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Chapter 7

Characteristics of Polynomial Functions

Lesson 7-1 (pp. 438-445)

Mental Math

a. $x^2 + 6x - 7$

b. $x^4 - x^2y^2$

Activity 1

Step 1:

$V = 4x^3 - 210x^2 + 2700x$

Step 2:

$0 < x < 22.5$

Step 3: Answers vary. Sample:

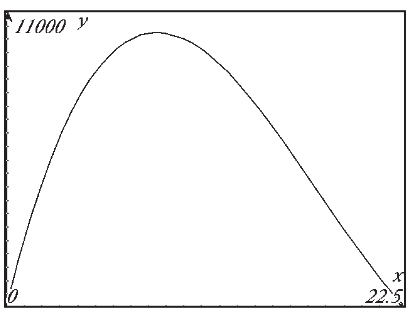
x	*V*
1	2494
4	7696
7	9982
10	10000
13	8398
16	5824
19	2926
22	352

Step 4: Answers vary. Sample:

minimum: 352

maximum: 10000

Step 5:



Step 6:

(8.486, 10234)

Step 7:

The maximum volume of the box, 10234 cm^3, occurs when the box is 8.486 cm tall.

Guided Example 3

a. $x < a$; $x > g$

b. $b < x < d$; $x > f$

Activity 2

Step 1:

x	f(x):= x^3−5*x−..	
2	-4.	
2.1	-3.239	
2.2	-2.352	
2.3	-1.333	
2.4	-0.176	
2.5	1.125	
2		

$2.4 < x < 2.5$

Step 2:

x	f(x):= x^3−5*x−..	
2.4	-0.176	
2.41	-0.052479	
2.42	0.072488	
2.43	0.198907	
2.44	0.326784	
2.45	0.456125	
2.4		

$x = 2.41$

Step 3:

x	f(x):= x^3−5*x−..	
-0.5	0.375	
-0.4	-0.064	
-0.3	-0.527	
-0.2	-1.008	
-0.1	-1.501	
0.	-2.	
-0.5		

x	f(x):= x^3−5*x−..	
-0.45	0.158875	
-0.44	0.114816	
-0.43	0.070493	
-0.42	0.025912	
-0.41	-0.018921	
-0.4	-0.064	
-0.45		

$x = 0.41$

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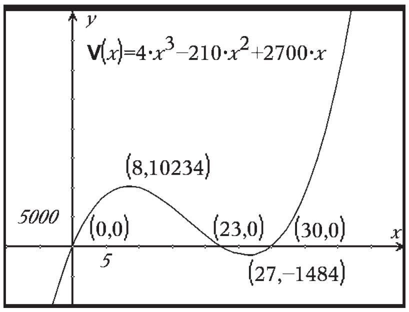
Questions

1. The expression has a variable with a negative integer exponent, $8x^{-3}$.

2. a.

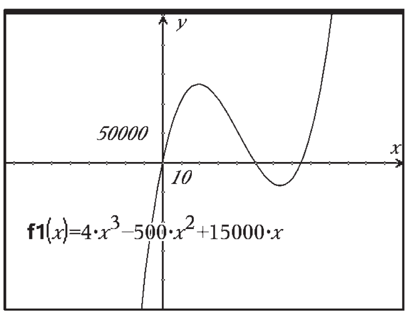


   b. $x \approx 8$

3. A box with height 30 cm would have length $60 - 2 \bullet 30 = 0$ cm, and thus zero volume.

4. a. $V(x) = x(150 - 2x)(100 - 2x) = 4x^3 - 500x^2 + 15000x$

   b.



   c. $V(x) < 0$ when $x < 0$ and $50 < x < 75$. This tells us that the height of the box cannot be negative or between 50 cm and 75 cm.

   d. (19.62, 132038)

   e. a square with side length 19.62 cm

   f. 132,038 cm^3

5. a. $a < x < c$ and $x > e$

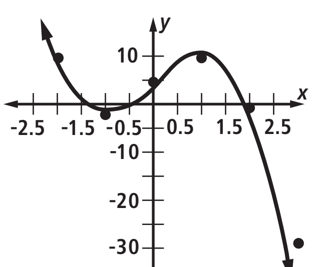
   b. $x < a$ and $c < x < e$

   c. $x < b$ and $x > d$

   d. $b < x < d$

6. a: x-intercept; b: local maximum;
   c: x-intercept, local minimum; d: y-intercept;
   e: maximum; f: x-intercept

7. a.

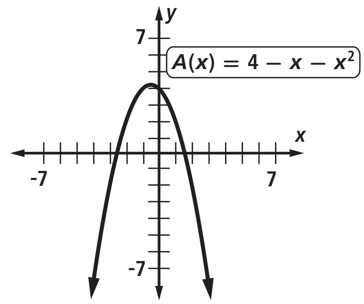


   b. –2 and –1; –1 and 0; 1 and 2

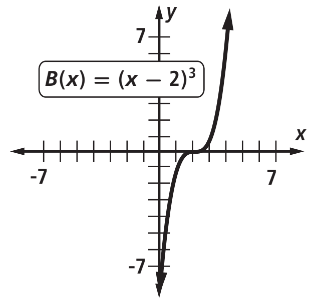
8. a. $A(x) = 800x^4 + 850x^3 + 1000x^2 + 900x + 1200$

