Exercises for Section 1.1

2. a. In 2006 China had the largest population; it was approximately 1300 million or 1.3 billion.

b. In 2006 India had approximately 1050 million; it would therefore need over 200 million more to exceed China's 2006 population.

c. In 2006 China had (1300/6500)•100 ≈ 20% of the world's population; India had (1100/6500)•100 ≈ 16.9% and the US had (300/6500)•100 ≈ 4.6%.

4. a. 5 to 9 is the most likely interval; 15 to 19 is the least likely.

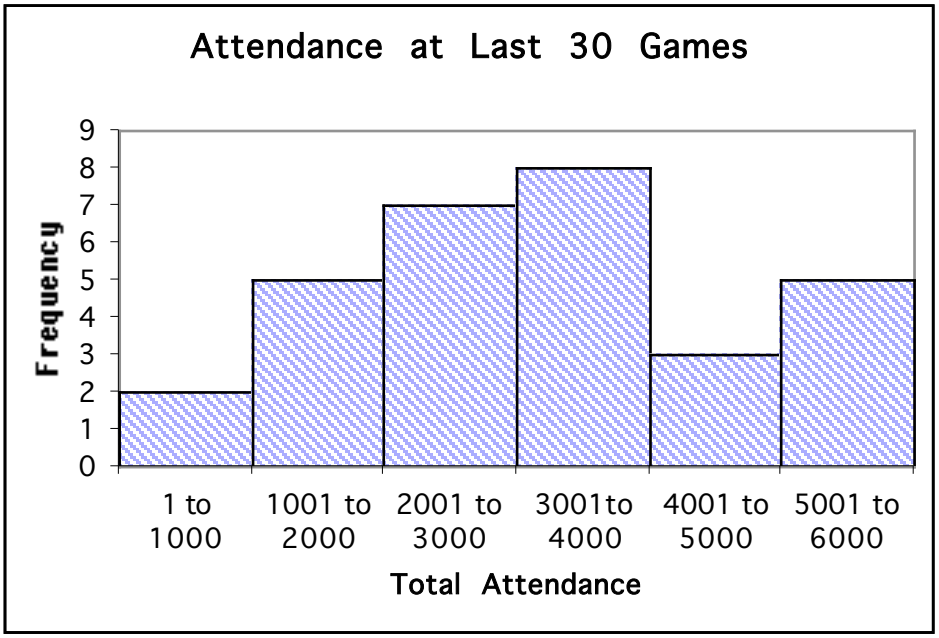
b. (26/39)•100 ≈ 67% of the games had a point spread of 9 or less; (36/39)•100 ≈ 92% of the games had a point spread of 14 or less.

6. a. i. Approximately 10% **ii.** Approximately 90% **iii.** Approximately 87%

b. 25% of 392,031,000 = 98,007,750.

c. Answers will vary; the sentence should mention two factors: the percentage of the white population is going down while the percentages of all minorities except of the American Indian, Eskimo and Aleuts are going up, most especially those of Hispanic origin.

8. The attendance counts ranged from 673 to 5435. A good picture can be had if we plot the data in a histogram using a horizontal scale from 0 to 6000 with each class width being 1000. The histogram is given in the accompanying diagram.



10. a. The mean contribution is $2500.

b. The mean income is $25,000.

c. One cannot predict the median since there is no information about the distribution of wealth.

12. Let x = grade on 5th exam and y = grade on 6th exam and let z = (x+y)/2, their average. Then we want a value of z such that the average of all 6 grades is at least an 82, *i.e.*, we want to find a value of z such that $82 \le (78+92+60+85+x+y)/6 = (315+2z)/6$ or $492 \le 315 + 2z$ or $z \le 177/2 = 88.5$. So the lowest possible average would be 88.5 on your two last exams.

14. a. Mean = 187/9 = 20.78; median = 22.
b. i. 23; **ii**. 22, 23, 24, or 25.

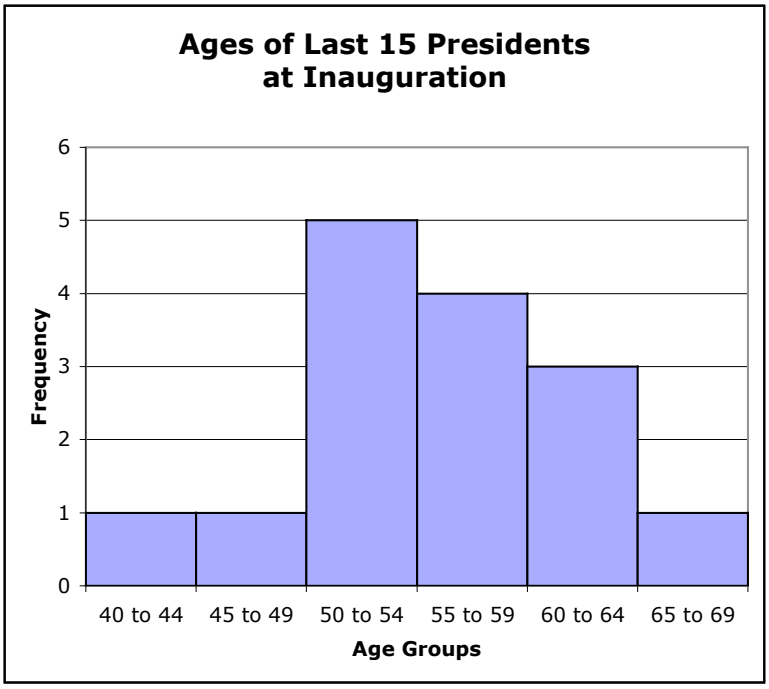
16. a. Mean = 55.2 yrs.; median = 55 yrs.

b. $\frac{828 + x}{16} = 54.94$ and thus $828 + x = 54.94 \cdot 16 = 879.04$ and thus $x = 879.04 - 828 = 51.04$ or 51 years old.

c.

