowchart shown below. Letters *A*, *B*, and *C* represent specific rocks in this classification scheme.

Rock Classification Flowchart





Mineral Arrangement
Before Metamorphism



Rock C Showing Banding
After Metamorphism

21. Rock *A* is composed of very fine-grained quartz and feldspar particles 0.005 centimeter in diameter. State the name of rock *A*.

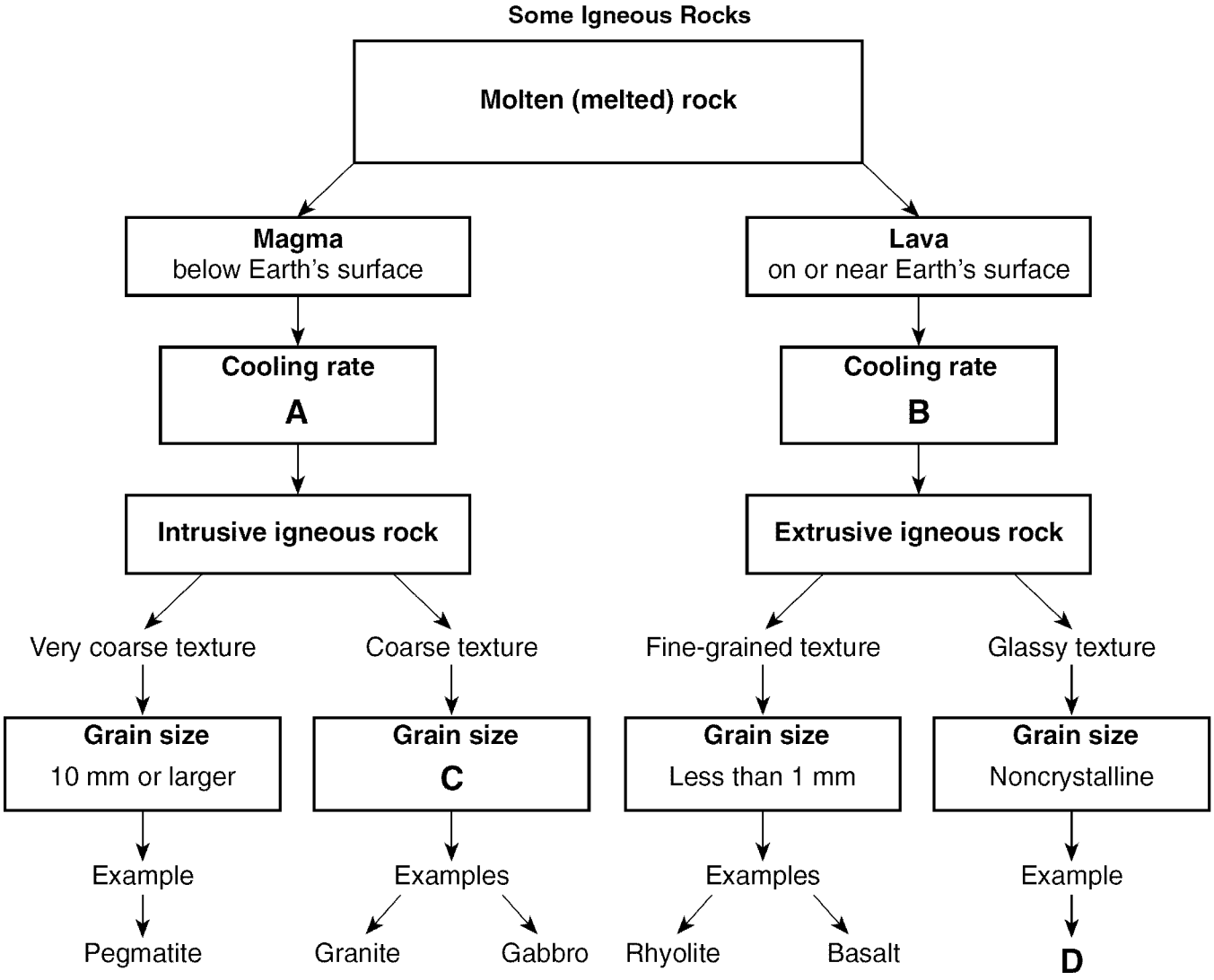
22. Rock *B* has a glassy, vesicular texture and is composed mainly of potassium feldspar and quartz. State the name of rock *B*.

23. Granite could be placed in the same position in the flowchart above as gabbro. Describe two differences between granite and gabbro.

24. The diagram above represents two magnified views showing the arrangement of minerals before and after metamorphism of rock *C*. State the name of rock *C*.

_____

Base your answers to questions **25** through **27** on the flowchart below and on your knowledge of Earth science. The flowchart shows the formation of some igneous rocks. The bold letters ***A***, ***B***, ***C***, and ***D*** indicate parts of the flowchart that have not been labeled.



25. Contrast the rate of cooling at ***A*** that forms intrusive igneous rock with a rate of cooling at ***B*** that forms extrusive igneous rock.

26. Give the numerical grain-size range that should be placed in the flowchart at ***C*** . Units must be included in your answer.

