CHAPTER 1

LINEAR EQUATIONS AND FUNCTIONS

EXERCISES 1.1

1. $3x + 1 = 4x - 5$

$1 = x - 5$ conditional equation

$x = 6$

3. $5(x + 1) + 2(x - 1) = 7x + 6$

$5x + 5 + 2x - 2 = 7x + 6$

$7x + 3 = 7x + 6$ contradiction

5. $4(x + 3) = 2(2x + 5)$

$4x + 12 = 4x + 10$ contradiction

7. $5x - 3 = 17$

$5x = 20$

$x = 4$

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9. $2x = 4x - 10$

$2x - 4x = -10$

$-2x = -10$

$x = 5$

11. $4x - 5 = 6x - 7$

$-5 + 7 = 6x - 4x$

$2 = 2x$

$1 = x$

13. $0.6x = 30$

$x = \frac{30}{0.60} = 50$

15. $\frac{2}{3} = \left(\frac{4}{5}\right)x - \frac{1}{3}$

$15\left(\frac{2}{3}\right) = 15\left\{\left(\frac{4}{5}\right)x - \frac{1}{3}\right\}$

$10 = 12x - 5$

$15 = 12x$

$\frac{5}{4} = x$

17. $5(x - 4) = 2x + 3(x - 7)$

$5x - 20 = 2x + 3x - 21$

$5x - 20 = 5x - 2$ No solution

19. $3s - 4 = 2s + 6$

$s - 4 = 6$

$s = 10$

21. $7t + 2 = 4t + 11$

$7t - 4t = 11 - 2$

$3t = 9$

$t = 3$

23. $4(x+1)+2(x-3)=7(x-1)$

$$4x+4+2x-6=7x-7$$
$$6x-2=7x-7$$
$$6x-7x=-7+2$$
$$-x=-5$$
$$x=5$$

25. $\dfrac{x+8}{2x-5}=2$

$$(x+8)=2(2x-5)$$
$$x+8=4x-10$$
$$8+10=4x-x$$
$$18=3x$$
$$6=x$$

27. $8-\{4[x-(3x-4)-x]+4\}=3(x+2)$

$$8-\{4[x-3x+4-x]+4\}=3x+6$$
$$8-\{4[-3x+4]+4\}=3x+6$$
$$8-\{-12x+16+4\}=3x+6$$
$$8-\{-12x+20)=3x+6$$
$$8+12x-20=3x+6$$
$$12x-12=3x+6$$
$$9x=18$$
$$x=2$$

29. $6x-3y=9$ for x

$$6x=3y+9$$
$$x=\frac{3y+9}{6}=\frac{1}{2}y+\frac{3}{2}$$

31. $3x+5y=15$

$$5y=15-3x$$

→

$$y = \frac{(15 - 3x)}{5}$$

$$y = 3 - \left(\frac{3}{5}\right)x$$

33. $V = LWH$

$$\frac{V}{LH} = W$$

35. $Z = \dfrac{(x - \mu)}{\sigma}$

$$Z\sigma = x - \mu$$

$$x = Z\sigma + \mu$$

37. Let $x =$ monthly installment ($). Since Sally paid $300, she owes $1300 − $300 = $1000. Therefore, $5x = 1000$ or $x = \$200$ monthly installment.

39. The consumption function is $C(x) = mx + b$. The slope is the "marginal propensity to consume." Therefore, $C(x) = 0.75x + b$. The disposable income $x = 2$ for a consumption $y = 11$ yields $11 = (0.75)(2) + b$, so $b = 9.5$ and consumption is $C(x) = 0.75x + 9.5$.

41. a) $d = 4.5(2) = 9$ miles

b) $18 = 4.5t$ and $t = 18/4.5 = 4$ seconds

43. The tax is 6.2%, or 0.062 as a decimal form, so $T = 0.062x$, where $0 \le x \le 87{,}000$.

45. a) $\text{BSA} = 1321 + (0.3433)(20{,}000) = 8187\,\text{cm}^2$

b) $1330 = 1321 + (0.3433)(\text{Wt})$

$9 = (0.3433)(\text{Wt})$

$9/0.3433 = 26.2$ kg = Wt.