   b. $5397.82

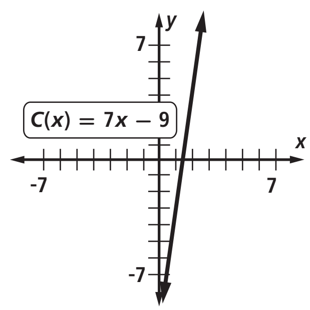
9. a. II



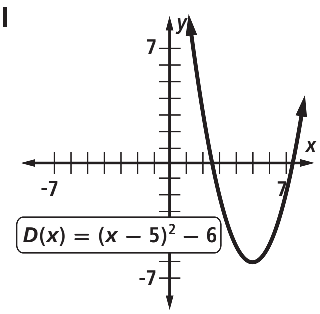
   b. I



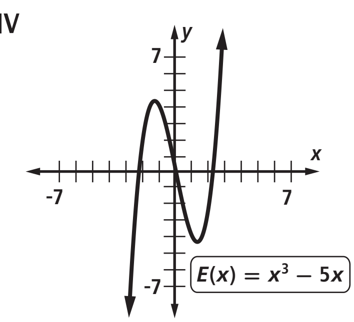
   c. I



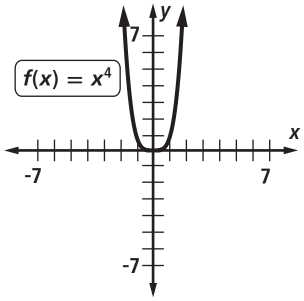
   d. III



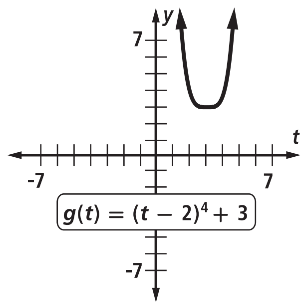
   e. IV



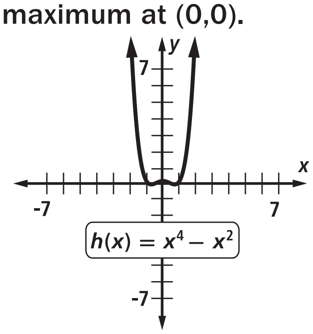
10. One minimum value at (0, 0)



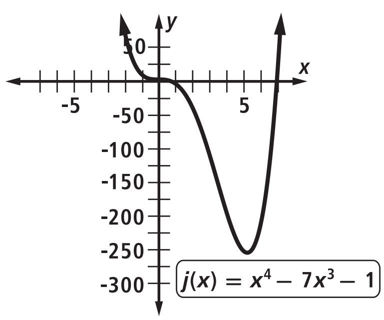
11. One minimum value at (2 ,3)



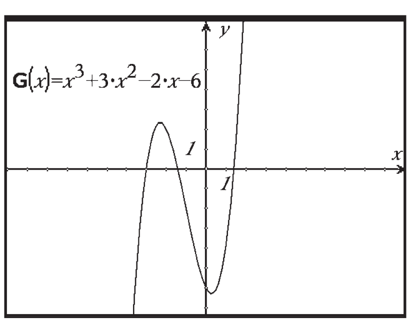
12. Two relative minima at $x \approx -0.7$ and $x \approx 0.7$ with mnimum value of –0.25. One relative maximum at (0,0).



13. One minimum value at about (5.2, –254.2).



14. a.



b. –6

c. –3, –1.4, 1.4

d. relative minimum at (0.29, –6.30)
relative maximum at (–2.29, 2.30)

e. $G(x) > 0$ for $-3 < x < -1.4$ and $x > 1.4$
$G(x) < 0$ for $x < -3$ and $-1.4 < x < 1.4$

f. $G(x)$ is increasing on $x < -2.29$ and $x > 0.29$.
$G(x)$ is decreasing on $-2.29 < x < 0.29$.

15.

Define $g(x)=x^3+3\cdot x^2-2\cdot x-6$	Done
zeros$(g(x),x)$	$\{-3,-\sqrt{2},\sqrt{2}\}$
fMax$(g(x),x,-3,-\sqrt{2})$	$x=\frac{-(\sqrt{15}+3)}{3}$
fMin$(g(x),x,-\sqrt{2},\sqrt{2})$	$x=\frac{\sqrt{15}-3}{3}$

zeros: $x = -3, -\sqrt{2}, \sqrt{2}$
relative minimum at $\left(\frac{\sqrt{15}-3}{3}, \frac{-10\sqrt{15}}{9} - 2\right)$

relative maximum at $\left(\frac{-\sqrt{15}-3}{3}, \frac{10\sqrt{15}}{9} - 2\right)$

16. a. $1200
b. the summer one year ago (or his fourth summer)
c. $6503.75; under a 5.75% annual rate, all the money Rick saved has grown to $6503.75

17. about 6400 miles

18. $(x, -y)$

19. $T(x, y) = (x - 3, y - 7)$

20. a. about 7.27 sec and 25.55 sec
b. about 4336.64 ft
c. about 32.87 sec

21. $(x - 9)^2$

22. $(3x + 4)(x - 2)$

23. a. Answers vary. Sample: $y = x^5$
b. Answers vary. Sample: $y = x(x - 1)^2(x + 2)^2 = x^5 + 2x^4 - 3x^3 - 4x^2 + 4x$
c. Answers vary. Sample:
$y = x(x - 1)(x - 2)(x + 1)(x + 2) = x^5 - 5x^3 + 4x$
d. Answers vary. Sample:
$y = x(x - 1)(x - 2)(x + 1)^2 = x^5 - x^4 - 3x^3 + x^2 + 2x$