Solutions Manual

Saxon Calculus

with Trigonometry and Analytic Geometry

SECOND EDITION

JOHN H. SAXON JR.
FRANK Y. H. WANG

Revised by:
BRET L. CROCK
JAMES A. SELLERS

Solutions Manual for

Calculus

with Trigonometry and Analytic Geometry

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Preface

This manual contains solutions to every problem in the *Calculus,* Second Edition, textbook. Early solutions of problems of a particular type contain every step. Later solutions omit steps considered unnecessary. We have attempted to stay as close as possible to the methods and procedures outlined in the textbook. Please keep in mind that many problems have more than one correct solution. While these solutions are designed to be representative of a student's work, students who submit alternative solutions should not necessarily lose credit. For ease of grading, the answer to each problem is usually set in boldface type to make it more noticeable. When a solution contains no boldface type, the entire solution is the answer to the problem.

The following people were instrumental in the development of this solutions manual, and we gratefully acknowledge their contributions: Bret Crock for writing and revising the solutions; Clint Keele, Matt Maloney, and Eric Scaia for editing the solutions; Tyler Akagi, Carmen Lemoine, and Kelli Robinson for working the problems and checking the answers; Eric Atkins, Brenda Bell, Jane Claunch, David LeBlanc, Tonea Morrow, Lucas Peters, Nancy Rimassa, Debra Sullivan, and Jason Vredenburg for typesetting the manual and creating the graphics; Chad Morris and Darlene Terry for proofreading the manual; Chris Davey and Susan Toth for copyediting the manual; and Carrie Brown and Brian Rice for supervising the project.

PROBLEM SET 1

1. A. $7\frac{1}{4}\text{ ft}^2 = 7.25\text{ ft}^2$

   B. $0.8\text{ yd}^2 \times \frac{3^2\text{ ft}^2}{1\text{ yd}^2} = 7.2\text{ ft}^2$

   Quantity A is greater: **A**

2. A. $7(2t - 2t) = 7(0) = 0$

   B. $-6(3t - 3t) = -6(0) = 0$

   Quantities A and B are equal: **C**

3. If $x = 8$ and $y = 3$, then quantity A is greater.
   If $x = 5$ and $y = 13$, then quantity B is greater.
   If $x = 6$ and $y = 6$, then the quantities are equal.

   Insufficient information: **D**

4. $a = \frac{3 + 6}{2} = 4.5$

   A. $3a = 13.5$

   B. $a + 6 = 10.5$

   Quantity A is greater: **A**

5.
$$\frac{m}{x} = y\left(\frac{1}{R_1} + \frac{a}{R_2}\right)$$
$$\frac{m}{x} = \frac{y}{R_1} + \frac{ay}{R_2}$$
$$mR_1R_2 = R_2xy + R_1axy$$
$$mR_1R_2 - R_1axy = R_2xy$$
$$R_1(mR_2 - axy) = R_2xy$$
$$R_1 = \boldsymbol{\frac{R_2xy}{mR_2 - axy}}$$

6. $a + \frac{1}{a + \frac{1}{a}} = a + \frac{1}{\frac{a^2 + 1}{a}} = a + \frac{a}{a^2 + 1}$

   $= \boldsymbol{\frac{a^3 + 2a}{a^2 + 1}}$

7. $\frac{1}{a + \frac{1}{x + \frac{1}{m}}} = \frac{1}{a + \frac{1}{\frac{mx + 1}{m}}} = \frac{1}{a + \frac{m}{mx + 1}}$

   $= \frac{1}{\frac{amx + a + m}{mx + 1}} = \boldsymbol{\frac{mx + 1}{amx + a + m}}$

8. $\frac{x^2y}{1 + m^2} + \frac{x}{y} = \frac{x^2y^2}{y(1 + m^2)} + \frac{x(1 + m^2)}{y(1 + m^2)}$

   $= \boldsymbol{\frac{x^2y^2 + x + m^2x}{y + m^2y}}$

9. $\frac{4 - 3\sqrt{2}}{8 - \sqrt{2}} = \frac{4 - 3\sqrt{2}}{8 - \sqrt{2}}\left(\frac{8 + \sqrt{2}}{8 + \sqrt{2}}\right)$

   $= \frac{32 + 4\sqrt{2} - 24\sqrt{2} - 6}{64 - 2} = \frac{26 - 20\sqrt{2}}{62}$

   $= \boldsymbol{\frac{13 - 10\sqrt{2}}{31}}$

10. $\frac{x^a y^{a+b}}{x^{-a/2}y^{b-1}} = x^a x^{a/2} y^{a+b} y^{-b+1} = \boldsymbol{x^{3a/2}y^{a+1}}$

11. $\frac{m^{x+2}b^{x-2}}{m^{2x/3}b^{-3x/2}} = m^{x+2}m^{-2x/3}b^{x-2}b^{3x/2}$

    $= \boldsymbol{m^{x/3+2}b^{5x/2-2}}$

12. $\sqrt{xy}\,x^{2/3}y^{-3/2} = x^{1/2}x^{2/3}y^{1/2}y^{-3/2} = \boldsymbol{x^{7/6}y^{-1}}$

13.
$$\begin{cases} 2x + 3y = -4 \\ x - 2z = -3 \\ 2y - z = -6 \end{cases}$$
$$z = 2y + 6$$
$$x - 2(2y + 6) = -3$$
$$x - 4y = 9$$
$$x = 4y + 9$$
$$2(4y + 9) + 3y = -4$$
$$8y + 18 + 3y = -4$$
$$11y = -22$$
$$y = -2$$
$$x = 4(-2) + 9 = 1$$
$$z = 2(-2) + 6 = 2$$

    (1, −2, 2)

14. $a^2x - a^2 - 4b^2x + 4b^2$

    $= a^2(x - 1) - 4b^2(x - 1)$

    $= (a^2 - 4b^2)(x - 1)$

    $= \boldsymbol{(a - 2b)(a + 2b)(x - 1)}$

15. $16a^{4m+3} - 8a^{2m+3} = \boldsymbol{8a^{2m+3}(2a^{2m} - 1)}$

16. $a^2b^{2x+2} - ab^{2x+1} = \boldsymbol{ab^{2x+1}(ab - 1)}$

17. $9x^2 - y^4 = (3x)^2 - (y^2)^2 = \boldsymbol{(3x + y^2)(3x - y^2)}$

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17. $9x^2 - y^4 = (3x)^2 - (y^2)^2 = \mathbf{(3x + y^2)(3x - y^2)}$

