Chapter 9 BLM Answers

BLM 9–1 Prerequisite Skills

1. a)

$$\begin{array}{r}
x^2-5x+4 \\
x+3\overline{\big)\,x^3-2x^2-11x+12} \\
\underline{x^3+3x^2} \\
-5x^2-11x \\
\underline{-5x^2-15x} \\
4x+12 \\
\underline{4x+12} \\
0
\end{array}$$

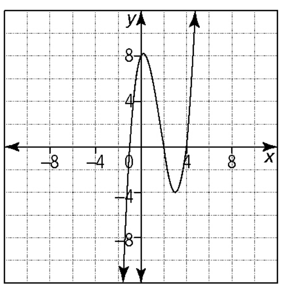
b) $g(x) = x^2 - 5x + 4$

2. a) $2g(15 - 2g)$ **b)** $2g(3f - 4g)$ **c)** $(x - 5)(x - 1)$
d) $(2x + 1)(x + 5)$ **e)** $(2a - 3)(3a - 1)$
f) $(x - 0.1)(x + 0.1)$ **g)** $5(2xy - 3)(2xy + 3)$

3. a) −2, 1, and 3 **b)** $h(x) = (x + 2)(x - 1)(x - 3)$
c) −2, 1, and 3

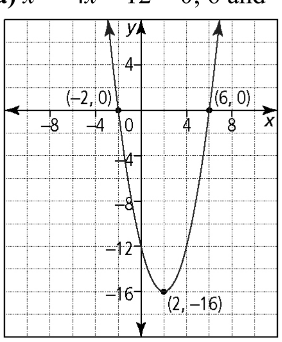
4. a) $b \neq 0, c \neq 0$ **b)** $x \neq \frac{1}{2}$ **c)** $x \neq \frac{5}{2}, x \neq -1$ **d)** $t \neq 3$
e) $x \neq -\frac{1}{3}, x \neq \frac{5}{2}$ **f)** $a \neq 1, a \neq 2$, and $a \neq -3$

5. a) $P(-1) = (-1)^3 - 5(-1)^2 + 2(-1) + 8 = 0$, therefore, $(x + 1)$ is a factor.
b) $P(x) = (x + 1)(x - 4)(x - 2)$ **c)** $x = -1, 2, 4$
d)



The x-intercepts are the solution to $P(x) = 0$.

6. a) $x^2 - 4x - 12 = 0$; 6 and −2 **b)** $y = (x - 2)^2 - 16$
c)

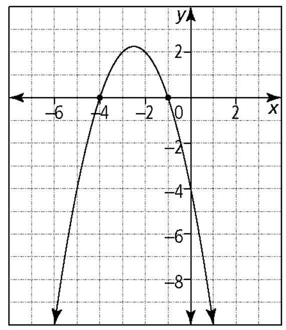


The x-intercepts are the solution to the equation. The x-coordinate of the vertex is the value that makes $(x - h) = 0$ and the y-coordinate is equal to k.

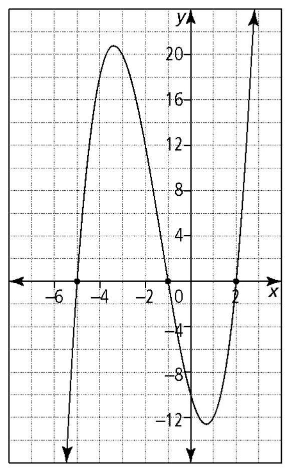
7. a) $x = 7$ **b)** $x = -3, \frac{1}{6}$ **c)** $x = 3 \pm \sqrt{2}$
d) $x = \frac{3 \pm \sqrt{41}}{4}$ **e)** $x = 1, -\frac{2}{3}, x \neq 0, x \neq -1$
f) $x = 6, x \neq 2, -2$

8. a) $(x + 5)^2 - 21 = 0$ **b)** $(x - 4)^2 - 3 = 0$
c) $3(x + 1)^2 - 2 = 0$ **d)** $2(x - 1)^2 - 5 = 0$