EXERCISES 1.2

1. Setting $y = 0$ determines the x-intercept and setting $x = 0$ determines the y-intercept.

a) $5x - 3y = 15$ x-intercept 3, y-intercept -5

b) $y = 4x - 5$ x-intercept 5/4, y-intercept -5

c) $2x + 3y = 24$ x-intercept 12, y-intercept 8

→

d) $9x - y = 18$ x-intercept 2, y-intercept -18

e) $x = 4$ x-intercept 4, no y-intercept(vertical line)

f) $y = -2$ no x-intercept (horizontal line), y-intercept -2

3. The slope is $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

a) (3, 6) and (−1, 4) $m = \dfrac{4-6}{-1-3} = \dfrac{-2}{-4} = \dfrac{1}{2}$

b) (1, 6) and (2, 11) $m = \dfrac{11-6}{2-1} = \dfrac{5}{1} = 5$

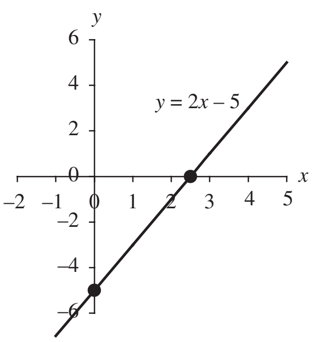
c) (6, 3) and (12, 7) $m = \dfrac{7-3}{12-6} = \dfrac{4}{6} = \dfrac{2}{3}$

d) (2, 3) and (2, 7) $m = \dfrac{7-3}{2-2} = \dfrac{4}{0}$ undefined

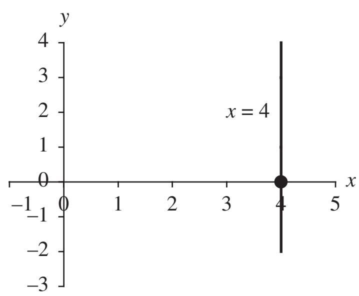
e) (2, 6) and (5, 6) $m = \dfrac{6-6}{5-2} = \dfrac{0}{3} = 0$

f) (5/3, 2/3) and (10/3, 1) $m = \dfrac{1 - 2/3}{10/3 - 5/3} = \dfrac{1/3}{5/3} = \dfrac{1}{5}$

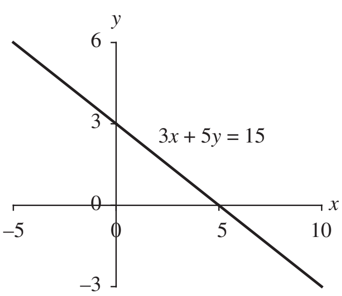
5. a) x-intercept 5/2 and y-intercept -5



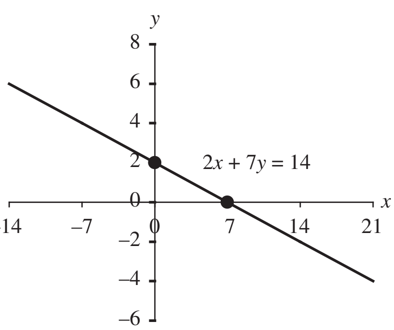
b) x-intercept 4 and no y-intercept



c) x-intercept 5 and y-intercept 3



d) x-intercept 7 and y-intercept 2



7. a) For $y = (5/3)x + 2$ and $5x - 3y = 10$; the slope of the first line is 5/3. Solving for y in the second equation yields $y = (5/3)x - (10/3)$. This slope is also 5/3.
The lines are parallel (same slope, different intercepts).

b) $6x + 2y = 4$ and $y = (1/3)x + 1$. The slope of the second line is apparent from the slope intercept form as 1/3. Solve for y in the first equation as $y = -3x + 2$. The slope is -3. The slopes are negative reciprocals, so the lines are perpendicular.