18. $a^6 - 27b^3c^3 = (a^2)^3 - (3bc)^3$
$= \mathbf{(a^2 - 3bc)(a^4 + 3a^2bc + 9b^2c^2)}$

19. $x^3y^6 + 8m^{12} = (xy^2)^3 + (2m^4)^3$
$= \mathbf{(xy^2 + 2m^4)(x^2y^4 - 2m^4xy^2 + 4m^8)}$

20. $\dfrac{12!}{8!\,4!} = \dfrac{12 \cdot 11 \cdot 10 \cdot 9 \cdot 8!}{8!\,4!} = \dfrac{12 \cdot 11 \cdot 10 \cdot 9}{4 \cdot 3 \cdot 2}$
$= 11 \cdot 5 \cdot 9 = \mathbf{495}$

21. $\dfrac{n \cdot (n!)}{(n+1)!} = \dfrac{n \cdot n!}{(n+1) \cdot n!} = \dfrac{\mathbf{n}}{\mathbf{n+1}}$

22. $\sum_{i=1}^{3} 4 = 4 + 4 + 4 = \mathbf{12}$

23. $\sum_{m=0}^{3} \dfrac{3^m}{m+1} = 1 + \dfrac{3}{2} + 3 + \dfrac{27}{4} = \dfrac{\mathbf{49}}{\mathbf{4}}$

24. $V = \dfrac{4}{3}\pi r^3$
$\dfrac{4}{3}\pi = \dfrac{4}{3}\pi r^3$
$r = 1$
$A = 4\pi r^2$
$= 4\pi(1)^2$
$= \mathbf{4\pi\ m^2}$

25. $A = \pi r^2$
$4\pi = \pi r^2$
$r = 2$
$V = \dfrac{1}{3}\pi r^2 h = \dfrac{1}{3}\pi\, 2^2(4)$
$= \dfrac{\mathbf{16}}{\mathbf{3}}\mathbf{\pi\ cm^3}$

Problem Set 2

1. Midpoint $= \left(\dfrac{4+10}{2}, \dfrac{2-2}{2}\right) = (7, 0)$
$d = \sqrt{(7-6)^2 + (0-8)^2}$
$= \sqrt{1 + 64} = \mathbf{\sqrt{65}}$

2. $(5\sqrt{2})^2 = y^2 + 5^2$
$50 = y^2 + 25$
$y^2 = 25$
$y = \mathbf{5}$

3. $2x - 3y + 2 = 0$
$3y = 2x + 2$
$\mathbf{y = \dfrac{2}{3}x + \dfrac{2}{3}}$

4. $4y = -3x + 2$
$y = -\dfrac{3}{4}x + \dfrac{1}{2}$
slope $= -\dfrac{3}{4}$ $\quad \perp$slope $= \dfrac{4}{3}$
$y + 1 = \dfrac{4}{3}(x - 1)$
$\mathbf{y = \dfrac{4}{3}x - \dfrac{7}{3}}$

5. $x^2 - 3x - 4 = 0$
$x^2 - 3x = 4$
$x^2 - 3x + \dfrac{9}{4} = 4 + \dfrac{9}{4}$
$\left(x - \dfrac{3}{2}\right)^2 = \dfrac{25}{4}$
$x = \dfrac{3}{2} \pm \dfrac{5}{2}$
$x = \mathbf{4, -1}$

6. $2x^2 = x + 3$
$2x^2 - x = 3$
$x^2 - \dfrac{1}{2}x = \dfrac{3}{2}$
$x^2 - \dfrac{1}{2}x + \dfrac{1}{16} = \dfrac{3}{2} + \dfrac{1}{16}$
$\left(x - \dfrac{1}{4}\right)^2 = \dfrac{25}{16}$
$x = \dfrac{1}{4} \pm \dfrac{5}{4}$
$x = \mathbf{\dfrac{3}{2}, -1}$

7. $3x^2 - x - 7 = 0$
$x = \dfrac{1 \pm \sqrt{1 - 4(3)(-7)}}{6}$
$x = \mathbf{\dfrac{1}{6} \pm \dfrac{\sqrt{85}}{6}}$

8.

$$\begin{array}{r} 2x^2 + 6x + 15 \\ x - 3 \overline{\smash{)}\, 2x^3 + 0x^2 - 3x + 5} \\ \underline{2x^3 - 6x^2} \qquad\qquad \\ 6x^2 - 3x \qquad \\ \underline{6x^2 - 18x} \qquad \\ 15x + 5 \\ \underline{15x - 45} \\ 50 \end{array}$$

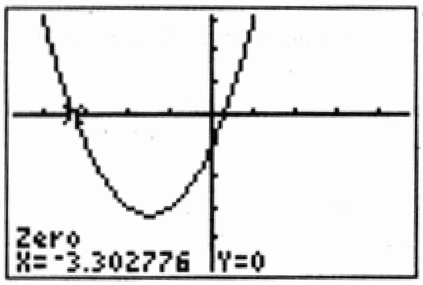
$$\mathbf{2x^2 + 6x + 15 + \frac{50}{x - 3}}$$

9. $\begin{cases} xy = -4 \\ y = -x - 2 \end{cases}$

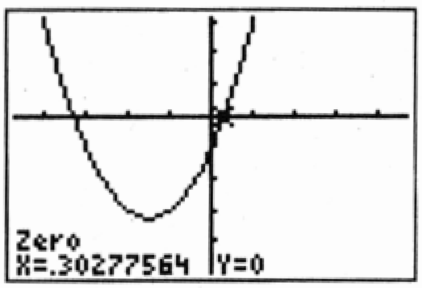
$$x(-x - 2) = -4$$
$$-x^2 - 2x = -4$$
$$x^2 + 2x - 4 = 0$$
$$x = \frac{-2 \pm \sqrt{4 - 4(1)(-4)}}{2}$$
$$x = -1 \pm \sqrt{5}$$

$$\mathbf{(-1 + \sqrt{5}, -1 - \sqrt{5}), (-1 - \sqrt{5}, -1 + \sqrt{5})}$$

10.