9. a) $x = -4, -1$



b) $x = -5, -1, 2$



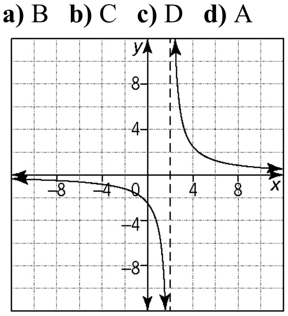
10. a) $\frac{x+1}{x+3}, x \neq 1, -3$ **b)** $\frac{k+3}{2(k-3)}, k \neq -\frac{5}{2}, 3$

11. a) $\frac{1}{2}, z \neq 4, \pm\frac{5}{2}$ **b)** $\frac{-3}{x}, x \neq \pm\frac{3}{2}, 0, 5$

BLM 9–2 Section 9.1 Extra Practice

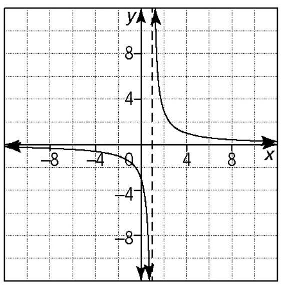
1. a) B **b)** C **c)** D **d)** A

2.



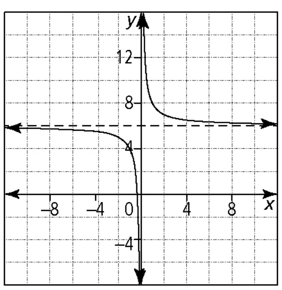
Characteristic	$y = \frac{5}{x - 2}$
Non-permissible value	$x = 2$
Behaviour near non-permissible value	As x approaches 2, $\lvert y \rvert$ becomes very large.
End behaviour	As $\lvert x \rvert$ becomes very large, y approaches 0.
Domain	$\{x \mid x \neq 2, x \in \mathrm{R}\}$
Range	$\{y \mid y \neq 0, y \in \mathrm{R}\}$
Equation of vertical asymptote	$x = 2$
Equation of horizontal asymptote	$y = 0$

3. a)



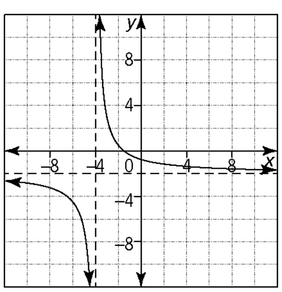
domain: $\{x \mid x \neq 1, x \in \mathrm{R}\}$; range: $\{y \mid y \neq 0, y \in \mathrm{R}\}$; intercept: $(0, -3)$; asymptotes: $x = 1$, $y = 0$

b)



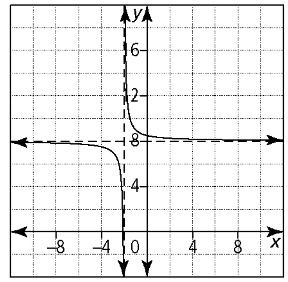
domain: $\{x \mid x \neq 0, x \in \mathrm{R}\}$; range: $\{y \mid y \neq 6, y \in \mathrm{R}\}$; intercept: $\left(-\frac{1}{3}, 0\right)$; asymptotes: $x = 0$, $y = 6$

c)



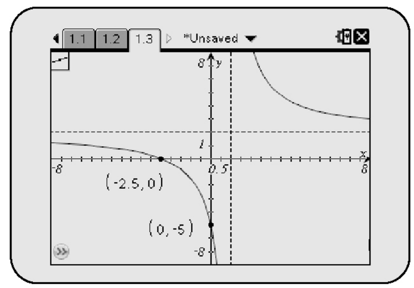
domain: $\{x \mid x \neq -4, x \in \mathrm{R}\}$; range: $\{y \mid y \neq -2, y \in \mathrm{R}\}$; intercepts: $(0, -0.75)$, $(-1.5, 0)$; asymptotes: $x = -4$, $y = -2$

d)