Age Interval	Count
40 to 44	1
45 to 49	1
50 to 54	5
55 to 59	4
60 to 64	3
65 to 69	1

d.



18. In income distributions there are always a few very high amounts that skew the mean away from the "typical". The median gives the true middle.

20. Answers will vary.

22. a. Use the midpoint of each age interval as the representative age of that class then multiply by the frequency count and then get the mean age 577/21 ≈27.5 yrs.

b. If one uses the low end points for each of the intervals, one gets the smallest possible mean: 535/21= 25.48; using the high end points of these intervals one gets the largest possible mean: 619/21 ≈ 29.48.

24. A frequency and relative frequency histogram of income distribution (using age intervals of 5-years) for all ages, the national average net worth for households, a definition of "living in poverty" would all be useful.

26. The histogram and the mean and median of the data gathered by each student will be quite different. Much depends on what kind of text the student chooses to analyze. For children's books we would expect the majority of the words to be short; for a work of literature there would probably be more of a balance among short, medium and long words, and for a medical textbook, we would expect there to be more long words.

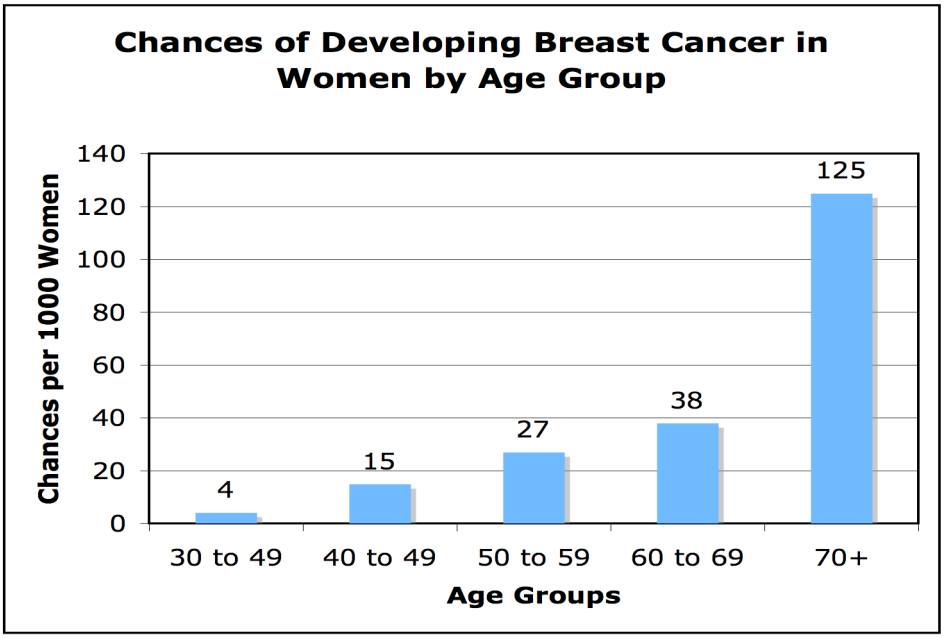
28. a. i. 11 million **ii.** 9 million
iii. About 8 million; 13 million **iv.** About 55 million.
b. Answers will differ. Major factors that could be mentioned: the number of persons in each age bracket are larger in 2050; there are far more females predicted in the 85+ category for 2050 than in 2005 and the largest categories are in the 0 to 4 age brackets in 2050 whereas in 2005 these were in the 40 to 44 and 45 to 49 age brackets.

Exercises for Section 1.2

2. a. June 2006 through to Dec 2006
b. Approximately 10750; in June 2006
c. Approximately 12,250; in Nov and Dec 2006
d. The Dow Jones rose from 10,750 to 12,250 from June 2006 to Dec 2006

4. a. The likelihood of getting breast cancer increases with age.

b.