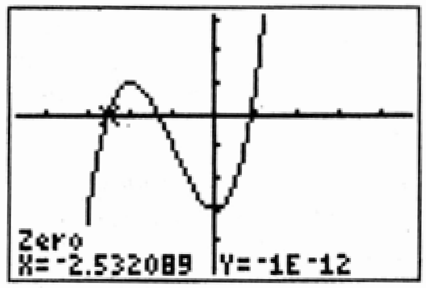


$x \approx$ **−3.302776**

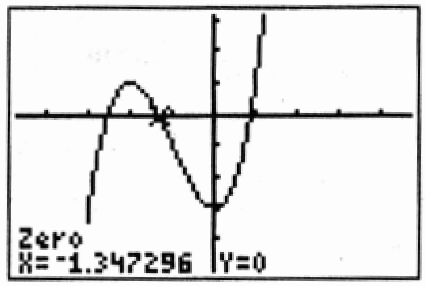


$x \approx$ **0.30277564**

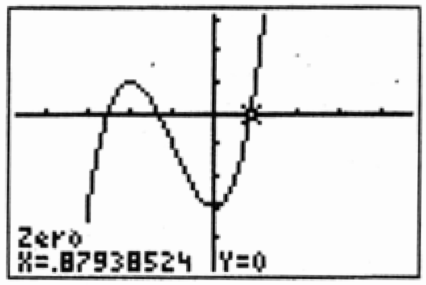
11.



$x \approx$ **−2.532089**

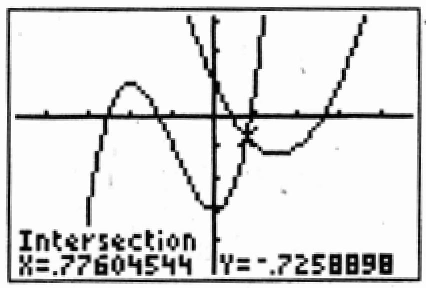


$x \approx$ **−1.347296**



$x \approx$ **0.87938524**

12. Let Y1=X²−3X+1 and Y2=X³+3X²−3.



(0.77604544, −0.7258898)

13.

$$k^2 = \frac{1}{bc}\left(\frac{x}{3} - \frac{6y}{d}\right)$$
$$k^2 = \frac{x}{3bc} - \frac{6y}{bcd}$$
$$3bcdk^2 = dx - 18y$$
$$dx = 3bcdk^2 + 18y$$
$$x = \mathbf{\frac{3bcdk^2 + 18y}{d}}$$

14. $$\frac{ax}{b + \frac{c}{d + \frac{m}{t}}} = \frac{ax}{b + \frac{c}{\frac{dt + m}{t}}} = \frac{ax}{b + \frac{ct}{dt + m}}$$

$$= \frac{ax}{\frac{bdt + bm + ct}{dt + m}} = \mathbf{\frac{adtx + amx}{bdt + bm + ct}}$$

15. $$3\sqrt{\frac{2}{5}} - 4\sqrt{\frac{5}{2}} + 3\sqrt{40} = \frac{3\sqrt{2}}{\sqrt{5}} - \frac{4\sqrt{5}}{\sqrt{2}} + 6\sqrt{10}$$

$$= \frac{3\sqrt{10}}{5} - 2\sqrt{10} + 6\sqrt{10} = \mathbf{\frac{23\sqrt{10}}{5}}$$

16. $$\frac{y^{a-2}z^{4a}}{y^{-2a-1}z^{a/3+2}} = y^{a-2}\,y^{2a+1}\,z^{4a}\,z^{-a/3-2}$$

$$= \mathbf{y^{3a-1}z^{11a/3-2}}$$

17. $$\sqrt{x^3y^3}\;y^{1/3}x^{2/3} = x^{3/2}x^{2/3}y^{3/2}y^{1/3} = \mathbf{x^{13/6}y^{11/6}}$$

18. $$\begin{cases} x + y + z = 4 & \text{(a)} \\ 2x - y - z = -1 & \text{(b)} \\ x - y + z = 0 & \text{(c)} \end{cases}$$

$3x = 3 \qquad (\text{a} + \text{b})$

$x = 1$

$3x - 2y = -1 \qquad (\text{b} + \text{c})$

$3 - 2y = -1$

$-2y = -4$

$y = 2$

$z = y - x = 2 - 1 = 1$

$\mathbf{(1, 2, 1)}$

19. $$14x^{4b-2} - 7x^{2b} = \mathbf{7x^{2b}(2x^{2b-2} - 1)}$$

20. $$x^3y^6 - 8x^6y^{12} = x^3y^6(1 - 8x^3y^6)$$

$$= x^3y^6[(1)^3 - (2xy^2)^3]$$

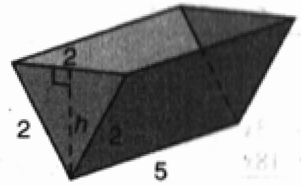
$$= \mathbf{x^3y^6(1 - 2xy^2)(1 + 2xy^2 + 4x^2y^4)}$$

21. $$\frac{n!}{(n-1)!} = \frac{n \cdot (n-1)!}{(n-1)!} = \mathbf{n}$$

22. $$\sum_{n=1}^{3}(n^2 - 2) = -1 + 2 + 7 = \mathbf{8}$$

23. $$\sum_{j=-2}^{1}\frac{2j - 3}{3} = -\frac{7}{3} - \frac{5}{3} - 1 - \frac{1}{3} = \mathbf{-\frac{16}{3}}$$

24.



$h = \sqrt{3}$

$V = (\text{Area}_{\text{Triangle}})(\text{Length})$

$= \frac{1}{2}(2)(\sqrt{3})(5)$

$= \mathbf{5\sqrt{3}\ m^3 \approx 8.6603\ m^3}$

25. If $x^2 = y^2$, then $x = \pm y$.

Insufficient information: **D**

Problem Set 3

1. If the switch is on, then the light is on.

2. If the light is not on, then the switch is not on.

3. If the switch is not on, then the light is not on.

4. If x is not a complex number, then x is not a real number.

5. $2y - x - 1 = 0$

$2y = x + 1$

$y = \frac{1}{2}x + \frac{1}{2}$

slope $= \frac{1}{2} \qquad \perp$slope $= -2$

$y - 2 = -2(x - 2)$

$\mathbf{y = -2x + 6}$

6. $$x^2 = -6x - 13$$

$$x^2 + 6x + 13 = 0$$

$$x^2 + 6x + 9 + 13 - 9 = 0$$

$$\mathbf{(x + 3)^2 + 4 = 0}$$

7. $x^2 - 3x - 7 = 0$

$$x = \frac{3 \pm \sqrt{9 - 4(1)(-7)}}{2}$$

$$= \mathbf{\frac{3}{2} \pm \frac{\sqrt{37}}{2}}$$

8. $\begin{cases} 2y^2 - x^2 = 1 \\ y + 1 = x \end{cases}$

$$2y^2 - (y + 1)^2 = 1$$
$$2y^2 - y^2 - 2y - 1 = 1$$
$$y^2 - 2y - 2 = 0$$
$$y = \frac{2 \pm \sqrt{4 - 4(1)(-2)}}{2}$$
$$y = 1 \pm \sqrt{3}$$