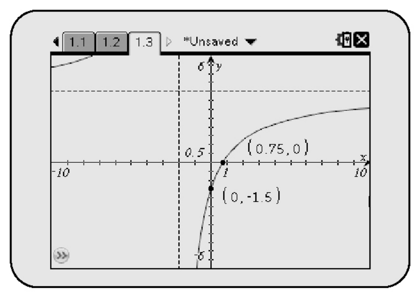
domain: $\{x \mid x \neq -2, x \in \mathrm{R}\}$; range: $\{y \mid y \neq 8, y \in \mathrm{R}\}$; intercepts: $(0, 8.5)$, $(-2.125, 0)$; asymptotes: $x = -2$, $y = 8$

4. a)



asymptotes: $x = 1$, $y = 2$;
intercepts: $(-2.5, 0)$, $(0, -5)$

b)

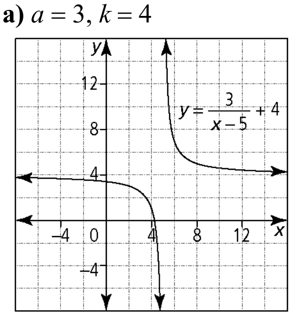


asymptotes: $x = -2$, $y = 4$;
intercepts: $(0, -1.5)$, $(0.75, 0)$

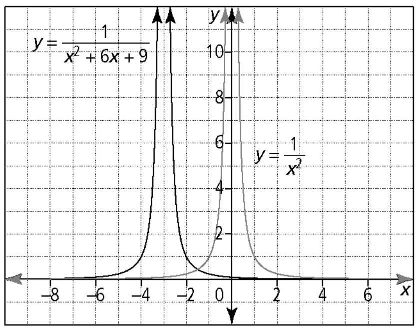
5. a) $y = \frac{3}{x}$ **b)** $y = \frac{4}{x}$ **c)** $y = \frac{2}{x - 5}$ **d)** $y = -\frac{2}{x + 4}$

6. a) $a = 3$, $k = 4$

b)



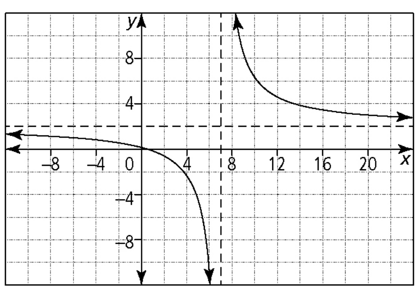
7.



The graph of $y = \frac{1}{x^2 + 6x + 9}$ is the graph of $y = \frac{1}{x^2}$ translated 3 units left.

8.

x	y
–5	0.92
–2	0.56
1	–0.17
4	–2.33
7	undefined
10	6.33
13	4.17
16	3.44
19	3.08



Characteristic	$y = \frac{2x - 1}{x - 7}$
Non-permissible value	$x = 7$
Behaviour near non-permissible value	As x approaches 7, $\lvert y\rvert$ becomes very large.
End behaviour	As $\lvert x\rvert$ becomes very large, y approaches 2.
Domain	$\{x \mid x \neq 7, x \in \mathrm{R}\}$
Range	$\{y \mid y \neq 2, y \in \mathrm{R}\}$
Equation of vertical asymptote	$x = 7$
Equation of horizontal asymptote	$y = 2$

9. a) $t = \frac{d}{s}$

b) $t = \frac{351}{65} = 5.4$, so 5.4 hours or 5 h and 24 min

c) 70.2 km/h

BLM 9–3 Section 9.2 Extra Practice

1. point of discontinuity at $(-3, \frac{1}{10})$ vertical asymptote: $x = 7$

2. You can factor the denominator: $y = \frac{x + 2}{(x + 2)(x + 1)}$.

Since the factor $(x + 2)$ appears in the numerator and denominator, the graph will have a point of discontinuity at $(-2, -1)$. The factor $(x + 1)$ appears in the denominator only, so there will be an asymptote at $x = -1$.

3.