27. State *one* igneous rock that could be placed in the flowchart at ***D***.

_____

Base your answers to questions **28** and **29** on the data table below, which shows some characteristics of four rock samples, numbered 1 through 4. Some information has been left blank.

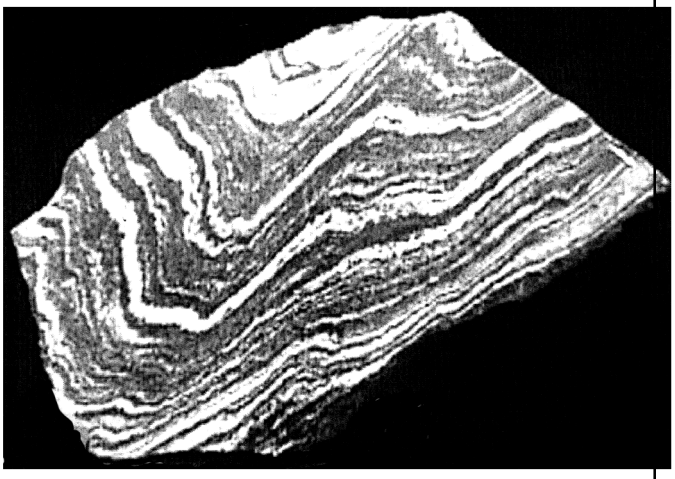
Data Table

Rock Sample Number	Composition	Grain Size	Texture	Rock Name
1	mostly clay minerals		clastic	shale
2	all mica	microscopic, fine	foliated with mineral alignment	
3	mica, quartz, feldspar, amphibole, garnet, pyroxene	medium to coarse	foliated with banding	gneiss
4	potassium feldspar, quartz, biotite, plagioclase feldspar, amphibole	5 mm		granite

28. Write the rock name of sample 2.

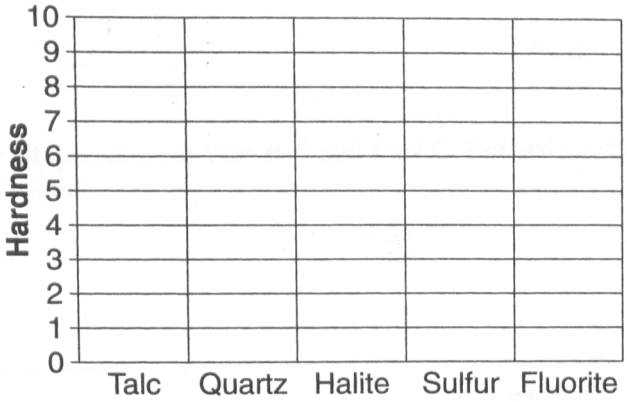
29. Write a term or phrase that correctly describes the texture of sample 4.

30. Base your answer to the following question on the photograph of a sample of gneiss below.



Identify *two* minerals found in gneiss that contain iron and magnesium.

Base your answers to questions **31** and **32** on the hardness of the minerals talc, quartz, halite, sulfur, and fluorite.



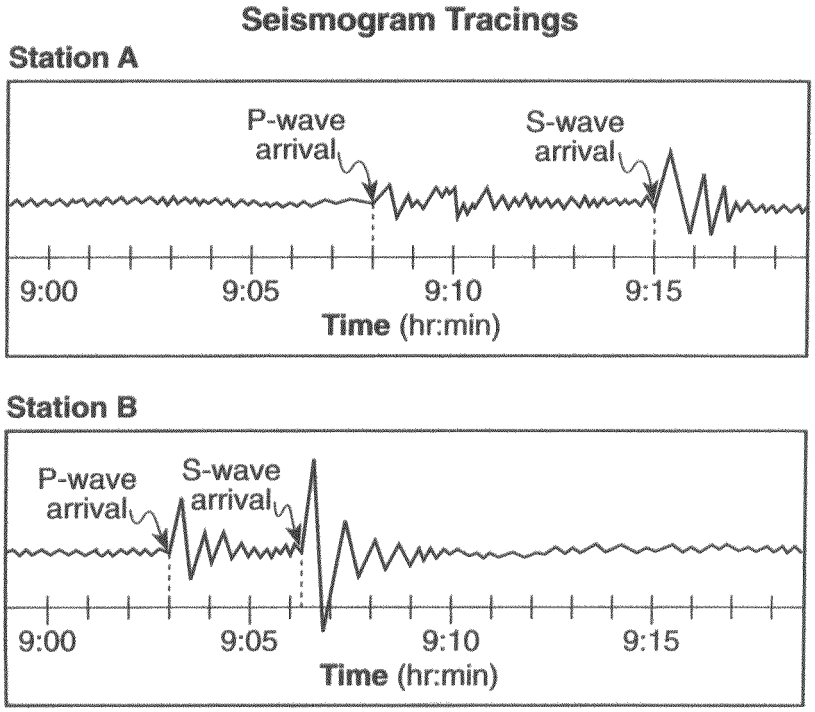
31. On the grid above, construct a bar graph to represent the hardness of these minerals.