c) $2x - 3y = 6$ and $4x - 6y = 15$. Solving for y in each equation, yields $y = (2/3)x - 2$ and $y = (2/3)x - (5/2)$. These lines have the same slope (and different intercepts) so they are parallel.

d) $y = 5x - 4$ and $3x - y = 4$. The slope of the first line is 5. In the second equation, ($y = 3x - 4$), the slope is 3. These slopes are neither the same nor negative reciprocals. The lines are neither parallel nor perpendicular.

e) $y = 5$ is a horizontal line while $x = 3$ is a vertical line.
The two lines are perpendicular.

9. Generally, lines have a single x-intercept. The exception $y = 0$ (the x-axis) with an infinite number of x-intercepts. Any horizontal line (except $y = 0$) has no x-intercepts. Generally, lines do not have more than one y-intercept. The exception $x = 0$ (the y-axis) with an infinite number of y-intercepts. Any vertical line (except $x = 0$) has no y-intercepts.

11. The ordered pairs with time and machine values are (0, 75,000) and (9, 21,000). The slope $m = \frac{21{,}000 - 75{,}000}{9 - 0} = \frac{-54{,}000}{9} = -6000$. The y-intercept is the initial cost, \$75,000. Therefore, to model the straight-line depreciation $V(t) = -6000t + 75{,}000$ where $V(t)$ is the machine's value (\$) at time t.

13. Ordered pairs (gallons of gasoline, miles traveled) are (7, 245) and (12, 420). The slope is $\frac{420 - 245}{12 - 7} = \frac{175}{5} = 35$. Let $x =$ gallons of gasoline and $y =$ miles traveled. Then either ordered pair, with the point slope formula, yields $y - 245 = 35(x - 7)$ or $y = 35x$.

15. Total cost is fixed plus variable costs. The fixed cost is monthly rent of \$1100. The variable cost is $5x$, where x is monthly production.

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The total cost is $C(x) = 1100 + 5x$.

17. a) Here, fixed cost is (\$50/day) and variable cost is (\$0.28/mile). So, $C(x) = 50 + 0.28x$

b) If one has \$92, the equation for the travel distance is $92 = 50 + 0.28x$

Solving,

$$42 = 0.28x$$
$$\frac{42}{0.28} = x$$
$$150 = x$$

The car can be rented and driven 150 miles for \$92.

19. Since R is a function of C, the ordered pairs (C, R) are (70, 84) and (40, 48). The slope is $\frac{48-84}{40-70} = \frac{36}{30} = \frac{6}{5}$. Either ordered pair determines the equation as the slope is known.

Therefore, $R - 84 = (6/5)(C - 70)$ or, $R = (6/5)C$.

EXERCISES 1.3

1. Here, the GCF is 8, so $8x - 24 = 8(x - 3)$

3. Here, the GCF is $5x$, so $5x^3 - 10x^2 + 15x = 5x(x^2 - 2x + 3)$

5. Here, the GCF is $5a^3bc^3$, so $5a^3b^2c^4 + 10a^3bc^3 = 5a^3bc^3(bc + 2)$

7. Here, the GCF is $5x^2y^3z^5$, so $20x^3y^5z^6 + 15x^4y^3z^7 + 20x^2y^4z^5 = 5x^2y^3z^5(4xy^2z + 3x^2z^2 + 4y)$

9. This is a difference of squares, so $x^2 - 25 = (x - 5)(x + 5)$

11. There is a GCF of 3 to yield $3(x^2 + 9)$. A sum of squares is not factorable.

13. There is a GCF of 2 to yield $2(x^3 - 8)$. Next, using the difference of cubes formula the expression factors as $2(x - 2)(x^2 + 2x + 4)$.

15. There is a GCF of $7(a + b)$ to yield $7(a + b)(x^2 - 4)$. Next, using the difference of squares formula yields $7(a + b)(x + 2)(x - 2)$.