Characteristic	$y = \frac{(x + 3)(x - 2)}{(x + 5)(x + 3)}$
Non-permissible value(s)	$x = -5$ and $x = -3$
Feature exhibited at each non-permissible value	asymptote at $x = -5$; point of discontinuity at $(-3, -2.5)$
Behaviour near each non-permissible value	As x approaches –5, $\lvert y\rvert$ becomes very large. As x approaches –3, y approaches –2.5.
Domain	$\{x \mid x \neq -3, -5, x \in \mathrm{R}\}$
Range	$\{y \mid y \neq 1, -\frac{5}{2}, y \in \mathrm{R}\}$

4. a)

x	y
–0.9	3.1
–0.99	3.01
–0.999	3.001
–0.9999	3.0001
–1	undefined
–1.0001	2.9999
–1.001	2.999
–1.01	2.99
–1.1	2.9

As x approaches –1, y approaches 3.

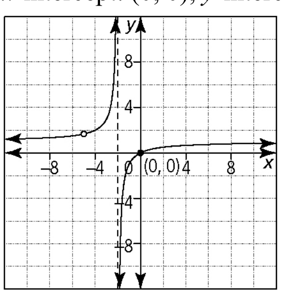
b)

x	y
1.9	–4.238 095 24
1.99	–4.472 636 82
1.999	–4.497 251 37
1.9999	–4.499 725 01
2	undefined
2.0001	–4.500 275 01
2.001	–4.502 751 38
2.01	–4.527 638 19
2.1	–4.789 473 68

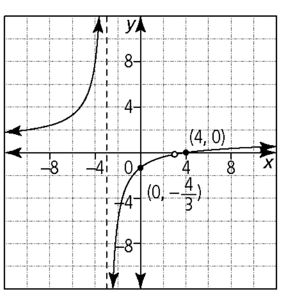
x	y
3.9	–109
3.99	–1 099
3.999	–10 999
3.9999	–109 999
4	undefined
4.0001	110 001
4.001	11 001
4.01	1 101
4.1	111

As x approaches 2, y approaches –4.5, and as x approaches 4, $|y|$ becomes very large, approaching negative infinity or positive infinity.

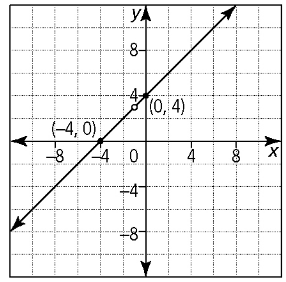
5. a) vertical asymptote: $x = -2$; point of discontinuity at $(-5, \frac{5}{3})$;
x-intercept: (0, 0); y-intercept: (0, 0)



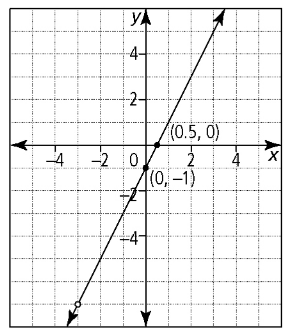
b) vertical asymptote: $x = -3$; point of discontinuity at $(3, -\frac{1}{16})$;
x-intercept: (4, 0); y-intercept: $(0, -\frac{4}{3})$



c) no vertical asymptote; point of discontinuity at (–1, 3);
x-intercept: (–4, 0); y-intercept: (0, 4)



d) no vertical asymptote; point of discontinuity at (–3, –7);
x-intercept: (0.5, 0); y-intercept: (0, –1)



6.

Characteristic	$y = \dfrac{x^2 - 3x}{3x - 9}$	$y = \dfrac{x^2 + 3x}{3x - 9}$
Non-permissible value(s)	$x = 3$	$x = 3$
Feature exhibited at each non-permissible value	point of discontinuity	asymptote
Behaviour near each non-permissible value	As x approaches 3, y approaches 1.	As x approaches 3, $|y|$ becomes very large.

7. a) C; Example: In factored form, the rational function has two non-permissible values in the denominator, which do not appear in the numerator. Therefore, the graph with two asymptotes is the most appropriate choice.
b) B; Example: In factored form, the rational function has one non-permissible value that appears in both the numerator and denominator, and another non-permissible value that is only in the denominator. Therefore, the graph with one asymptote and one point of discontinuity is the most appropriate choice.
c) A; Example: In factored form, one non-permissible value appears in the numerator and denominator. Therefore, the graph has a point of discontinuity, but no asymptote.