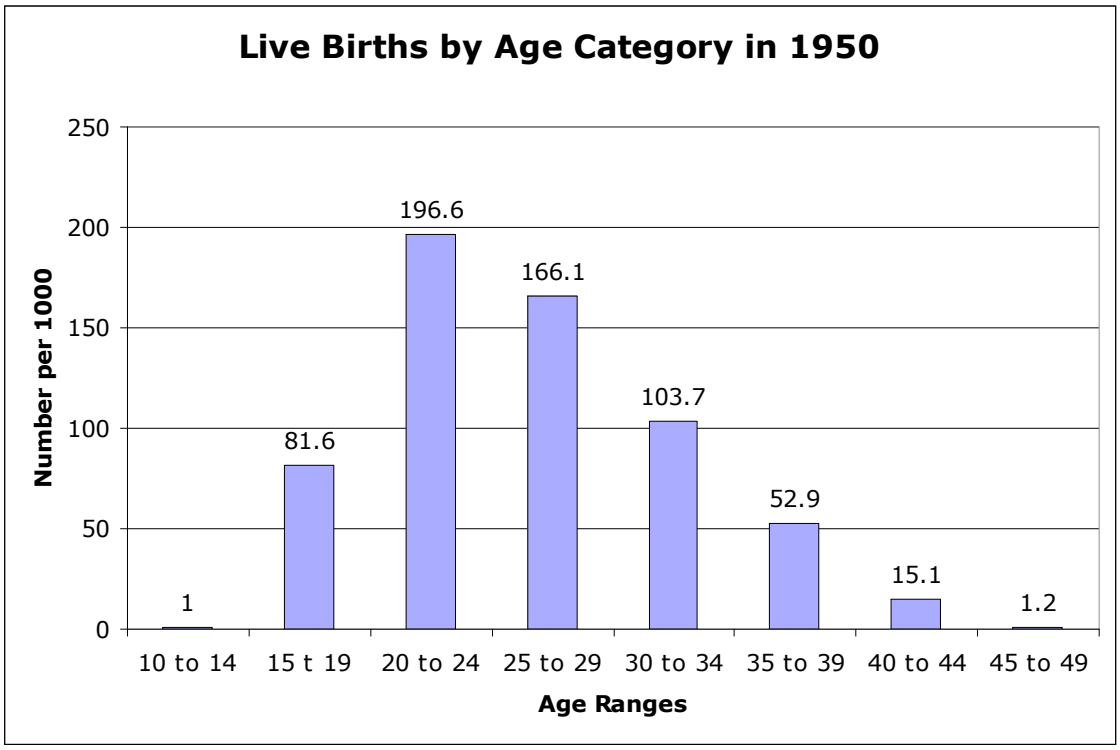


c. The ratio is 15 to 4**,** which is 3.75 times more likely or almost 4 to 1; the ratio is 27 to 15, which is 1.8 times more likely or almost 2 to 1.

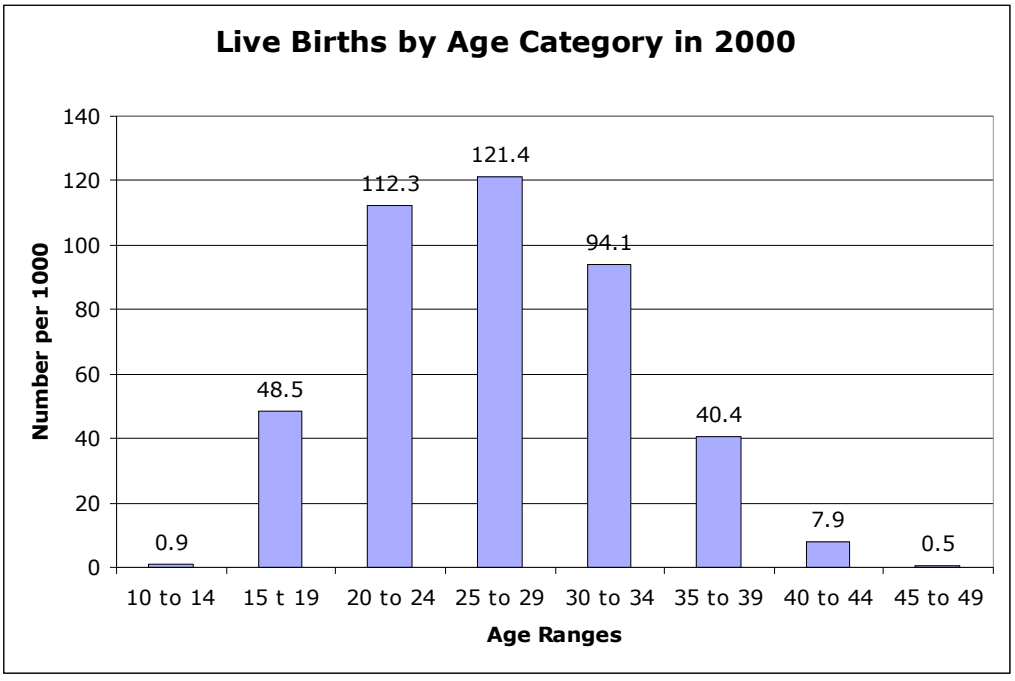
d. Answers here will vary from student to student. Clearly insurance companies would be reluctant to lower the age for paid-for mammograms below 50. The well being of women on the other hand might argue for the lowering. Also early detection in the 40 – 49 range, could lower insurance costs if cancer is detected earlier.

6. a.

In 1950 the 20 to 24 years age category had the highest birth rate that rate corresponds to (199.6/1000)•100 ≈ 20% of the women in that age category. The lowest live birth rate was for women in the 10-to-14 age category. That rate was (1.0/1000)•100 = 0.1% of the women in that age category.