17. The last term is +4 and since the middle term is positive, one seeks two positive factors of 4 that add to 5. The expression factors as $x^2 + 5x + 4 = (x + 4)(x + 1)$.

19. The last term is positive, and since the middle term is positive, one seeks two positive factors of 1 that add to 3. This is not possible. Therefore, $x^2 + 3x + 1$ is not factorable.

21. Here, the last term is negative so seek one positive factor and one negative factor of 16 that add to give −6. Therefore, $x^2 - 6x - 16 = (x - 8)(x + 2)$.

23. First, the GCF is 2 so $2x^2 + 12x + 16 = 2(x^2 + 6x + 8)$. Next, two positive factors of 8 that add to 6 are needed. The expression is completely factored as

$$2x^2 + 12x + 16 = 2(x + 4)(x + 2).$$

25. Seek two positive factors of 20 that add to 9. The expression factors as

$$a^2b^2 + 9ab + 20 = (ab + 4)(ab + 5).$$

27. First, the GCF is 2 so $2x^2y^2 + 28xy + 90 = 2(x^2y^2 + 14xy + 45)$. Next, seek two positive factors of 45 that add to 14. The expression factors as $2(xy + 9)(xy + 5)$.

29. Seek two positive factors of 5 that add to 7. Since this is not possible, the expression $x^2 + 7x + 5$ is prime.

31. This is a quadratic in x^2. Seek two negative factors of 4 that add to 5. Therefore, $x^4 - 5x^2 + 4 = (x^2 - 4)(x^2 - 1)$. The factors are both differences of squares, so factoring yields $x^4 - 5x^2 + 4 = (x - 2)(x + 2)(x - 1)(x + 1)$.

33. First, group the expression by powers to yield $(x^2 - a^2) + (5x - 5a)$. Then, factor each pair to yield $(x - a)(x + a) + 5(x - a)$. Next, a GCF of $(x - a)$ is factored from the expression to yield $(x - a)[(x + a) + 5]$.

35. First, the GCF is 2, so $4ab - 8ax + 6by - 12xy = 2[2ab - 4ax + 3by - 6xy]$. Group by pairs as $2[(2ab - 4ax) + (3by - 6xy)]$. Factoring each pair yields $2[2a(b - 2x) + 3y(b - 2x)] = 2[(b - 2x)(2a + 3y)]$.

37. Using $a = 1$, $b = 9$, and $c = 8$ in the quadratic formula yields $x = \dfrac{-(9) \pm \sqrt{(9)^2 - 4(1)(8)}}{2(1)} = \dfrac{-9 \pm \sqrt{49}}{2} = \dfrac{-9 \pm 7}{2}$. So $x = -8$ or $x = -1$.

39. Using $a = 1$, $b = 17$, and $c = 72$ in the quadratic formula yields $x = \dfrac{-(17) \pm \sqrt{(17)^2 - 4(1)(72)}}{2(1)} = \dfrac{-17 \pm \sqrt{1}}{2} = \dfrac{-17 \pm 1}{2}$.
So, $x = -8$ or $x = -9$.

41. Using $a = 1$, $b = 4$, and $c = 7$ in the quadratic formula yields $x = \dfrac{-(4) \pm \sqrt{(4)^2 - 4(1)(7)}}{2(1)} = \dfrac{-4 \pm \sqrt{-12}}{2}$. There are no real solutions.

43. First, rewrite as $x^2 - 9x + 18 = 0$. Next, using $a = 1$, $b = -9$, and $c = 18$ in the quadratic formula yields
$x = \dfrac{-(-9) \pm \sqrt{(-9)^2 - 4(1)(18)}}{2(1)} = \dfrac{9 \pm \sqrt{9}}{2} = \dfrac{9 \pm 3}{2}$. So, $x = 6$ or $x = 3$.

45. Using $a = 2$, $b = -3$, and $c = 1$ in the quadratic formula yields $x = \dfrac{-(-3) \pm \sqrt{(-3)^2 - 4(2)(1)}}{2(2)} = \dfrac{3 \pm \sqrt{1}}{4}$. So, $x = 1$ or $x = 1/2$.