8. a) $y = \dfrac{(x-3)(x+2)}{(x-3)}$ or $y = \dfrac{x^2 - x - 6}{x-3}$

b) $y = \dfrac{(x-2)(x+2)}{(x+2)}$ or $y = \dfrac{x^2 - 4}{x+2}$

c) $y = \dfrac{(x+4)}{(4-x)(4+x)}$ or $y = \dfrac{x+4}{16-x^2}$

d) $y = \dfrac{(x+5)}{(x+3)(x+5)}$ or $y = \dfrac{x+5}{x^2+8x+15}$

9. Example: $y = \dfrac{-12(2x+5)}{(x-2)(2x+5)}$

BLM 9–4 Section 9.3 Extra Practice

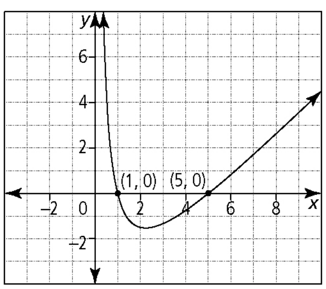
1. a) $x = \dfrac{3}{5}$ **b)** $x = 5$ **c)** $x = 24$ **d)** $x = 4$

2. a) $x = 10$ and $x = -4$ **b)** $x = 7$ and $x = 1$

c) $x = 10$ and $x = -3$ **d)** $x = \dfrac{3}{2}$ and $x = -2$

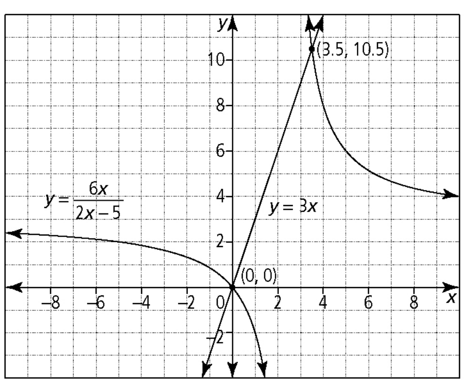
3. a) $x = 5$ and $x = 1$

b)

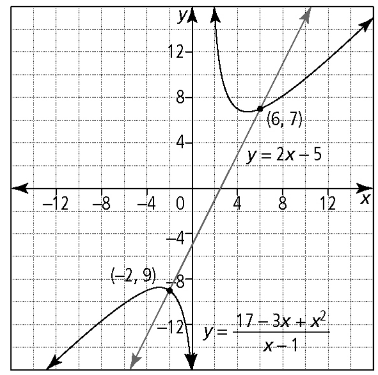


c) The value of the function is 0 when the value of x is 1 or 5. The x-intercepts of the graph of the function are the same as the roots of the corresponding equation.

