Instructions: Answer any 11 of the following 14 questions. You may answer more than 11 to earn extra credit.

"I can't believe you had a brain freeze during the test on the Ice Age."

1. State the domain of each function.

(a) $f(x) = 1 + 5x + \dfrac{x^2 - 4x}{x^2 + 100}$
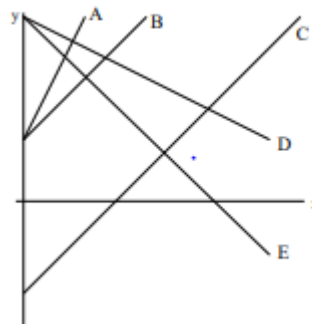
(b) $g(x) = \sqrt{99 - x}$

(c) $h(x) = \dfrac{x - 11}{10(x - 3)(5 - x)}$

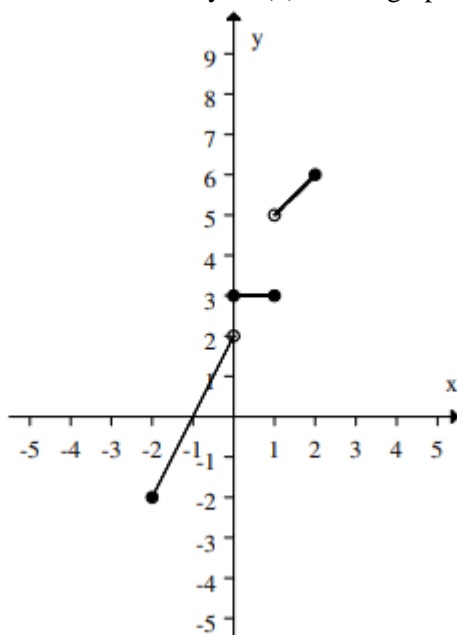(d) $s(x) = \dfrac{x^2 + 1}{\sqrt{99 - x}}$

(e) $G(x) = x(x + 4)(x - 7)^{33} + x + 123$

2. Given below are the equations for five different lines. Match each formula with its graph below:

- $f(x) = 20 + 2x$

- $g(x) = 20 + 4x$

- $h(x) = 2x - 30$

- $u(x) = 60 - x$

- $v(x) = 60 - 2x$

3. Write an equation of the function y = f(x) whose graph is below.

$$f(x) = \begin{cases} \end{cases}$$

4.

To the right, you are given a graph of the amount, Q, of a radioactive substance remaining after t years. Only the t-axis has been labeled. Use the graph to give a **practical interpretation** of each of the three quantities that follow. A practical interpretation is an explanation of meaning using everyday language.
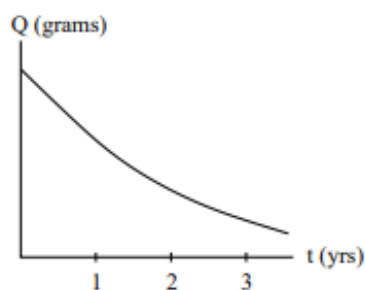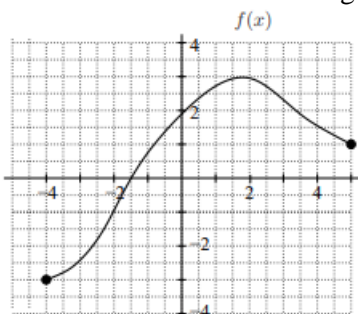

(a) f(1)

(b) f(3)

(c) $\dfrac{f(3)-f(1)}{3-1}$

5. Let y = f(x) be defined by:

$$f(x) = \begin{cases} -3, & -2 \le x < 1 \\ x+1, & 1 \le x \le 3 \\ x-3, & 3 < x < 4 \end{cases}$$
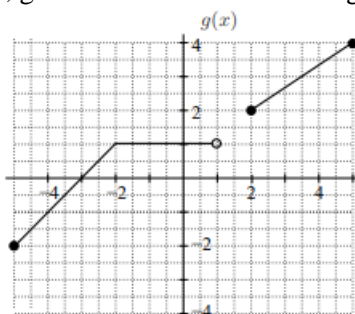
   a. Graph this function.

b. What is the domain of f ?

c. What is the range of f ?