EXERCISES 1.4

1.


3.


5.


7. $(4, \infty)$
9. $(-3, 7)$
11. $[1, 8)$
13. $[5, 8)$
15. All real numbers
17. $[5/2, \infty)$
19. $(-\infty, -3) \cup (-3, 1) \cup (1, \infty)$

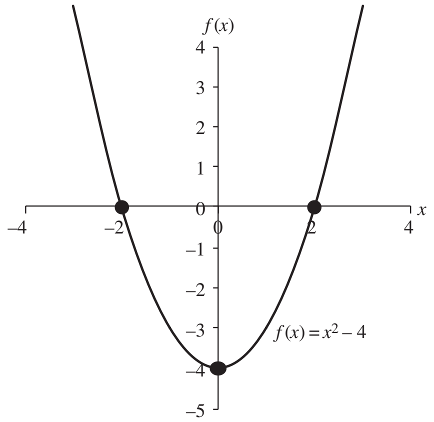
21. a) $f(0) = 3$
b) $f(1) = 15$
c) $f(x + 3) = 7(x + 3)^3 + 5(x + 3) + 3$

23. a) $f(-1) = 10$
b) $f(a^2) = a^{10} + 11$
c) $f(x + h) = (x + h)^5 + 11$

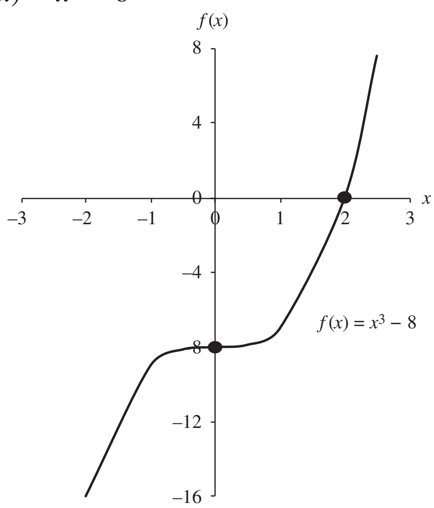
25. It is not a function. It fails the vertical line test.

27. It is not a function. It fails the vertical line test.

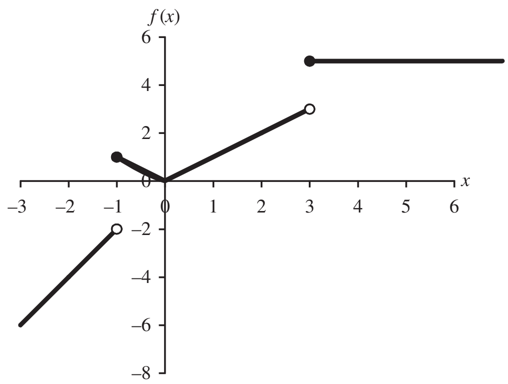
29. $f(x) = x^2 - 4$



31. $f(x) = x^3 - 8$



33. It is the piecewise graph.



35. a) $(3x^5 + 7x^3 + 8) - (4x^5 - 2x^3 + 2x) = -x^5 + 9x^3 - 2x + 8$
b) $(4x^5 - 2x^3 + 2x) - (3x^5 + 7x^3 + 8) = x^5 - 9x^3 + 2x - 8$
c) $(4x^5 - 2x^3 + 2x)(3x^5 + 7x^3 + 8)$
d) $3(4x^5 - 2x^3 + 2x)^5 + 7(4x^5 - 2x^3 + 2x)^3 + 8$

37. a) $2x^5 + h$
b) $(x + h)^2 + 4$
c) $(2a^5)(a^2 + 4)$
d) $2(x + 1)^5[(x + 2)^2 + 4]$

