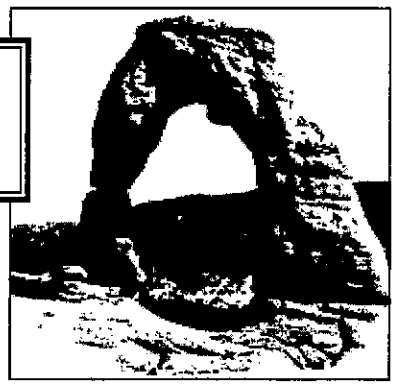
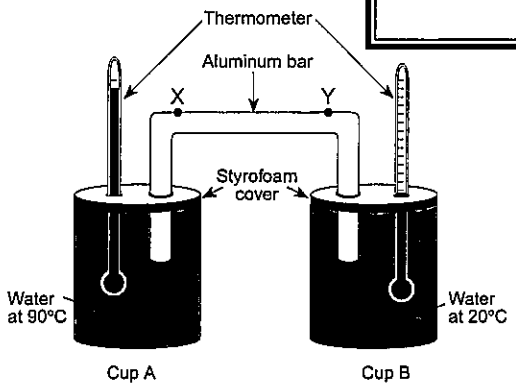
Rate of Change

$$\text{Rate of change} = \frac{\text{change in value}}{\text{time}}$$





Overview:

Certain Earth science events occur extremely fast, like an earthquake, while other events may take thousands or millions of years, like mountain building. In all cases, Earth scientists like to calculate these rate of changes. From these rates of change, comparisons and conclusions can be made about the event.

The Equation:

All events take time. For example, if a pile of sand 10 feet high is eroded over 60 days to a height of 7.0 feet, what is the rate of change for this pile of sand? The change in value involves subtracting two values, in this case 10 ft – 7 ft, giving a change in value of 3 ft. Next, as the equation shows, divide by the time.

Solution: RC (rate of change) $= \frac{10 \text{ ft} - 7 \text{ ft}}{60 \text{ day}}$ $\quad \text{RC} = \frac{3 \text{ ft}}{60 \text{ day}}$ $\quad \text{RC} = 0.05 \text{ ft/day}$

Additional Information:

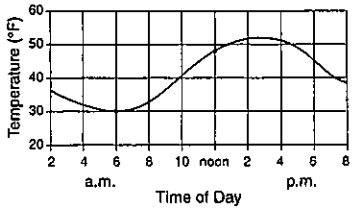
Many rate of change problems involve a graph. The change in value would be found on the *y*-axis, while time is located on the *x*-axis. It is absolutely necessary to include the units to get credit for your answer.

Set 1 — Rate of Change

1. The temperature of water in a container was 60°C. Ten minutes later, the water temperature was 35°C. What was the rate of cooling of the water?

   (1) 25°C/min
   (2) 2.5°C/min
   (3) 35°C/min
   (4) 3.5°C/min 1_____

2. The graph below shows temperature readings for a day in April. The average rate of temperature change, in Fahrenheit degrees per hour, between 6 a.m. and noon was



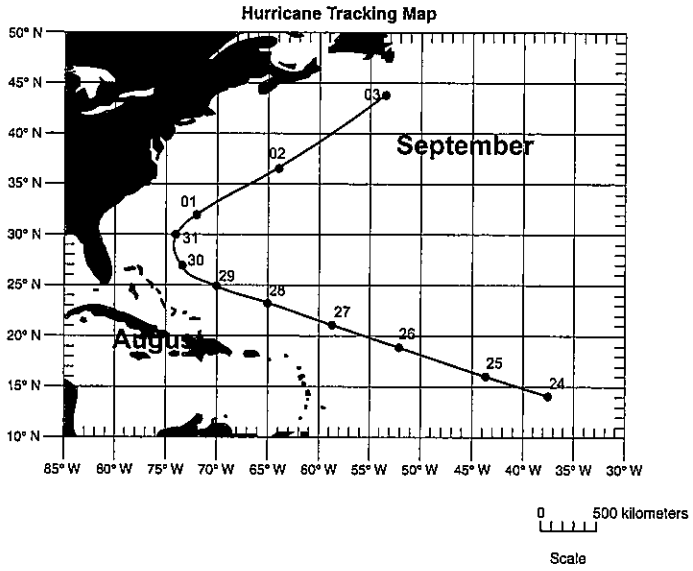
   (1) 6°F/hr (3) 3°F/hr
   (2) 8°F/hr (4) 18°F/hr 2_____