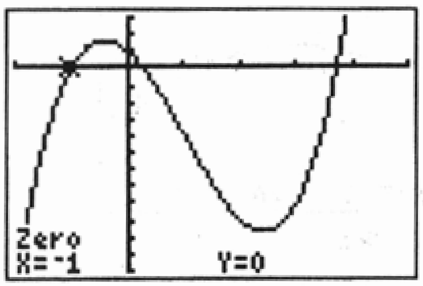
$x = y + 1 = 2 \pm \sqrt{3}y$

$\mathbf{(2 + \sqrt{3}, 1 + \sqrt{3}), (2 - \sqrt{3}, 1 - \sqrt{3})}$

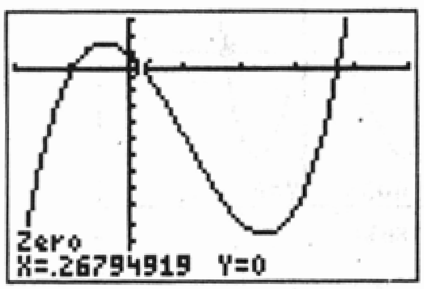
9.
$$\begin{array}{r} x^2 - 12x - 2 \\ x - 1 \overline{\big) x^3 - 13x^2 + 10x - 8} \\ \underline{x^3 - x^2} \\ -12x^2 + 10x \\ \underline{-12x^2 + 12x} \\ -2x - 8 \\ \underline{-2x + 2} \\ -10 \end{array}$$

$$\mathbf{x^2 - 12x - 2 - \frac{10}{x - 1}}$$

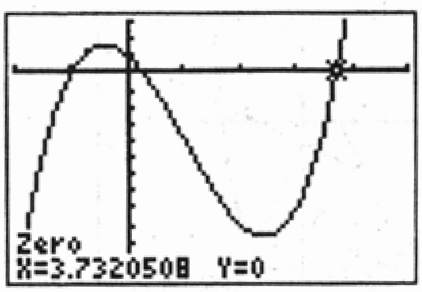
10.



$x = \mathbf{-1}$



$x \approx \mathbf{0.26794919}$



$x \approx \mathbf{3.7320508}$

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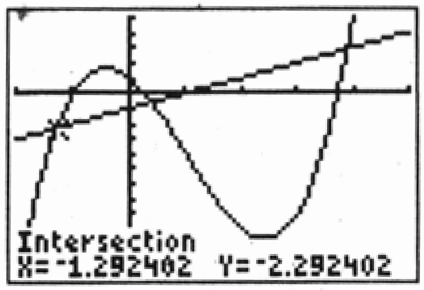
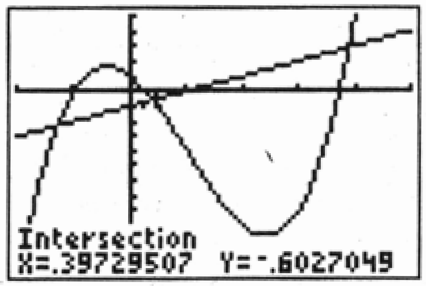
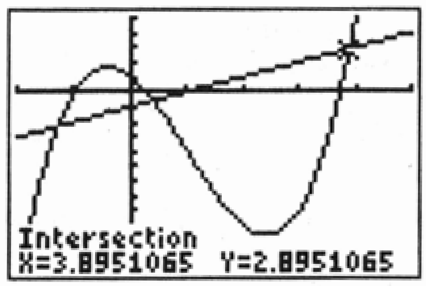


(−1.292402, −2.292402)



(0.39729507, −0.6027049)



(3.8951065, 2.8951065)

12.
$$\frac{m + b}{c} = \frac{1}{k}\left(\frac{a}{R_1} + \frac{b}{R_2}\right)$$
$$\frac{m + b}{c} = \frac{a}{kR_1} + \frac{b}{kR_2}$$
$$kR_1R_2(m + b) = acR_2 + bcR_1$$
$$kmR_1R_2 + bkR_1R_2 = acR_2 + bcR_1$$
$$kmR_1R_2 + bkR_1R_2 - bcR_1 = acR_2$$
$$R_1(kmR_2 + bkR_2 - bc) = acR_2$$
$$\mathbf{\frac{acR_2}{kmR_2 + bkR_2 - bc}} = R_1$$

13. $\dfrac{4 - 2\sqrt{3}}{2 - \sqrt{3}} = \dfrac{2(2 - \sqrt{3})}{2 - \sqrt{3}} = \mathbf{2}$

14. $5\sqrt{\dfrac{3}{7}} - 2\sqrt{\dfrac{7}{3}} + \sqrt{84} = \dfrac{5\sqrt{21}}{7} - \dfrac{2\sqrt{21}}{3} + 2\sqrt{21}$

$= \mathbf{\dfrac{43\sqrt{21}}{21}}$

15. $\sqrt{x^3y^5}\; y^{1/4}x^{3/2} = x^{3/2}x^{3/2}y^{5/2}y^{1/4} = \mathbf{x^3y^{11/4}}$

16. $$\frac{1}{1+\frac{1}{1+\frac{1}{1+\frac{1}{2}}}} = \frac{1}{1+\frac{1}{1+\frac{1}{\frac{3}{2}}}} = \frac{1}{1+\frac{1}{1+\frac{2}{3}}}$$

$$= \frac{1}{1+\frac{1}{\frac{5}{3}}} = \frac{1}{1+\frac{3}{5}} = \frac{1}{\frac{8}{5}} = \mathbf{\frac{5}{8}}$$

17. $$\frac{m}{x+\frac{p}{1-\frac{y}{m}}} = \frac{m}{x+\frac{p}{\frac{m-y}{m}}} = \frac{m}{x+\frac{mp}{m-y}}$$

$$= \frac{m}{\frac{mx-xy+mp}{m-y}} = \mathbf{\frac{m^2-my}{mx-xy+mp}}$$

18. $a^3b^3 - 8x^6y^9 = (ab)^3 - (2x^2y^3)^3$
$= \mathbf{(ab - 2x^2y^3)(a^2b^2 + 2abx^2y^3 + 4x^4y^6)}$