EXERCISES 1.5

1. $1^{3/7} = \left(\sqrt[7]{1}\right)^3 = 1$

3. $(25)^{3/2} = (\sqrt{25})^3 = (5)^3 = 125$

5. $(64)^{5/6} = \left(\sqrt[6]{64}\right)^5 = (2)^5 = 32$

7. $\left(\frac{2}{3}\right)^{-2} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$

9. $(0.008)^{1/3} = \sqrt[3]{0.008} = 0.20$

11. $\frac{15^3}{5^3} = \left(\frac{15}{5}\right)^3 = 3^3 = 27$

13. $x^3x^5 = x^8$

15. $(2xy)^3 = 2^3x^3y^3 = 8x^3y^3$

17. $\frac{x^3x^5}{x^{-4}} = \frac{x^8}{x^{-4}} = x^{12}$

19. $\frac{x^4y^5}{x^2y^{-2}} = x^{4-2}y^{5-(-2)} = x^2y^7$

21. $\left(\frac{2x^3}{y^2}\right)^2 = \frac{(2)^2(x^3)^2}{(y^2)^2} = \frac{4x^6}{y^4}$

23. $\sqrt[3]{x^5}\sqrt[3]{x^4} = \sqrt[3]{x^9} = x^3$

25. $(81x^4y^8)^{1/4} = \sqrt[4]{81x^4y^8} = 3xy^2$

27. $\dfrac{(16x^4y^5)^{3/2}}{\sqrt{y}} = \dfrac{(16)^{3/2}x^6y^{15/2}}{y^{1/2}} = (\sqrt{16})^3x^6y^7 = 64x^6y^7$

29. $\dfrac{(8x^5y^7)^{2/3}}{\sqrt[3]{xy^2}} = \dfrac{(8)^{2/3}x^{10/3}y^{14/3}}{x^{1/3}y^{2/3}} = 4x^3y^4$

EXERCISES 1.6

1. $f(x) = 6x + 11$

a) $\dfrac{f(x+h) - f(x)}{h} = \dfrac{[6(x+h)+11] - [6x+11]}{h} = \dfrac{6h}{h} = 6$

b) $\dfrac{f(x) - f(a)}{x-a} = \dfrac{[6x+11] - [6a+11]}{x-a} = \dfrac{6x-6a}{x-a} = \dfrac{6(x-a)}{x-a} = 6$

3. $f(x) = 7x - 4$

a) $\dfrac{f(x+h) - f(x)}{h} = \dfrac{[7(x+h)-4] - [7x-4]}{h} = \dfrac{7h}{h} = 7$

b) $\dfrac{f(x) - f(a)}{x-a} = \dfrac{[7x-4] - [7a-4]}{x-a} = \dfrac{7x-7a}{x-a} = \dfrac{7(x-a)}{x-a} = 7$

5. $f(x) = x^2 - 7x + 4$

a) $\dfrac{f(x+h) - f(x)}{h} = \dfrac{[(x+h)^2 - 7(x+h) + 4] - [x^2 - 7x + 4]}{h}$

$\dfrac{2xh + h^2 - 7h}{h} = \dfrac{h(2x+h-7)}{h} = 2x + h - 7$

b) $\dfrac{f(x) - f(a)}{x-a} = \dfrac{[x^2 - 7x + 4] - [a^2 - 7a + 4]}{x-a}$

$= \dfrac{(x^2 - a^2) - (7x - 7a)}{x-a}$

$= \dfrac{(x-a)(x+a) - 7(x-a)}{x-a} = x + a - 7$

7. $f(x) = x^2 + 6x - 8$

a) $\dfrac{f(x+h) - f(x)}{h} = \dfrac{[(x+h)^2 + 6(x+h) - 8] - [x^2 + 6x - 8]}{h}$