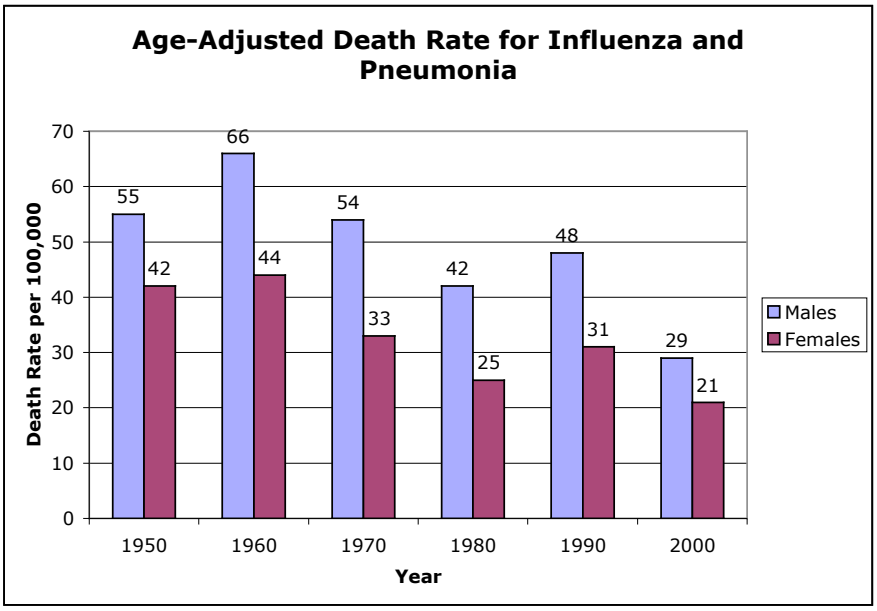
b.



The highest live birth rate in 2000 was for women 25 to 29 years old.; that rate corresponds to (121.4/1000)•100 = 12.14% of women in that age category. The lowest live birth rate was (0.5/1000)•100 = 0.05%; that rate corresponds to women in the 45 to 49 yr category.

c. Student answers will vary. From 1950 to 2000 live births per 1000 women have dropped in every age category. In 1950, the highest live birth rate was in the 20 to 24 age category but in 2000 it shifted up to the 25 to 29 age category.

8. a.



b. The death rate was highest for both men and women in 1960

c. No

d. Student answers will vary. Some key observations would be: the percentage of male victims was persistently higher than that for females; the peak occurred in 1960 for both sexes, and since then (except for 1990) there has been an overall decline in the death rate, reaching an all time low in 2000.

10. a. $(-2)^2 - 2(-2) + 1 = 4+4+1 = 9$; $1^2 - 2 + 1 = 0$; $2^2 - 2(2) + 1 = 4 - 4 + 1 = 1$. Thus the pairs (1,0) and (2,1) satisfy the equation.

b. If $x = 3$, then $3^2 - 2(3) + 1 = 9 - 6 + 1 = 4$. Thus another pair is (3, 4)

12.

x	y
-3	7
-2	2
-1	-1
0	-2
1	-1
2	2
3	7

The graph's symmetry helped quite a bit.

14. a. Add 1 to the value of x and divide the result into 1.

b. (0, 1) **c.** (-3/4, 4) **d.** No, the formula is not defined if x = -1.

16. a. (0,0), (3,33), (-2,-2)
b. (0,1), (3,-8), (-2,-3)
c. (0,0), (3,36), (-2,-4)
d. (0,6), (3,6), (-2,36)

18. Comments could include statements like the following: From the 2006 data China has a substantially larger population than the U.S. in every age category except for those 85 and older. The population of China is substantially younger than that of the U.S For every age category up until age 44, China has a larger population percentage than the U.S. The largest percentage of China's population is in the interval from 35 to 39, representing approximately 9.5% of the population. In the U.S., the highest percentage, about 7.5%, was for people from 50 to 54.

20. Omitted. Answers from students will vary considerably.

Exercises for Section 1.3

2. a. This is a function; each input has only one output.
b. This is not a function; 0 and 1 each have two outputs.
c. This is not a function; 10 and 7 each have two outputs.
d. This is a function; each input has only one output.

4. Graphs labeled B and C describe functions. They both pass the vertical line test.

6. No, height is not a function of weight because an input of 120 results in two different outputs. Weight, however, is a function of height because each height value corresponds to a unique weight value.

8. a. $y = 3x$ **b.** $y = 3x - 2$ **c.** $y = -x^2$

10. a. $S = 0.80P$ **b.** $P = N+6$; subtract 12 **c.** $C = T - (2/3)W$

12. a. $z = (3/5)t - 2$; it is a function; each input for t has only one output for z.
b. $z = 3t^2$; it is a function; each input for t has only one output for z.
c. $z = 2t - 9$; it is a function; each input for t has only one output for z.