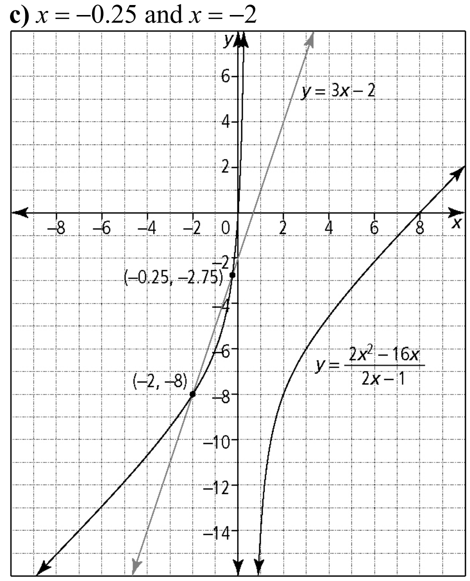
4. a) $x = 0$ and $x = 3.5$



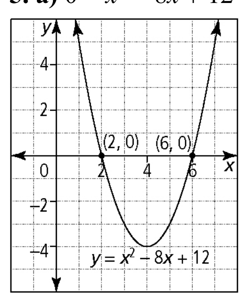
b) $x = -2$ and $x = 6$



c) $x = -0.25$ and $x = -2$

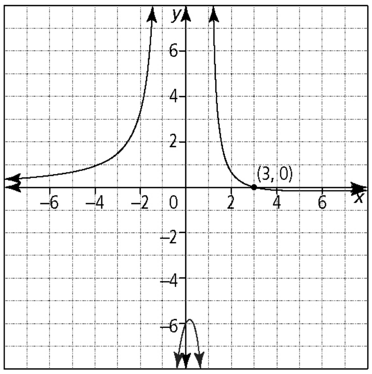


5. a) $0 = x^2 - 8x + 12$



$x = 2$ and $x = 6$

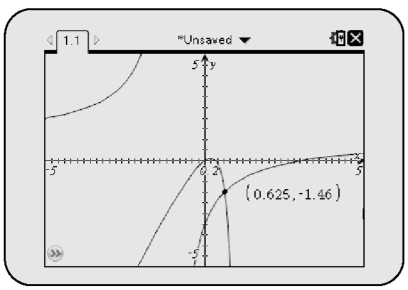
b) $y = \dfrac{6 - 2x}{x^2 - 1}$



$x = 3$

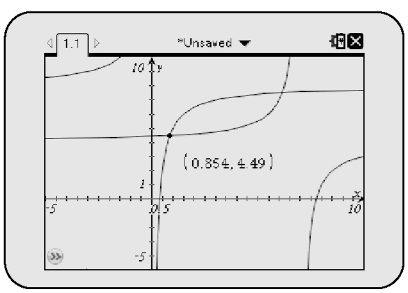
6. a) $x \approx 0.76$ and $x \approx 5.24$ **b)** $x \approx -2.79$ and $x \approx 1.79$
c) $x \approx 0.53$ and $x \approx 4.87$

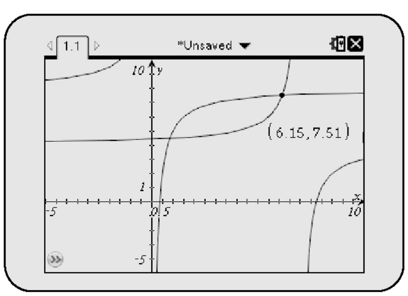
7. a)



$x \approx 0.63$

b)





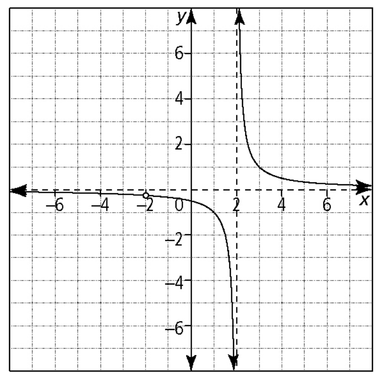
$x \approx 0.85$ and $x \approx 6.15$

8. The solution $n = 3$ is a non-permissible value, so there is no solution.

9. Carmen: 36 h; James: 45 h

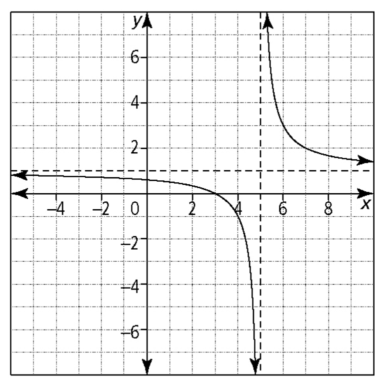
BLM 9–6 Chapter 9 Test

1. D
2. B
3. C
4. D
5. C
6. A
7. C
8. B
9. a)



b) domain: $\{x \mid x \neq \pm 2, x \in \mathrm{R}\}$;
range: $\{y \mid y \neq 0, -\frac{1}{4}, y \in \mathrm{R}\}$;
vertical asymptote: $x = 2$; horizontal asymptote: $y = 0$
c) As $|x|$ becomes very large, y approaches 0.