32. Which mineral shown on the grid would be the best abrasive? State *one* reason for your choice.

_____

33. A seismic station in Gainesville, Florida, recorded the arrival of the first *P*-wave at 1:30:00 (1 hour, 30 minutes, 00 seconds) and the first *S*-wave from the same earthquake at 1:34:30.
a Determine the distance, in kilometers, from Gainesville to the epicenter of this earthquake.
b State what additional information is needed to determine the location of the epicenter of this earthquake.

Base your answers to questions **34** and **35** on the diagram below, which shows two seismogram tracings, at stations *A* and *B,* for the same earthquake. The arrival times of the P-waves and S-waves are indicated on each racing.



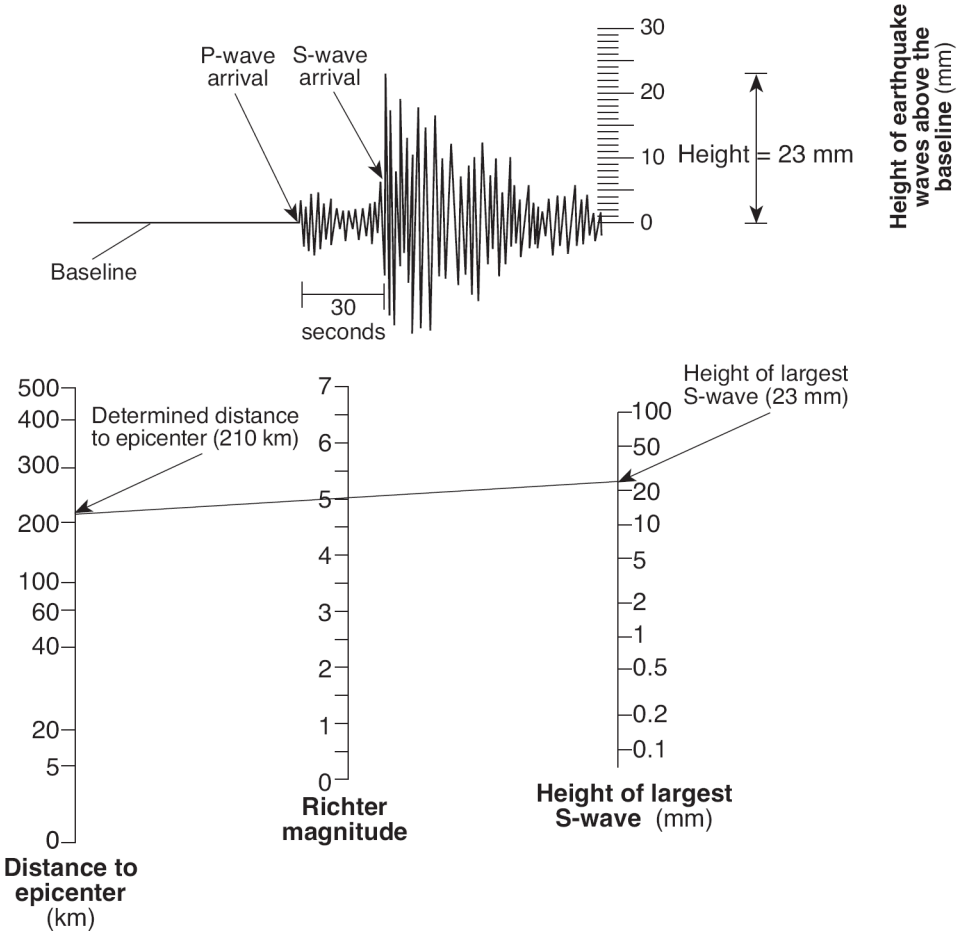
34. Explain how the seismic tracings recorded at station *A* and station *B* indicate that station *A* is farther from the earthquake epicenter than station *B*.

35. Seismic station *A* is located 5,400 kilometers from the epicenter of the earthquake. How much time would it take for the first S-wave produced by this earthquake to reach seismic station *A?*

Base your answers to questions **36** through **38** on the example of a seismogram and set of instructions for determining the Richter magnitude of an earthquake below. The example shows the Richter magnitude of an earthquake 210 kilometers from a seismic station.

Instructions for determining Richter magnitude:
• Determine the distance to the epicenter of the earthquake. (The distance in the example is 210 kilometers.)
• Measure the maximum wave height of the *S*-wave recorded on the seismogram. (The height in the example is 23 millimeters.)
• Place a straightedge between the distance to the epicenter (210 kilometers) and the height of the largest *S*-wave (23 millimeters) on the appropriate scales. Draw a line connecting these two points. The magnitude of the earthquake is determined by where the line intersects the Richter magnitude scale. (The magnitude of this example is 5.0.)

Example of a Seismogram of an Earthquake



36. Using the set of instructions and the seismogram and scales below, determine the Richter magnitude of an earthquake that was located 500 kilometers from this seismic station.

37. Identify the information shown on the seismogram that was used to determine that the distance to the epicenter was 500 kilometers.

38. How long did it take the first *S*-wave to travel 500 kilometers to reach this seismic station?