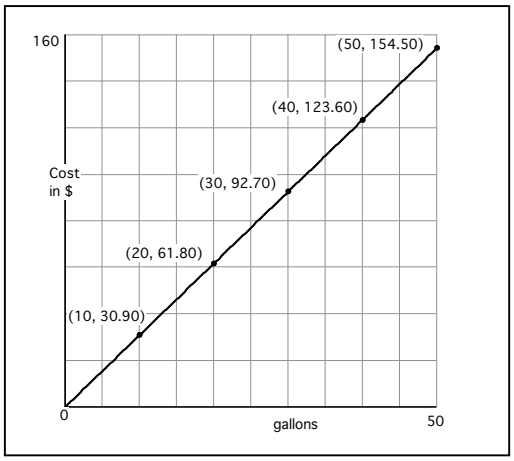
Exercises for Section 1.4

2. $f(0) = 0$, $f(-1) = 0.5$, $f(1)$ is not defined, $f(20) \approx 1.0526$, $f(100) \approx 1.010$

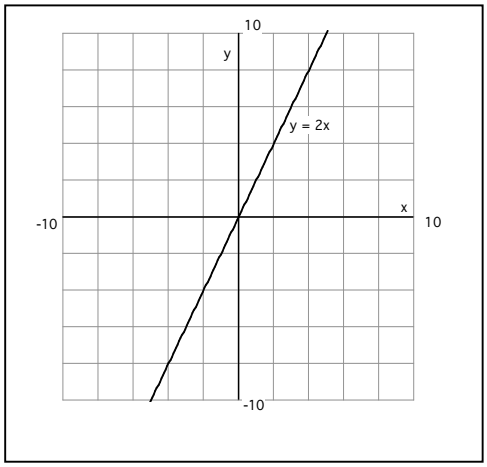
4. a. $C = 3.09 \bullet G$, where C is cost in dollars and G = number of gallons purchased.
b. G is the independent variable and C the dependent one.
c. For each input of G, there is one and only one value for C; thus it is a function.
d. The domain could be $G \geq 0$. The corresponding range would be $C \geq 0$. There is not enough data to indicate a suitable maximum gasoline capacity and corresponding suitable maximum cost.

e. Here is a small table of values and the graph of the function.

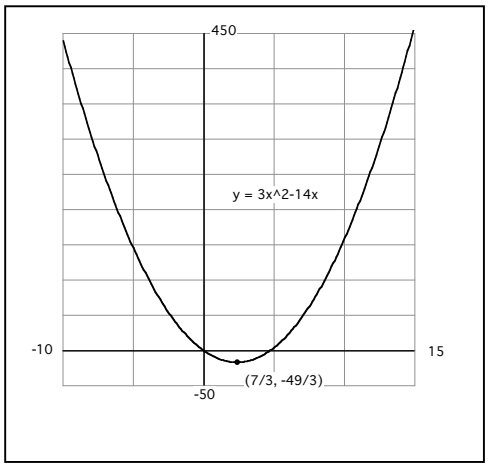
No. of Gallons	Cost
10	30.90
20	61.80
30	92.70
40	123.60
50	154.50



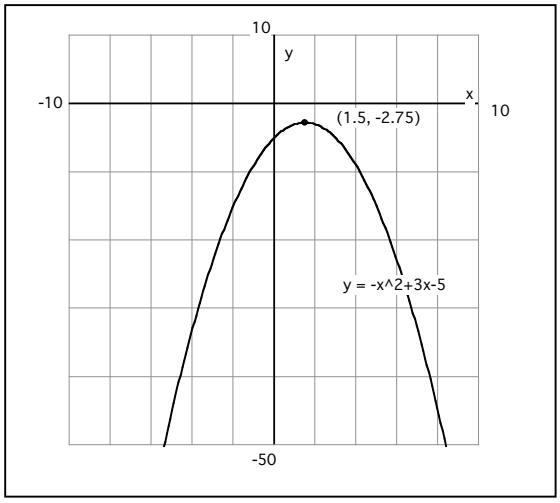
6. a. $y = 2x$; domain: x is all real numbers; range: y is all real numbers



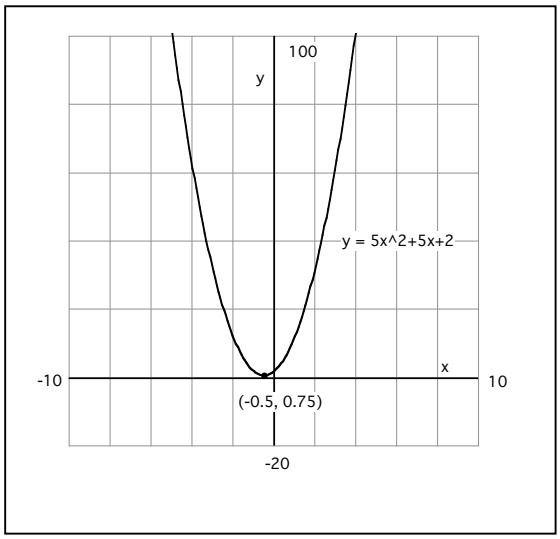
b. $y = 3x^2 - 14x$ **;** domain: all real numbers; range: $y \geq -49/3$



c. $y = -x^2 + 3x - 5$: domain: all real numbers; range : $y \le -2.75$



d. $y = 5x^2 + 5x + 2$; domain: all real numbers; range: $y \ge 0.75$



8. g(0) = 3, g(1) = 5, g(-1) = 1

10. **a.** f(-3) = 4, f(0) = -4, f(1) = – 3, f(2.5) = 2
b. f(x) = 0 when x = -2 and 2

12.
a. f(3) = 0;	domain:	x is all real numbers.
b. f(3) = 1/3,	domain:	x is all real numbers, except zero.
c. f(3) does not exist,	domain:	x is all real numbers, except three.
d. f(3) = 3;	domain:	all real *x*, except one.

