Section 4.1 Linear Functions Solutions

2. $f(3)=2$ and $f(-3)=-4 \Rightarrow (3,2)+(-3,-4)$ $m=\frac{-4-2}{-3-3}=\frac{-6}{-6}=1$

   $2=1(3)+b \Rightarrow b=-1$ $f(x)=x-1$

4. $(2,4)$ and $(3,9)$ $m=\frac{9-4}{3-2}=5$ $4=5(2)+b \Rightarrow b=-6$ $f(x)=5x-6$

6. $g(2)=1$ and g is perpendicular to $6x-3y=2 \Rightarrow y=\frac{2-6x}{-3} \Rightarrow$

   $y=2x-\frac{2}{3}$ so g has slope $-\frac{1}{2} \Rightarrow y=-\frac{1}{2}(x-2)+1 \Rightarrow g(x)=-\frac{1}{2}x+2$

8. x-and y-intercepts on inverse are 5 and $-1 \Rightarrow$ points on f^{-1} are $(5,0)$ and $(0,-1)$ so on f we have $(0,5)$ and $(-1,0)$

   $\Rightarrow m=\frac{5-0}{0-(-1)}=5$ $f(x)=5x+5$

9. $f(x)=3x-4$ and $g(x)=1-2x$ $(f\circ g)(x)=f(1-2x)=3(1-2x)-4$

   $=3-6x-4=-6x-1$. So yes $f\circ g$ is linear.

10. $(-3,2)(1,1)(5,2)$ Explain why no linear function goes through all 3 points $(-3,2)(1,1)$ $m=\frac{2-1}{-3-1}=-\frac{1}{4}$ and

    $(-3,2)(5,2)$ $m=\frac{2-2}{-3-5}=0$. Since slopes are not the same, the 3 points are not collinear

12. Cost is \$ 120,000 salvage is \$4000 after 10 years.

    So slope $\frac{4000-120{,}000}{10-0}=\frac{-116{,}000}{10}=-11{,}600$ so the machinery is decreasing in value by \$11,600 each year

    a) $C(t)=-11{,}600t+120{,}000$

    b) $C(8)=-11{,}600(8)+120{,}000=\$\,27{,}200$

14. I will use C and F instead of x and y $(0,32)(100,212)$

    a) $m=1.8 \Rightarrow F=1.8C+32$

    b) $98.6=1.8C+32 \Rightarrow C=37°C$

    c) $C=1.8C+32 \Rightarrow -32=.8C \Rightarrow 40°=C$ $40°C=40°F$

16. $C(x)=220x+4000$ a) marginal cost is \$220/unit

    b) $C(500)=220(500)+4000=\$\,114{,}000$ c) $114{,}000+220$

    $=114{,}220=C(501)$

18. a) $\frac{8-4}{6-1} = \frac{4}{5}$ ft/sec b) velocity is zero (slope zero)

c) $\frac{16-0}{2-0} = 8$ miles/hour

19. A: $x = 3t + 100$ B: $x = 20t - 36$

a) B because velocity (slope) is greater

b) A $x_A(0) = 100$ $x_B(0) = -36$

c) $3t + 100 = 20t - 36 \Rightarrow 136 = 17t \Rightarrow t = 8$ seconds

20. $x = 4t + 10$ a) velocity is 4 cm/sec

b. $x(2) = 4(2) + 10 = 18$ cm c) $x(3)$ would be $18 + 4 = 22$ and $x(3) = 4(3) + 10 = 22$ cm.

22. a) $\frac{\Delta P}{\Delta t} = \frac{13{,}018{,}365 - 11{,}351{,}118}{1990 - 1985} = 333{,}449.4$ people/year (round to 333,449)

if $t = 0$ is 1985 $P(t) = 333{,}449t + 11{,}351{,}118$

b) $P(15) = 333{,}449(15) + 11{,}351{,}118 = 16{,}352{,}853$ people

c). actual is 15,982,378 % error = $\frac{16{,}352{,}853 - 15{,}982{,}378}{15{,}982{,}378}$

$\approx .023$ (so off - above - by 2.3%)

24. 1993 → 40.9 and 1995 → 37.3

a) $m = \frac{37.3 - 40.9}{1995 - 1993} = -1.8$ $y = -1.8x + 40.9$ if $t = 0$ is 1993

b) $1997 - 1993 = 4$ $y(4) = 33.7$ rating %

c) $\frac{33.1 - 33.7}{33.1} = .018$ OR 1.8% error

26. (12, 105) (18, 225) independent - t, no. of days
dep. P - population.

a) $m = \frac{225 - 105}{18 - 12} = 20$ fruit flies/day $P = 20t - 135$

b) $P(15) = 20(15) - 135 = 165$ fruit flies.

Percentage error $\left|\frac{165 - 152}{152}\right| = 8.55\%$

c) $P(9) = 45$ ff % error = $\left|\frac{45 - 39}{39}\right| = 15.4\%$

d) $P(39) = 645$ ff % error = $\left|\frac{938 - 645}{938}\right| = 31.2\%$

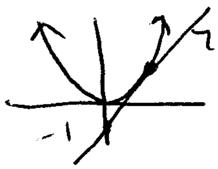
30a) $f(1997) = -2810.96(1997) + 5{,}653{,}063.25 = 39{,}576$ warheads.

% error $\dfrac{39576 - 36110}{36110} = 9.6\%$

b) $10{,}000 = -2810.96(1997) + 5{,}653{,}063.25 \Rightarrow x = 2007.5$ (year)

$0 = -2810.96(1997) + 5{,}653{,}063.25 \Rightarrow x = 2011$ (year)

36. $y = x^2$ tangent line at $(1,1)$ is $y = 2x - 1$

a) 

b)

	0.9	0.99	0.999
x^2	.81	.9801	.998001
$2x-1$	.8	.98	.998

44. $f(x) = mx + b$

$f\left(\frac{x_1 + x_2}{2}\right) = m\left(\frac{x_1 + x_2}{2}\right) + b = \frac{mx_1}{2} + \frac{mx_2}{2} + b =$

$\frac{mx_1 + mx_2 + 2b}{2} = \frac{mx_1 + b + mx_2 + b}{2} = \frac{f(x_1) + f(x_2)}{2}$

52. $ax + b \leq$ has no solutions which means $f(x) = ax + b$ always lies above the horizontal axis which means $f(x)$ must be a horizontal line. Therefore $f(x) = b$ is its equation (slope would be zero)