6. For each of the following functions below, give the domain and the range.

$f(x)$

$g(x)$

Domain: Domain:

Range: Range:

7. In month $t = 0$, a large group of bats escapes from a ship onto an island where there are no bats. The island bat population, $p(t)$, in month t is given by

$$p(t) = \frac{6000}{2+(0.8)^t} \; for \; t \geq 0$$

a. Evaluate $p(0)$, $p(10)$, $p(50)$, $p(100)$, and $p(500)$ and explain their meaning in terms of bats.

b. Graph the function by first plotting the points that you have computed in part (a).

c. What is the domain of $p(t)$?

d. Using your graph and your knowledge of the scenario, estimate the range of $p(t)$. What does this tell you about the bat population?

8. Let $C = 30 - 0.35t$, where C is the cost of a case of apples (in dollars) t days after they were picked.

a. Complete the table below:

t (days)	0	5	10	15
C (dollars)				

b. What was the initial cost of a case of apples?

c. Find the average rate of change of C with respect to t during the first 10 days.

d. Explain in practical terms (that is, in terms of cost and apples) what this average rate of change means. Use a complete sentence.

9. Let $h(x) = 2x^2 - 4x + 1$. Evaluate and *simplify* the following expressions.

a. $h(2)$

b. $h(p - 2)$

c. $h(p) - 2$

d. $h(p) - h(2)$.

10. The cost, in dollars, of renting a car for a day from three different rental agencies and driving it d miles is given by the following functions:

$$C_1 = 0.50d \qquad\qquad C_2 = 30 + 0.20d \qquad\qquad C_3 = 50 + 0.10d$$

(a) For each agency, describe the rental agreement in words.

Agency 1

Agency 2

Agency 3

(b) Graph the *cost function* for each agency on *one set of axes.*

(c) For what driving distance does Agency 1 cost the same as Agency 2?

(d) Determine the different circumstances for which each agency is cheapest. Explain how you know.

11. Line l in Figure 1.52 below is parallel to the line $y = 2x + 1$. Find the coordinates of point P. Show your work!
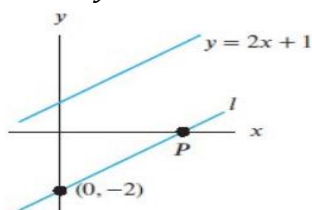

Figure 1.52

12. Table 2.4 shows $N(s)$, the number of sections of Economics 101, as a function of s, the number of students in the course. If s is between two numbers listed in the table, then $N(s)$ is the higher number of sections.

Table 2.4

s	50	75	100	125	150	175	200
$N(s)$	4	4	5	5	6	6	7

    a.   Evaluate and interpret (using complete sentences):

        i. $N(150)$

        ii. $N(80)$

    b.   Solve for s and interpret (using complete sentences).

        i. $N(s) = 7$

        ii. $N(s) = 4$

13. Let $f(x) = 3 - x^3$.

    a.   Find $f(0)$ and $f(2)$. What is the *average rate of change* of $f(x)$ on the interval $0 \le x \le 2$?
    b.   Find the average rate of change of $f(x)$ on the interval $2 \le x \le 4$.
    c.   Find the average rate of change of $f(x)$ on the interval $b \le x \le 2b$, where b is a positive constant. Simplify, if possible.

14. A stalactite is an icicle-shaped formation that hangs from the ceiling of a cave and is produced by precipitation of minerals from water dripping through the cave ceiling. Most stalactites have pointed tips. Albertine's favorite stalactite in Mammoth Cave Natural Park grows according to the formula $L(t) = 17.75 + \frac{1}{250}\, t$, where $L(t)$ represents the length of the stalactite, in inches, and t represents the time, in years, since the stalactite was first measured.

    a.   What is the value of the vertical intercept?

b.   Explain the meaning of the vertical intercept in practical terms. Include units in your answer.

c.   What is the slope of L(t)?

Mammoth Cave

d. Using a complete sentence, explain the meaning of the slope in practical terms. Include units in your answer.