14. **a**. domain: all real numbers
b. domain: all real numbers
c. domain: all real numbers except –1
d. domain: all real numbers
e. domain: all real numbers

16. a. Domain: all real numbers except -2; cannot divide by zero.
Range: all real numbers except zero; a fraction is zero if only if its numerator is zero and its denominator is not.

b. Domain: all real numbers ≥ 5; square roots are of nonnegative numbers only.
Range: all real numbers ≥ 0; square root values are nonnegative.

c. Domain: all real numbers except 3/2: cannot divide by zero.
Range: all real numbers except 0 (see part (**a**))

d. Domain: all real numbers except 2 and -2; cannot divide by zero.
Range: all real numbers except zero (see part (**a**)).

e. Domain: all real numbers ≥ -3; square roots are of nonnegative numbers only.
Range: real numbers ≥ 0; square root values are nonnegative.

18. f: domain: all real numbers: no restrictions
g: domain: all real numbers: no restrictions
h: domain: all real numbers except 2 to prevent division by 0
F: domain: all real numbers: no restriction
G: domain all real numbers except -2 and 2 to prevent division by 0
H: domain: all real numbers ≥ 2: square roots are of nonnegative values

Section 1.5

2. a. The federal funds rate rose to approximately 6.5% in going from 2000 to 2001 but then steadily declined until 2002 when it leveled off at approximately 1.8% and then fell to approximately 1.0% in mid 2003.

b. Credit card rates rose from 15% in 2000 to 16% for a while in 2001 and then steadily declines to approximately 13% in 2003.

c. 30-year mortgage rates were at their peak at 8.5% in mid 2000 and then have been steadily declining since (after a small blip up in early 2002). In mid 2003 they reached about 5%.

d. The maximum federal fund rate during that period was approximately 6.5%. It occurred from the middle of 2000 to that year's end.

e. The minimum federal funds rate during that period was approximately 1%. It occurred in mid 2003.

f. Student answers will vary but one factor stands out: a decline in the federal funds rate seems to be accompanied by a general decline in all the loan rates.

4. For Graph A:
a. $[-4, \infty)$
b. $(-\infty, -4]$
c. no
d. yes, at x = -4
e. concave down over $(-\infty,\infty)$

For Graph B.
a. $(-\infty, 4]$
b. $[4, \infty)$
c. yes at x = 4
d. no
e. concave up over $(-\infty,\infty)$

6. a. C **b.** B **c.** D **d.** A

8. a. f(-6) = -4; f(2) = 6; f(12) = 2
b. f(0) = 2
c. f(x) = 0 at x = -3, 5 and 11;

d. $f(8) < 0$

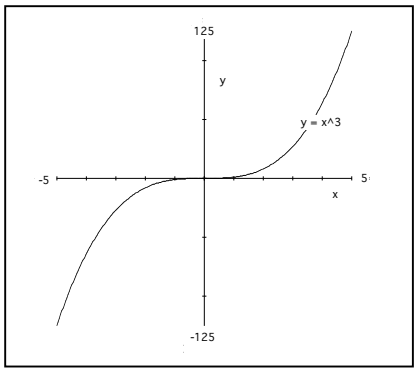
e. the graph of $y = 1$ would intersect the graph of $y = f(x)$ three times: around $x = -2$, 4 and 11.5.

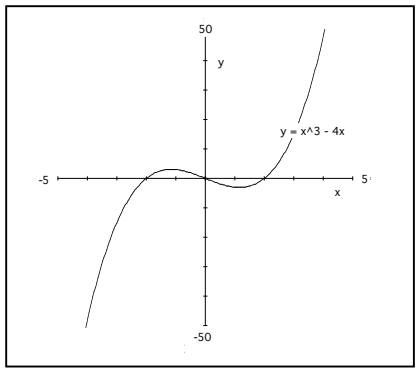
f. domain of $f = [-6, 12]$; range of $f = [-4, 6]$

g. the maximum is $y = 6$ at $x = 2$; the minimum is $y = -4$ at $x = -6$

10. i. matches **c.** **ii.** matches **a.** **iii.** matches **d.** **iv.** matches **b.**

12. a. $f(x) = x^3$ **b.** $g(x) = x^3 - 4x$





f's graph is concave down on $(-\infty, 0)$ and concave up on $(0, \infty)$

g's graph is concave down on $(-\infty, 0)$ and concave up on $(0, \infty)$

14. a. In Graph A there is a maximum at (-2, 3). In Graph B there are no maxima or minima

b. In Graph A the function is increasing over $(-\infty, -2)$ and $(0.25, 2)$.
In Graph B the function is increasing over $(-\infty, -1)$ and $(1, \infty)$.

16. Descriptions here replace actual drawings because of graphing software limitations.

a. In the northeastern part of the US, the graph would rise and then fall several times, representing the alternating periods of snow and melting. The graph may eventually go down to zero. In the southwestern part of the US, the graph could be a nearly flat curve close to or exactly on the horizontal axis. The shape of this will depend very much on where the student lives.

b. Again, the shape of the graph would depend on what part of the country the student is from. In general, the graph should start out with moderate temperatures during the early morning hours and then steadily rise to an uncomfortable range of values and then as the sun goes down it should slowly drop to the more moderate temperatures.

c. This graph would be a curve that rises somewhat quickly and then goes down very slowly a bit at a time (from each bailing) and this situation would repeat itself several times during the fishing trip.