$\dfrac{2xh + h^2 + 6h}{h} = \dfrac{h(2x+h+6)}{h} = 2x + h + 6$

b) $\dfrac{f(x) - f(a)}{x-a} = \dfrac{[x^2 + 6x - 8] - [a^2 + 6a - 8]}{x-a}$

$= \dfrac{(x^2 - a^2) + (6x - 6a)}{x-a}$

$= \dfrac{(x-a)(x+a) + 6(x-a)}{x-a} = x + a + 6$

9. $f(x) = 5x^2 - 2x - 3$

a) $\dfrac{f(x+h) - f(x)}{h} = \dfrac{[5(x+h)^2 - 2(x+h) - 3] - [5x^2 - 2x - 3]}{h}$

$\dfrac{10xh + 5h^2 - 2h}{h} = \dfrac{h(10x + 5h - 2)}{h} = 10x + 5h - 2$

b) $\dfrac{f(x) - f(a)}{x - a} = \dfrac{[5x^2 - 2x - 3] - [5a^2 - 2a - 3]}{x - a}$

$= \dfrac{(5x^2 - 5a^2) - (2x - 2a)}{x - a}$

$= \dfrac{5(x-a)(x+a) - 2(x-a)}{x - a} = 5x + 5a - 2$

11. $f(x) = x^3 - 4x + 5$

a) $\dfrac{f(x+h) - f(x)}{h} = \dfrac{[(x+h)^3 - 4(x+h) + 5] - [x^3 - 4x + 5]}{h}$

$\dfrac{3x^2h + 3xh^2 + h^3 - 4h}{h} = \dfrac{h(3x^2 + 3xh + h^2 - 4)}{h}$

$= 3x^2 + 3xh + h^2 - 4$

b) $\dfrac{f(x) - f(a)}{x - a} = \dfrac{[x^3 - 4x + 5] - [a^3 - 4a + 5]}{x - a}$

$= \dfrac{(x^3 - a^3) - (4x - 4a)}{x - a}$

$= \dfrac{(x-a)(x^2 + ax + a^2) - 4(x-a)}{x - a}$

$= x^2 + ax + a^2 - 4$

13. $f(x) = 2x^3 - 7x + 3$

a) $\dfrac{f(x+h) - f(x)}{h} = \dfrac{[2(x+h)^3 - 7(x+h) + 3] - [2x^3 - 7x + 3]}{h}$

$\dfrac{6x^2h + 6xh^2 + 2h^3 - 7h}{h} = \dfrac{h(6x^2 + 6xh + 2h^2 - 7)}{h}$

$= 6x^2 + 6xh + 2h^2 - 7$

b) $\dfrac{f(x) - f(a)}{x - a} = \dfrac{[2x^3 - 7x + 3] - [2a^3 - 7a + 3]}{x - a}$

$= \dfrac{(2x^3 - 2a^3) - (7x - 7a)}{x - a}$

$= \dfrac{2(x-a)(x^2 + ax + a^2) - 7(x-a)}{x - a}$

$= 2(x^2 + ax + a^2) - 7$

15. $f(x) = \dfrac{3}{x^3}$

a)
$$\frac{f(x+h)-f(x)}{h} = \frac{\dfrac{3}{(x+h)^3} - \dfrac{3}{x^3}}{h} = \frac{3x^3 - 3(x+h)^3}{x^3h(x+h)^3}$$
$$= \frac{-9x^2h - 9xh^2 - 3h^3}{x^3h(x+h)^3}$$
$$= \frac{-3h(3x^2+3xh+h^2)}{x^3h(x+h)^3} = \frac{-3(3x^2+3xh+h^2)}{x^3(x+h)^3}$$

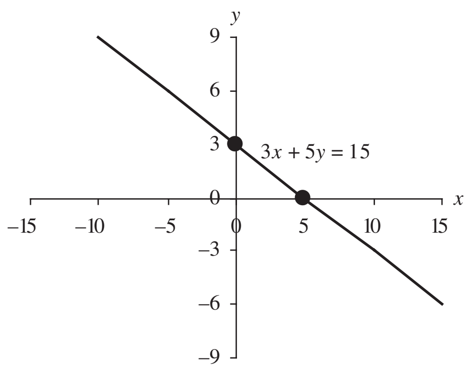
b)
$$\frac{f(x)-f(a)}{x-a} = \frac{\dfrac{3}{x^3} - \dfrac{3}{a^3}}{x-a} = \frac{\dfrac{3a^3-3x^3}{a^3x^3}}{x-a} = \frac{3(a-x)(a^2+ax+x^2)}{(x-a)a^3x^3}$$
$$= \frac{-3(a^2+ax+x^2)}{a^3x^3}$$

