**Warm Up**

12/15

Does the following equation represent exponential growth or decay?

Rate = % change

$$y = 4(.65)^x$$

What is the Factor? 0.65

What is the Rate? 35% ↓

Factor = 1 + Rate

$0.65 = 1 + \text{Rate}$

$-1 \quad -1$

$-0.35 = \text{Rate}$

Negative sign indicates a decrease

35% ↓

## Homework Questions?

Page 68, #'s 4-7

**4.** Penicillin decays exponentially in the human body. Suppose you receive a 300-milligram dose of penicillin to combat strep throat. About 180 milligrams will remain active in your blood after 1 day.

**a.** Assume the amount of penicillin active in your blood decreases exponentially. Make a table showing the amount of active penicillin in your blood for 7 days after a 300-milligram dose.

**b.** Write an equation for the relationship between the number of days *d* since you took the penicillin and the amount of the medicine *m* remaining active in your blood.

**c.** What is the equation for a 400-milligram dose?

Factor = 0.6

40% ↓

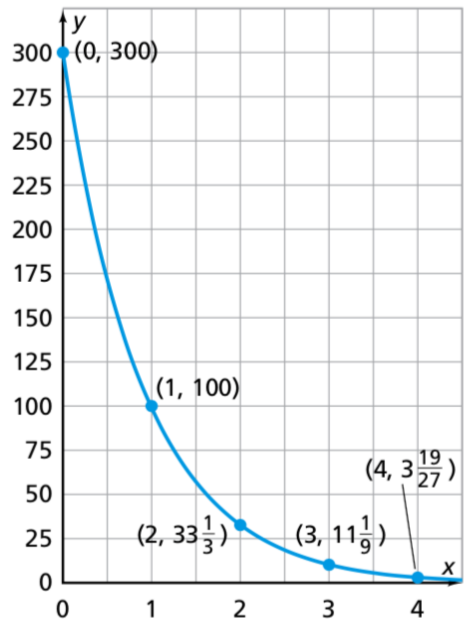
**For Exercises 5 and 6, tell whether the equation represents exponential decay or exponential growth. Explain your reasoning.**

**5.** $y = 0.8(2.1)^x$ Growth 110% ↑

**6.** $y = 20(0.5)^x$ Decay

Factor is < 1
Must be decay
50% ↓

**7.** The graph below shows an exponential decay relationship.




| | |
|---|---|
| 0 | 300 |
| 1 | 100 |
| 2 | $33\frac{1}{3}$ |

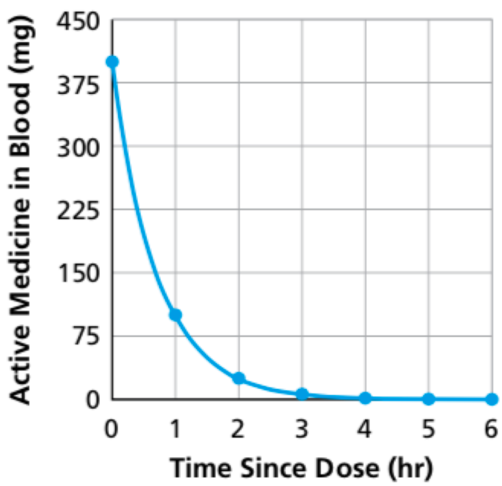
> 0.33

**a.** Find the decay factor and the $y$-intercept.

**b.** What is the equation for the graph?

# Problem 4.2 Recap

# Part A

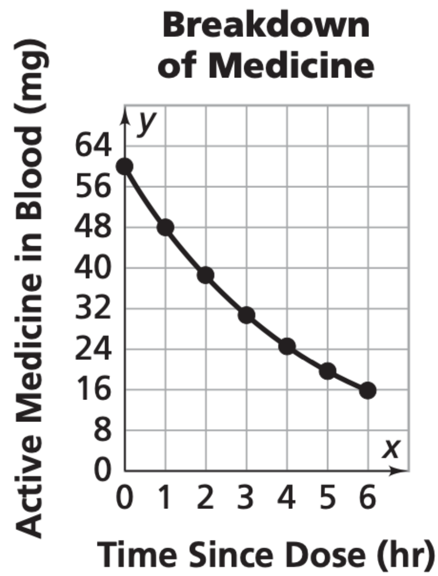



$m = 400\left(\frac{1}{4}\right)^h$

$m = 400(0.25)^h$

75% ↓

# Part B




$m = 60(0.8)^h$

20% ↓

check out the factors to get rates

**4.** Dwayne was confused by the terms *decay rate* (or *rate of decay*) and *decay factor*. He said:

> Because the rate of decay is 20%, the decay factor should be 0.2, and the equation should be $m = 60(0.2)^h$.

Do you agree with him? Explain.

**5.** Steven recalled that when the growth rate is 80%, the growth factor is 1.8 or 180%. How is the relationship between growth rate and growth factor similar to the relationship between decay rate and decay factor?

# 4.3 Cooling Water
## Modeling Exponential Decay

Sometimes a cup of hot cocoa or tea is too hot to drink at first. So you must wait for it to cool.

- What pattern of change would you expect to find in the temperature of a hot drink as time passes?
- What shape would you expect for a graph of data (*time, drink temperature*)?

This experiment will help you explore these questions.

Glue the data table into your notebook leaving room as shown below:

x = # of 5 min. increments

| x<br># of 5 min increments | Time (min) | Water Temp. (°C) | Room Temp. (°C) | | |
|---|---|---|---|---|---|
| 0 | 0 | 89 | 27 | | |
| 1 | 5 | 71 | 27 | | |
| 2 | 10 | 59 | 27 | | |
| 3 | 15 | 52 | 27 | | |
| 4 | 20 | 47 | 27 | | |
| 5 | 25 | 43 | 27 | | |
| 6 | 30 | 40 | 27 | | |
| 7 | 35 | 37 | 27 | | |
| 8 | 40 | 35 | 27 | | |
| 9 | 45 | 33 | 27 | | |
| 10 | 50 | 32 | 27 | | |
| 11 | 55 | 31 | 27 | | |
| 12 | 60 | 30 | 27 | | |

## Problem 4.3

**A** **1.** Complete the table with data from your experiment.

**Hot Water Cooling**

| Time (min) | Water Temperature | Room Temperature |
|---|---|---|
| 0 | ■ | ■ |
| 5 | ■ | ■ |
| 10 | ■ | ■ |
| ■ | ■ | ■ |

# of 5 min. intervals

Make a graph of your (*time, water temperature*) data.

**2.** Describe the pattern of change in the data. When did the water temperature change most rapidly? When did it change most slowly?

**3.** Is the relationship between time and water temperature an exponential decay relationship? Explain. Is there a constant factor?

**B** **1.** Add a column to your table. In this column, record the difference between the water temperature and the air temperature for each time value.

**2.** Make a graph of the (*time, temperature difference*) data. Compare this graph with the graph you made in Question A.

**3.** Describe the pattern of change in the data. When did the temperature difference change most rapidly? Most slowly?

**4.** Estimate the decay factor for the relationship between temperature difference and time in this experiment.

**5.** Write an equation for the (*time, temperature difference*) data. Your equation should allow you to predict the temperature difference at the end of any 5-minute interval.

**C** **1.** What do you think the graph of the (*time, temperature difference*) data would look like if you had continued the experiment for several more hours?

**2.** What factors might affect the rate at which a cup of hot liquid cools?

**3.** What factors might introduce errors in the data you collect?

**D** Compare the graphs in Questions A and B with the graphs in Problems 4.1 and 4.2. What similarities and differences do you observe?

# Homework

Finish classwork