19. $2x^3 + 3x^2 - 2x = x(2x^2 + 3x - 2)$
$= \mathbf{x(2x - 1)(x + 2)}$

20. $\sum_{j=1}^{4} (j^2 - 2j) = -1 + 0 + 3 + 8 = \mathbf{10}$

21. $\frac{41!}{38!\,3!} = \frac{41 \cdot 40 \cdot 39 \cdot 38!}{38!\,3!} = \frac{41 \cdot 40 \cdot 39}{3 \cdot 2}$
$= 41 \cdot 20 \cdot 13 = \mathbf{10{,}660}$

22. $\frac{a^2 - b^2}{a + b} = \frac{(a+b)(a-b)}{(a+b)} = \mathbf{a - b}$

23. $\frac{n!\,(n+1)!}{(n+2)!} = \frac{n!\,(n+1)!}{(n+2)(n+1)!} = \mathbf{\frac{n!}{n+2}}$

24. $\frac{r}{h} = \frac{r}{h}$

$\frac{2}{6} = \frac{r}{2}$

$r = \frac{2(2)}{6} = \frac{2}{3}$

$V = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi\left(\frac{2}{3}\right)^2(2)$

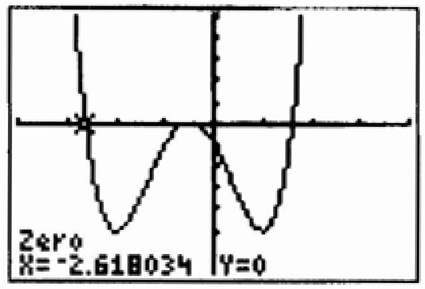
$= \mathbf{\frac{8}{27}\pi\ cm^3 \approx 0.9308\ cm^3}$

25. If x and y are both positive or both negative and $x > y$, then $\frac{1}{y} > \frac{1}{x}$. If x is positive and y is negative, then $\frac{1}{x} > \frac{1}{y}$.

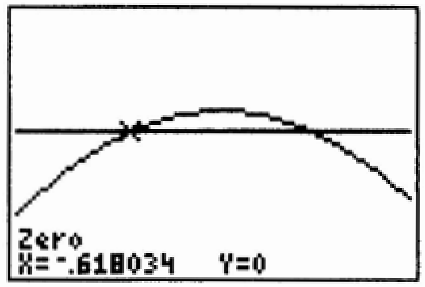
Insufficient information: **D**

Problem Set 4

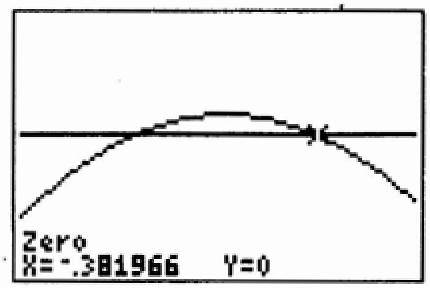
1.



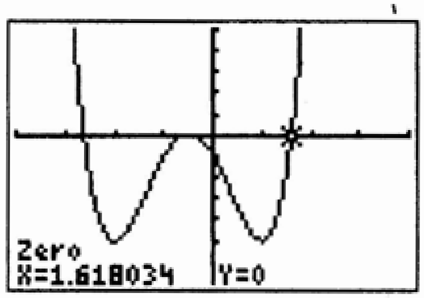
$x \approx$ **−2.618034**



$x \approx$ **−0.618034**

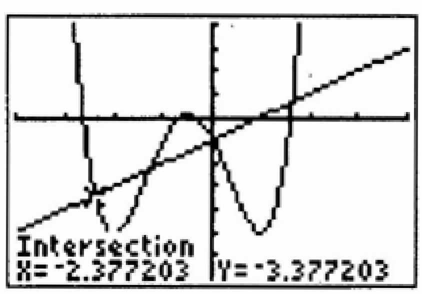


$x \approx$ **−0.381966**

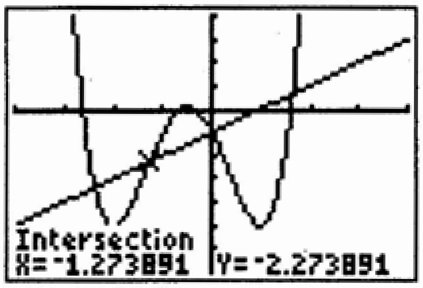


$x \approx$ **1.618034**

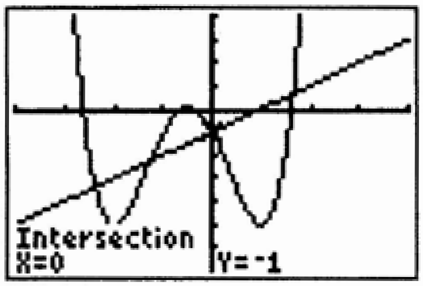
2. Let Y1=X^4+2X³−3X²−4X−1 and Y2=X−1.



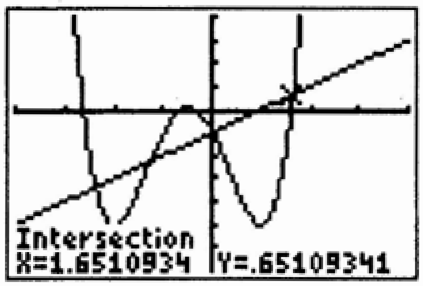
(−2.377203, −3.377203)



(–1.273891, –2.273891)



(0, –1)



(1.6510934, 0.65109341)

3. $\cos^2\frac{\pi}{3} - \cot\frac{\pi}{4} + \sin\frac{\pi}{6} = \left(\frac{1}{2}\right)^2 - 1 + \frac{1}{2}$

$= \mathbf{-\frac{1}{4}}$

4. $\sec 60° + \csc^2\frac{\pi}{3} = 2 + \left(\frac{2}{\sqrt{3}}\right)^2 = \mathbf{\frac{10}{3}}$

5. $3\cos\frac{17\pi}{6} + 2\cos -\frac{5\pi}{3} = 3\cos\frac{5\pi}{6} + 2\cos\frac{\pi}{3}$

$= 3\left(-\frac{\sqrt{3}}{2}\right) + 2\left(\frac{1}{2}\right) = \mathbf{-\frac{3\sqrt{3}}{2} + 1}$

6. $4\tan -\frac{3\pi}{4} + \sin -\frac{\pi}{4} = 4(1) + \left(-\frac{\sqrt{2}}{2}\right)$

$= \mathbf{4 - \frac{\sqrt{2}}{2}}$

7. $(\sin^2\theta)(\csc\theta)(\cot\theta) = \left(\frac{\sin^2\theta}{1}\right)\left(\frac{1}{\sin\theta}\right)\left(\frac{\cos\theta}{\sin\theta}\right)$

$= \mathbf{\cos\theta}$

8. $\frac{\tan\theta\sin\theta}{\sec\theta} = \frac{\sin\theta}{\cos\theta}\sin\theta\cos\theta = \mathbf{\sin^2\theta}$

9. If a function is one-to-one, then it is not both increasing and decreasing.

10. Contrapositive: If your thumb does not hurt, then you did not hit your thumb with a hammer.

Converse: If your thumb hurts, then you hit your thumb with a hammer.