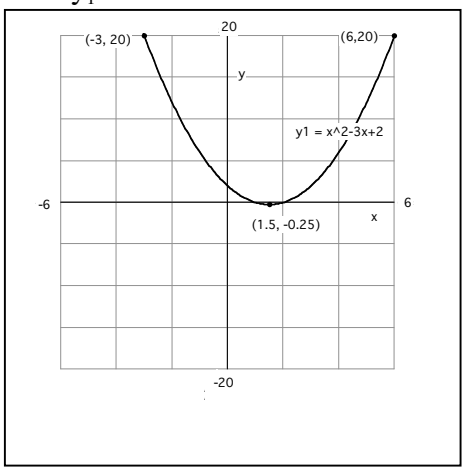
d. This graph will be somewhat periodic. If one starts the year at the vernal equinox, the number of hours of daylight will more or less steadily go up as the weeks go by reaching a high point at the summer solstice. It would then slowly go down until it

reaches the autumnal equinox and then it would keep going down until it reaches the winter solstice and then start to rise to return on the vernal equinox more or less close to what it was the year before. [It should resemble the shape of a sine curve -- but students may not know this terminology.]

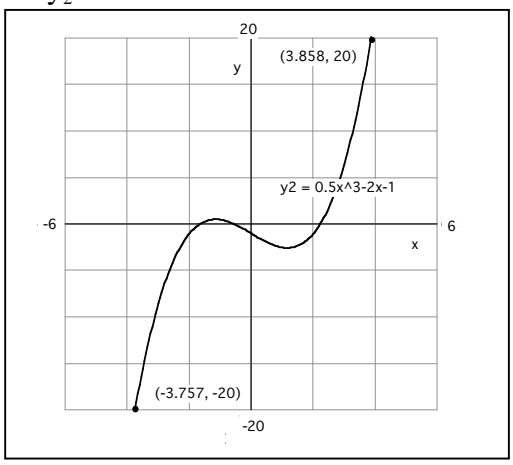
e. The graph will be concave up and it will descend slowly and level off at room temperature.

18. Student answers will vary. Some notable aspects: slow rise from 1950 to 1960; speedy rise from 1980 to 2000; with a little slowing down just before 2000.

20. For y_1



For y_2:



a. Using technology, one finds that the maximum value for y_1 occurs twice: at $x = -3$ and $x = 6$; $y = 20$ at both places. The maximum value for y_2 occurs at approximately $x = 3.9$ and is 20;

b. Using technology, one finds that the minimum value for y_1 occurs at $x = 1.5$ and is $y = -0.25$. The minimum value for y_2 occurs at x approximately $x = -3.8$ and is –20;.

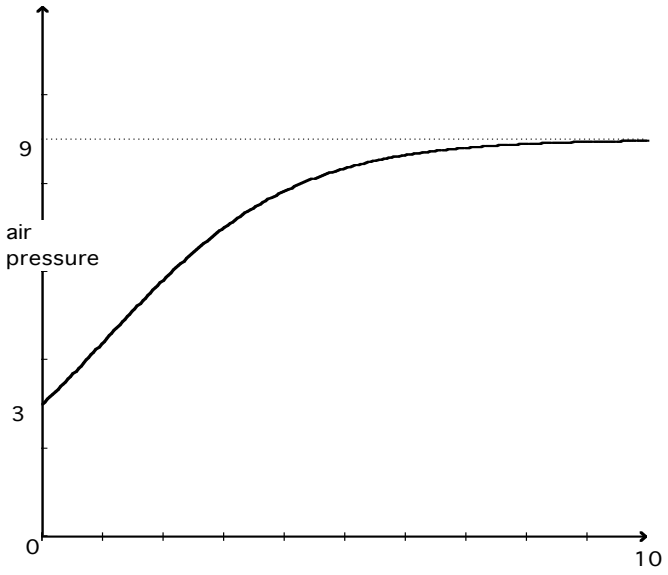
22. a. Expect level buying throughout the year except for peaks just before Thanksgiving, Christmas and Easter though the peaks at Christmas and Easter will be smaller than at Thanksgiving.

b. Expect level buying throughout the year except for peaks just before and at St. Valentines' Day, Easter, and Halloween. Expect these peaks to be about at the same heights.0

c. Answers here will vary but expect a peak in sales in late spring (just before summer) when the commercial push comes.

d. Expect peaks in sales just before school begins in September and again in January and again in late May, early June (if the school runs a summer session).

24, One graph that fits the description is given here.



26. a. Ali's graph is the black line that has little diamonds to mark the stages.
b. Ben's graph is the dotted blue line has little squares to mark the stages**.**
c. Cat's graph is the solid blue line that has little circles to mark the stages.

28. The values of f(x) increase over the interval $(-\infty, 0)$ and then they decrease over the interval $(0, \infty)$. The graph is concave up in the interval $(-\infty, -1)$, it is concave down over (-1,1) and then concave up again from $(1, \infty)$. The function is always positive and reaches a maximum value of 3 at $x = 0$.