3. The rate of temperature change for the water in cup *A* for the first 10 minutes was approximately

	Temperature of Water (°C)	
Minute	Cup *A*	Cup *B*
0	90	20
1	88	20
2	86	20
3	85	21
4	83	21
5	82	22
6	81	22
7	80	22
8	79	22
9	78	23
10	77	23

   (1) 0.77°C/min
   (2) 1.3°C/min
   (3) 7.7°C/min
   (4) 13.0°C/min 3_____

4. Calculate the average daily rate of movement of the hurricane from August 24 to August 28. Follow the directions given below.



   a) Write the equation used to determine the rate of change.

   b) Substitute data into the equation.

   c) Calculate the average daily rate of movement of hurricane and label it with the proper units.

5. The highest elevation of Mt. Zembat in Alaska 40 years ago was measured at 7600 feet. Today the highest elevation is 7598 feet. What is the rate of change in elevation for this mountain.

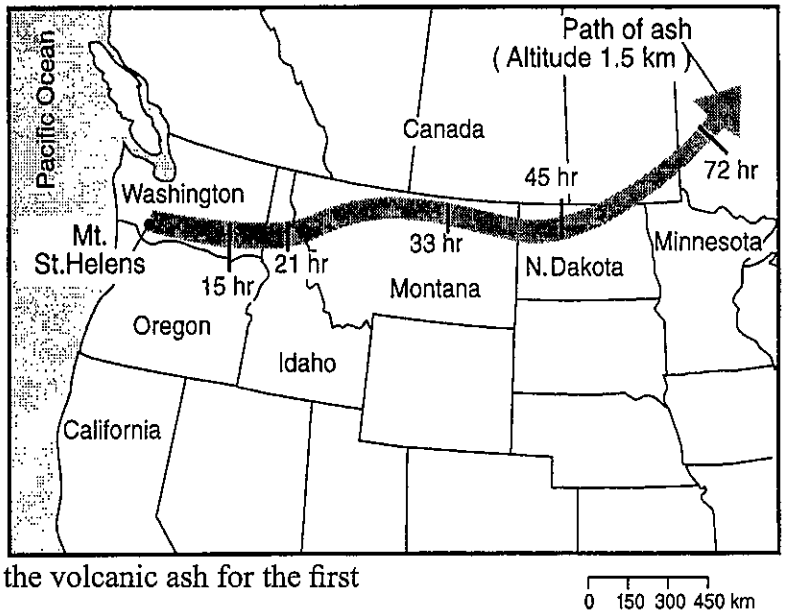
(1) 0.05 ft/yr
(2) 0.6 ft/yr
(3) 0.45 ft/yr
(4) 20 ft/yr 5_____

6. A 25-gram sample of halite was placed in a jar with five other mineral samples and water. The jar was shaken vigorously for 5 minutes. The halite sample was then found to have a mass of 15 grams. What was the rate of weathering of the halite sample?

(1) 0.50 g/min
(2) 2.0 g/min
(3) 3.0 g/min
(4) 10. g/min 6_____

Base your answers to question 7 on the information and the accompanying map.

The eruption of Mt. St. Helens in 1980 resulted in the movement of volcanic ash across the northwestern United States. The movement of the ash at 1.5 km above sea level is shown as a shaded path on the map. The times marked on the path indicate the length of time the leading edge of the ash cloud took to travel from Mt. St. Helens to each location.



7. Calculate the average rate of movement of the volcanic ash for the first 15 hours, following the directions below.

a) Write the equation used to determine the average rate of the volcanic ash movement.

b) Substitute values into the equation.

c) Solve the equation and label the answer with the correct units.