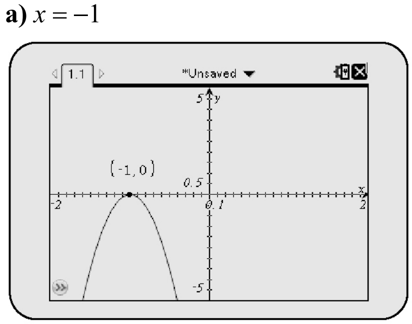
10. a)



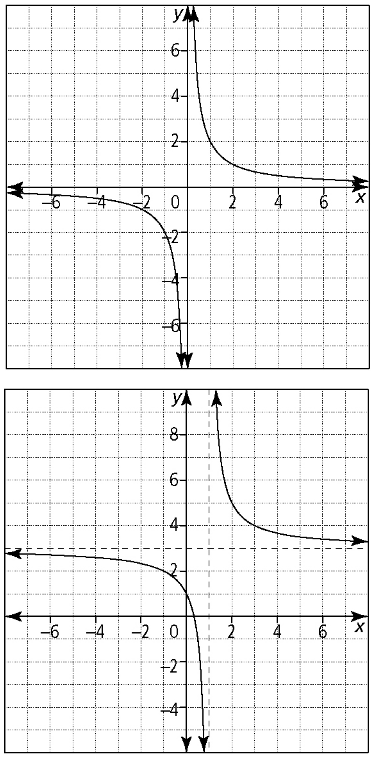
b) x-intercept = 3; y-intercept = 0.6
c) $x = 3$
d) The root of the equation is the same as the x-intercept.

11. a) B **b)** A **c)** C

12. a) $x = -1$
b)



13. a)



Characteristic	$f(x)=\frac{2}{x}$	$g(x)=\frac{3x-1}{x-1}$
Non-permissible value	$x = 0$	$x = 1$
Behaviour near non-permissible value	As x approaches 0, $\lvert y\rvert$ becomes very large.	As x approaches 1, $\lvert y\rvert$ becomes very large.
End behaviour	As $\lvert x\rvert$ becomes very large, y approaches 0.	As $\lvert x\rvert$ becomes very large, y approaches 3.
Domain	$\{x \mid x \neq 0, x \in \mathrm{R}\}$	$\{x \mid x \neq 1, x \in \mathrm{R}\}$
Range	$\{y \mid y \neq 0, y \in \mathrm{R}\}$	$\{y \mid y \neq 3, y \in \mathrm{R}\}$
Equation of vertical asymptote	$x = 0$	$x = 1$
Equation of horizontal asymptote	$y = 0$	$y = 3$

b) $g(x) = f(x - 1) + 3$

$$g(x) = \frac{2}{x-1} + 3$$

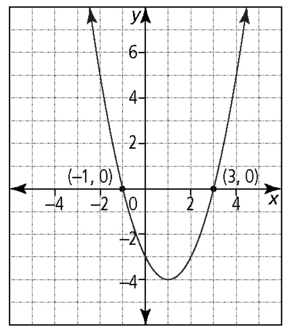
c) a vertical translation 3 units up and a horizontal translation 1 unit right

14. a) Example:

Method 1: Graph $y = \frac{3x^2 - 12x - 5}{x-4} - 2(2x+1)$, and determine the x-intercepts of the graph.

Method 2: Graph $y = \frac{3x^2 - 12x - 5}{x-4}$ and $y = 2(2x + 1)$, and determine the x-coordinates of the points where the two graphs intersect.

b)



$x = -1$ and $x = 3$

15. a) $l = \frac{6000}{w}$

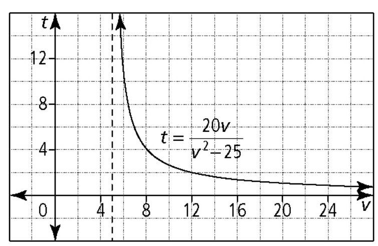
b) change in $l = \frac{6000}{w} - \frac{6000}{w+1}$

$$= \frac{6000}{w^2 + w}$$

c) $w = 24$ cm

16. a) domain: $\{v \mid v > 5, v \in \mathrm{R}\}$; range: $\{t \mid t > 0, t \in \mathrm{R}\}$

b)



c) $v = 15$ km/h