Inverse: If you did not hit your thumb with a hammer, then your thumb does not hurt.

11. $-3y = \frac{x}{3} + 2$

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

slope $= -\frac{1}{9}$

$\mathbf{y + 3 = -\frac{1}{9}(x + 9)}$

$-9y - 27 = x + 9$

$\mathbf{x + 9y + 36 = 0}$

12. $2x^2 + 7x - 15 = 0$

$(2x - 3)(x + 5) = 0$

$x = \mathbf{\frac{3}{2}, -5}$

13. $x^2 + x - 1 = 0$

$x = \frac{-1 \pm \sqrt{1 - 4(1)(-1)}}{2}$

$x = \mathbf{-\frac{1}{2} \pm \frac{\sqrt{5}}{2}}$

14. $(3x^2 - 4x + 5)(2x - 1)$

$= 6x^3 - 3x^2 - 8x^2 + 4x + 10x - 5$

$= \mathbf{6x^3 - 11x^2 + 14x - 5}$

15. $\begin{cases} x^2 + y^2 = 8 \\ x + y = 0 \end{cases}$

$y = -x$

$x^2 + (-x)^2 = 8$

$2x^2 = 8$

$x = \pm 2$

(2, –2), (–2, 2)

16. $\dfrac{1}{r} = v\left(\dfrac{1}{r_1} + \dfrac{1}{r_2}\right)$

$\dfrac{1}{r} = \dfrac{v}{r_1} + \dfrac{v}{r_2}$

$r_1 r_2 = r(r_2 v + r_1 v)$

$r = \mathbf{\dfrac{r_1 r_2}{v(r_1 + r_2)}}$

17. $\dfrac{(n-1)!\,n!}{(n-2)!} = \dfrac{(n-1)(n-2)!\,n!}{(n-2)!} = \mathbf{(n-1)n!}$

18. $5\sqrt{\dfrac{1}{5}} - 3\sqrt{5} + \sqrt{50} = \sqrt{5} - 3\sqrt{5} + 5\sqrt{2}$

$= \mathbf{5\sqrt{2} - 2\sqrt{5}}$

19. $\dfrac{x^3 - y^3}{x^2 + xy + y^2} = \dfrac{(x-y)(x^2 + xy + y^2)}{x^2 + xy + y^2}$

$= \mathbf{x - y}$

20. $\displaystyle\sum_{i=-1}^{1} (2^i + i) = -\frac{1}{2} + 1 + 3 = \mathbf{\frac{7}{2}}$

21. $\dfrac{1}{1 + \dfrac{1}{1 + \dfrac{1}{3}}} = \dfrac{1}{1 + \dfrac{1}{\frac{4}{3}}} = \dfrac{1}{1 + \dfrac{3}{4}} = \dfrac{1}{\frac{7}{4}} = \mathbf{\dfrac{4}{7}}$

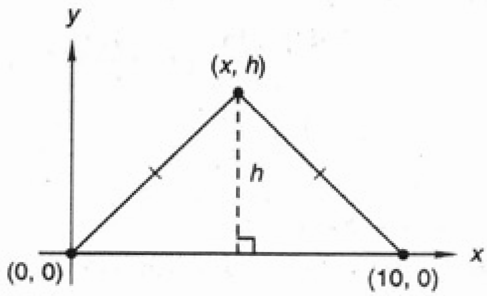
22. $SA = \text{Perimeter}_{\text{Base}} \cdot \text{Height} + 2\text{Area}_{\text{Base}}$

$= 2(w + l)(h) + 2(wl)$

$= 2(hw + hl) + 2(wl)$

$= \mathbf{2(hw + hl + lw)\ units^2}$

23.



$h = \dfrac{10}{2} = 5$

(5, 5)

24. If $0 < x < 1$, then $x > x^{10}$ and quantity A is greater.

If $x = 1$, then $x = x^{10}$ so A and B are equal.

If $x > 1$, then $x < x^{10}$ and B is greater.

Insufficient information: **D**

25. Because $AB = BC$, $m\angle BAC = m\angle BCA$.

$m\angle BAD + m\angle DAC = m\angle BAC$

$m\angle BAD = m\angle BAC - m\angle DAC$

$x = m\angle BCA - m\angle DAC$

$x = y - m\angle DAC$

Since $m\angle DAC \neq 0$, $y > x$.

Quantity B is greater: **B**

Problem Set 5

1. $T = \dfrac{kM}{E}$

$5 = \dfrac{k(1000)}{2}$

$1000k = 10$

$k = \dfrac{1}{100}$

$T = \dfrac{\frac{1}{100}(3000)}{3} = \dfrac{30}{3} = \mathbf{10\ days}$

2. $C = mF + b$

$12 = 10m + b$

$-\ \ 6 = 4m + b$

$6 = 6m$

$m = 1$

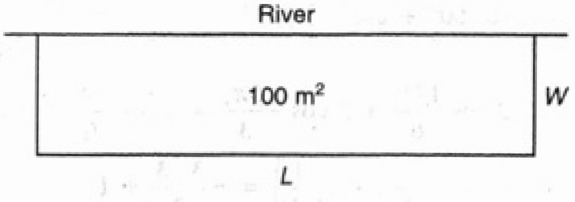
$b = 2$

$C = F + 2$

$C = 9$

$9 million

3.



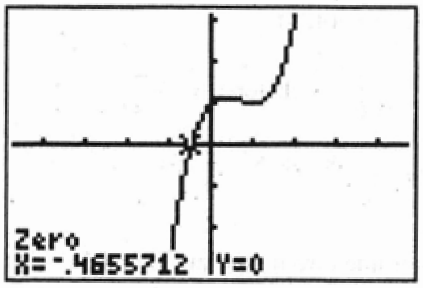
$LW = 100$

$W = \dfrac{100}{L}$

$F = L + 2W$

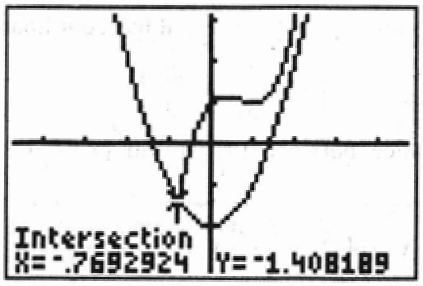
$F = L + 2\left(\dfrac{100}{L}\right)$

$F = \mathbf{\left(L + \dfrac{200}{L}\right)\ m}$

4. 