SUPPLEMENTARY EXERCISES CHAPTER 1

1. $9(x-3) + 2x = 3(x+1) - 2$
$$9x - 27 + 2x = 3x + 3 - 2$$
$$11x - 27 = 3x + 1$$
$$8x = 28$$
$$x = \frac{7}{2}$$

3. $Z = \dfrac{x-\mu}{\sigma}$ so $Z\sigma = x - \mu$ and $\mu = x - Z\sigma$.

5. $3x + 5y = 15$



7. First, find the slope $m = \dfrac{1-7}{2-5} = \dfrac{-6}{-3} = 2$. Next, use the point slope form with either point to yield $y - 7 = 2(x - 5)$.

9. Rewriting in slope intercept form $4x - 3y = 12$ as $y = \frac{4}{3}x - 4$. The slope is $\frac{4}{3}$. A line parallel has the same slope, so the line of interest is $y - 5 = \frac{4}{3}(x - 2)$.

11. The GCF of $2x^3 - 18x^2 - 20x$ is $2x$, so the initial factoring yields $2x(x^2 - 9x - 10)$. Complete factoring yields $2x(x - 10)(x + 1)$.

13. Group as $(2ax - 2ay) + (bx - by)$ before factoring the GCF from each pair of terms. Then $2a(x - y) + b(x - y) = (x - y)(2a + b)$ is the completely factored expression.

15. Multiplying by 3 to eliminate the fraction yields $2(x - 1) < 3(x - 2)$. Next, $2x - 2 < 3x - 6$ yields $4 < x$ so the interval notation solution is $(4, \infty)$.

17. To determine the domain, factor the denominator. This yields $\dfrac{2x+5}{x(x+8)(x+1)}$. The domain is all real numbers except $x = 0$, $x = -8$, or $x = -1$.

19. a) $(f - g)(x) = -x^3 + 4x^2 + 3x + 5$

b) $(f \cdot g)(x) = (x^2 + 3x + 1)(x^3 - 3x^2 - 4)$

c) $(f \circ g)(x) = f(g(x)) = (x^3 - 3x^2 - 4)^2 + 3(x^3 - 3x^2 - 4) + 1$

21. $\left(\dfrac{-2x^5}{3x^2}\right) \cdot \left(\dfrac{3x^{-2}}{4x^5}\right) = \dfrac{-6x^3}{12x^7} = \dfrac{-1}{2x^4}$

23. $\left(\dfrac{2x^3}{3y^{-2}z^4}\right)^{-3} = \left(\dfrac{2x^3y^2}{3z^4}\right)^{-3} = \left(\dfrac{3z^4}{2x^3y^2}\right)^3 = \dfrac{27z^{12}}{8x^9y^6}$

25. $f(x) = x^3 + 3x + 1$

a) $$\frac{f(x+h) - f(x)}{h} = \frac{[(x+h)^3 + 3(x+h) + 1] - [x^3 + 3x + 1]}{h}$$
$$\frac{3x^2h + 3xh^2 + h^3 + 3h}{h} = \frac{h(3x^2 + 3xh + h^2 + 3)}{h}$$
$$= 3x^2 + 3xh + h^2 + 3$$

b) $$\frac{f(x) - f(a)}{x - a} = \frac{[x^3 + 3x + 1] - [a^3 + 3a + 1]}{x - a}$$
$$= \frac{(x^3 - a^3) + (3x - 3a)}{x - a}$$
$$= \frac{(x - a)(x^2 + ax + a^2) + 3(x - a)}{x - a} = x^2 + ax + a^2 + 3$$