Chapter One Review

2. **a**. North Korea has a much smaller GDP, a larger population or both.
b. About 480 Iraqis. The U.S. spends about 9.7 times more of its GDP, so about $107/person.
c. About $82.5 billion in China and $32.4 billion in India.

4. **a.** mean = 8,748.4 thousand metric tons
median = 5,280.5 thousand metric tons
b. 48.7%, or almost half of what the leading ten nations caught
32.6% or almost a third of what the world caught
c.. The median would not change but the mean would increase.

6. **a**. Answers are approximate: In 2006, type B–, = 2%, AB+ = 4%, AB– = 1%, (these three types with O+ and O– would be approximately half of the pie chart),
A+ = 34%, A– = 6%, B+ = 10%.
b. To determine the number of people with each blood type you would take the total population in the US (300 million in 2006) and multiply by the

corresponding percentage expressed as a decimal or fraction. For example, the amount of people with A- would be (300 million)• (0.06) ≈ 18 million.

8. $E = 2.50H + 0.18P$

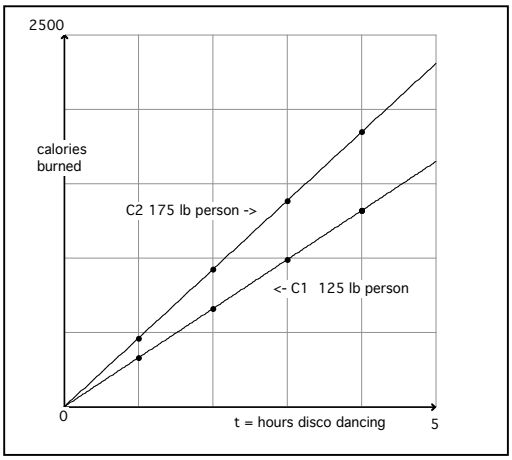
10. Answers will vary.
There were four major causes of the natural disasters during the 1990s: flooding, other geophysical disasters, tropical cyclones and severe storms. The worldwide cost of floods in the 1990's was close to $200 billion, making this type of disaster the most expensive. The second most costly were other geophysical disasters, such as earthquakes, which totaled over $160 billion in damages. Over $100 billion was spent on damage caused by tropical cyclones and over $75 billion on severe storms. Bushfires heat-waves, droughts and tsunamis were the next four costly disasters, but none of them cost more than $25 billion.\

12. **a.** $y = 2(x+1)$, y is a function of x
b. $y = x^2 - 1$, y is a function of x
c. $y = x^3 + 1$, y is a function of x

14. **a**. Yes, the graph represents a function, it passes the vertical line test. The domain is [5, 75] mph and the range is about [10, 30] mpg.
b. Driving at less than 25mph is relatively inefficient; peak efficiency occurs between 35 and 60 mph; efficiency starts to decline again after 60 mph.

16. **a**. $C_1 = 330t$; $C_2 = 462t$
b. Yes
c. Independent variable: t; dependent variables: C_1 and C_2; domain for both functions: $t \geq 0$; Range for both functions: C_1 and $C_2 \geq 0$
d. The graph of C_2 is steeper than the graph of C_1.

Hours	C_1 calories	C_2 calories
1	330	462
2	660	924
4	1320	1848
5	1650	2310



e. The corresponding graph for a 200 lb. person would be steeper than the graphs for C_1 and C_2.

18. **a**. $f(-1) = 0, f(0) = -1, f(2) = 0$

b. $f(-2) = -2$ and $f(1) = -2$

c. i. increasing over intervals $(-\infty, -1)$ and $(1, +\infty)$

ii. decreasing over interval $(-1, 1)$

iii. concave up over interval $(0, +\infty)$

iv. concave down over interval $(-\infty, 0)$

20. **a.** $N(1993) = 3{,}500$. The coordinates of the corresponding point are (1993, 3500). $N(1993)$ represents the number of juvenile arrests made for murder in 1993 which was 3,500 arrests. It is also the maximum number of juvenile arrests during the time period.

b. The minimum over the time period is found at approximately (2003, 990).

c. The function is increasing over the interval [1980 to 1993]; it is decreasing over the interval [1993 to 2000]. It is relatively stable over interval [2000, 2003].

d. Estimates for domain: [1980, 2003] and range: [990, 3500]

e. From 1980 to 1993 juvenile arrests for murder rose steadily from approximately 1,500 in 1980 to a peak of about 3500 in 1993. Thereafter they steadily declined until the year 2000, when the number of juvenile arrests for murder began to level off at around 1000 arrests per year.

22. **a.** $g(0) = -1$, $g(-1) = -2$

b. domain: x is all real numbers ;

24. **a.** domain and range: all real numbers ≥ 0

b. domain: all real numbers ≥ 6

range: all real numbers ≥ 0

26. Answers will vary. Some things to consider: In Yemen, the majority of the population is very young. In Japan a considerable number of people live well into their seventies or even into their nineties, while in Yemen very few people live that long. In Japan the 50-54 age group and 25-29 age group are the largest. In Yemen the 4 and under age group are the largest and the numbers decline steadily as the ages increase. One hypothesis: Yemen is a very poor country with a less advanced medical system so the mortality rate is high at every age.