$x \approx \mathbf{-0.4655712}$

5. Let Y1=X³−2X²+X+1 and Y2=X²−2.



(−0.7692924, −1.408189)

6. $50° \times \frac{\pi}{180°} \approx \mathbf{0.8727}$

7. $2 \cos \frac{5\pi}{4} - \sec \frac{\pi}{4} = 2\left(-\frac{\sqrt{2}}{2}\right) - \frac{2}{\sqrt{2}}$

$= -\sqrt{2} - \sqrt{2} = \mathbf{-2\sqrt{2}}$

8. $\tan^2 \frac{\pi}{3} - \cot^2 \frac{\pi}{3} = (\sqrt{3})^2 - \left(\frac{1}{\sqrt{3}}\right)^2 = 3 - \frac{1}{3}$

$= \mathbf{\frac{8}{3}}$

9. $\sin^2 \frac{2\pi}{3} - \csc \frac{\pi}{2} = \left(\frac{-\sqrt{3}}{2}\right)^2 - (-1)$

$= \frac{3}{4} + 1 = \mathbf{\frac{7}{4}}$

10. $(\sin^2 x)(\csc x)(\cos x) = \sin^2 x \left(\frac{1}{\sin x}\right)(\cos x)$

$= \mathbf{\sin x \cos x}$

11. $\frac{\cos\alpha \sec\alpha}{\csc\alpha} = \frac{\cos\alpha\left(\frac{1}{\cos\alpha}\right)}{\frac{1}{\sin\alpha}} = \frac{1}{\frac{1}{\sin\alpha}}$

$= \mathbf{\sin\alpha}$

12. **If the polygon does not have four sides, then the polygon is not a triangle.**

13. $2x^2 - 3x + 1 = 0$

$$x = \frac{3 \pm \sqrt{9 - 4(2)(1)}}{4}$$

$$x = \mathbf{1, \frac{1}{2}}$$

14. Parallel to the y-axis implies a vertical line. Vertical lines have equations of the form $x = c$, where c is some constant. The vertical line through the point (2, 3) must be $x = 2$, or in general form $\mathbf{x - 2 = 0.}$

15. $\begin{cases} y = x^2 + 1 \\ y = 2x \end{cases}$

$x^2 + 1 = 2x$

$x^2 - 2x + 1 = 0$

$$x = \frac{2 \pm \sqrt{4 - 4(1)(1)}}{2}$$

$x = 1$

$y = 2(1) = 2$

(1, 2)

16. $x^2 = \sqrt{y+1}$

$x^4 = y + 1$

$\mathbf{y = x^4 - 1}$

17. $\frac{x^3 - a^3}{x - a} = \frac{(x-a)(x^2 + ax + a^2)}{x - a}$

$= \mathbf{x^2 + ax + a^2}$

18. $\frac{\sqrt{3} + \sqrt{2}}{\sqrt{3} - \sqrt{2}} = \frac{\sqrt{3} + \sqrt{2}}{\sqrt{3} - \sqrt{2}}\left(\frac{\sqrt{3} + \sqrt{2}}{\sqrt{3} + \sqrt{2}}\right)$

$= \frac{3 + 2\sqrt{6} + 2}{3 - 2} = \mathbf{5 + 2\sqrt{6}}$

19. $\frac{4}{m + \frac{a}{x-1}} = \frac{4}{\frac{mx - m + a}{x - 1}} = \mathbf{\frac{4x - 4}{mx - m + a}}$

20. $\frac{18!}{16!\,2!} = \frac{18 \cdot 17 \cdot 16!}{16! \cdot 2} = 9 \cdot 17 = \mathbf{153}$

21. $\sum_{n=1}^{4} [(-2)^n + 1] = -1 + 5 - 7 + 17 = \mathbf{14}$

22.
$$A = \pi r^2$$
$$9\pi = \pi r^2$$
$$r = 3 \text{ cm}$$
$$V = \frac{1}{3}\pi r^2 h$$
$$12\pi = \frac{1}{3}\pi(9)h$$
$$h = 4 \text{ cm}$$
$$l^2 = r^2 + h^2$$
$$l^2 = 9 + 16$$
$$l = 5 \text{ cm}$$
$$SA = \pi r^2 + \pi rl = 9\pi + 15\pi$$
$$= \mathbf{24\pi\ cm^2 \approx 75.3982\ cm^2}$$

23. (a) $y = -\frac{4}{3}x + \frac{25}{3}$

slope $= -\frac{4}{3}$ $\quad\perp$slope $= \mathbf{\frac{3}{4}}$

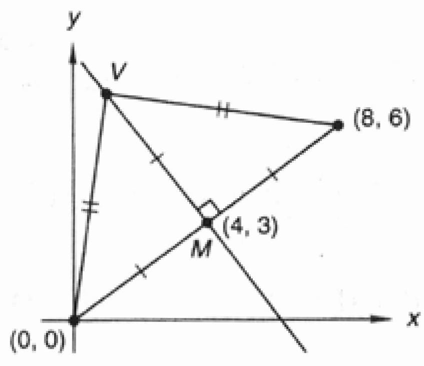
(b) $y + 4 = \frac{3}{4}(x - 3)$
$$y = \frac{3}{4}x - \frac{9}{4} - 4$$
$$\mathbf{y = \frac{3}{4}x - \frac{25}{4}}$$

(c) $-\frac{4}{3}x + \frac{25}{3} = \frac{3}{4}x - \frac{25}{4}$
$$\frac{175}{12} = \frac{25}{12}x$$
$$x = 7$$
$$y = \frac{3}{4}(7) - \frac{25}{4} = \frac{21}{4} - \frac{25}{4} = -1$$

(7, –1)

(d) $d = \sqrt{(7-3)^2 + (-1+4)^2} = \sqrt{4^2 + 3^2}$
$= \sqrt{16 + 9} = \sqrt{25} = \mathbf{5\ units}$

24.



$\text{Midpoint}_{\text{Base}} = (4, 3)$

$\text{Slope}_{\text{Base}} = \frac{3}{4}$ $\quad\perp$slope $= -\frac{4}{3}$

$\text{Length}_{\text{Base}} = \sqrt{8^2 + 6^2} = 10$

$MV = 5$

Equation of line through points M and V:
$$y - 3 = -\frac{4}{3}(x - 4)$$
$$y = -\frac{4}{3}x + \frac{25}{3}$$

Since V is on $y = -\frac{4}{3}x + \frac{25}{3}$, it has coordinates
$$\left(x, -\frac{4}{3}x + \frac{25}{3}\right)$$

The distance between (4, 3) and $\left(x, -\frac{4}{3}x + \frac{25}{3}\right)$ equals 5.
$$5 = \sqrt{(x-4)^2 + \left(-\frac{4}{3}x + \frac{25}{3} - 3\right)^2}$$
$$25 = (x-4)^2 + \left(-\frac{4}{3}x + \frac{16}{3}\right)^2$$
$$25 = x^2 - 8x + 16 + \frac{16}{9}x^2 - \frac{128}{9}x + \frac{256}{9}$$
$$25 = \frac{25}{9}x^2 - \frac{200}{9}x + \frac{400}{9}$$
$$0 = \frac{25}{9}x^2 - \frac{200}{9}x + \frac{175}{9}$$
$$0 = 25x^2 - 200x + 175$$
$$0 = x^2 - 8x + 7$$
$$0 = (x - 7)(x - 1)$$
$$x = 7, 1$$

If $x = 7$, then $y = -1$, which is in the fourth quadrant. If $x = 1$, then $y = 7$. The coordinates of the third vertex are **(1, 7).**

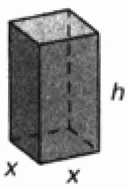
25. If $x < y$, $x < 0$, and $y < 0$, then $-x > -y$.

Quantity A is greater: **A**

Problem Set 6

1. $\frac{PV}{T} = \frac{PV}{T}$
$$\frac{5(5)}{100} = \frac{4P}{1000}$$
$$400P = 25{,}000$$
$$P = \mathbf{62.5\ newtons\ per\ square\ meter}$$

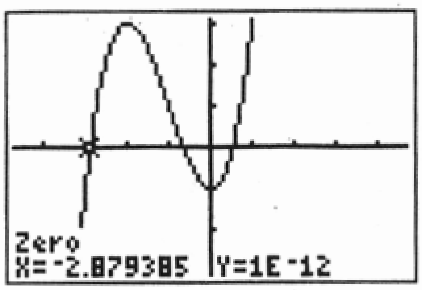
2.



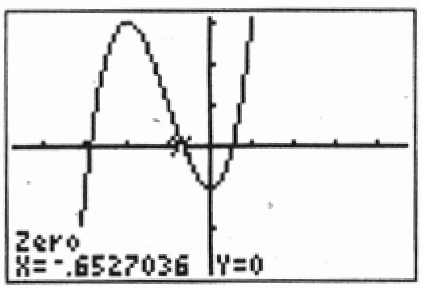
$$A = 2x^2 + 4xh$$
$$100 = 2x^2 + 4xh$$
$$100 - 2x^2 = 4xh$$
$$h = \frac{100 - 2x^2}{4x}$$
$$h = 25x^{-1} - \frac{1}{2}x$$

$$V = x^2h$$
$$V = x^2\left(25x^{-1} - \frac{1}{2}x\right)$$
$$V = \mathbf{25x - \frac{1}{2}x^3}$$

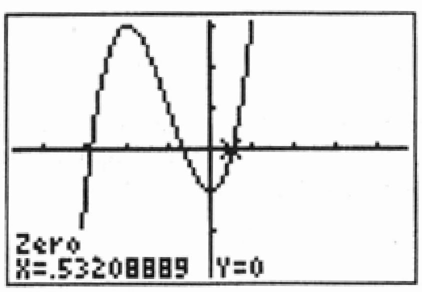
3.



$x \approx$ **−2.879385**

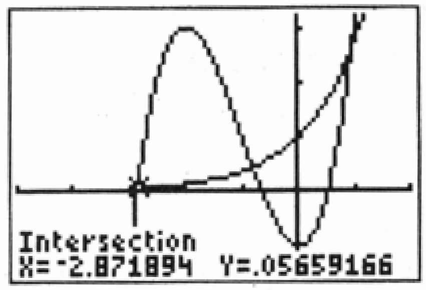


$x \approx$ **−0.6527036**

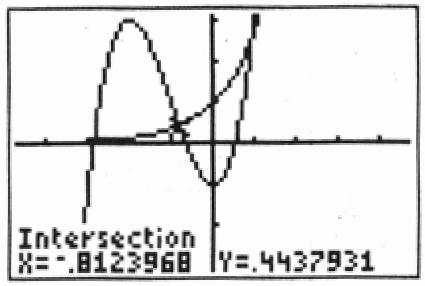


$x \approx$ **0.53208889**

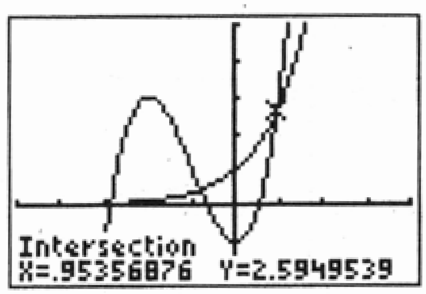
4. Let Y1=X³+3X²−1 and Y2=e^(X).



(−2.871894, 0.05659166)



(−0.8123968, 0.4437931)



(0.95356876, 2.5949539)

5. $1.570796327 \times \frac{180°}{\pi} = \mathbf{90°}$

6. Choice **B** is correct because every x-value is mapped to exactly one y-value.

7. (a) $\psi(1) \approx$ **3**

(b) $\psi(-1) \approx$ **0**

(c) $\psi(-2) = $ **1**

8. When $f(x) = x^2 + 1$, appropriate y-values are obtained for the given x-values.

The correct choice is **C.**

9.

$$f(x) = 2x^2 - 1$$
$$f(x + \Delta x) = 2(x + \Delta x)^2 - 1$$
$$f(x + \Delta x) = 2[x^2 + 2x(\Delta x) + (\Delta x)^2] - 1$$
$$f(x + \Delta x) = \mathbf{2x^2 + 4x(\Delta x) + 2(\Delta x)^2 - 1}$$

10. $x - 1 \geq 0$

$x \geq 1$

Domain: $\{x \in \mathbb{R} \mid x \geq 1\}$

Range: $\{y \in \mathbb{R} \mid y \geq 0\}$

11. $x + 1 \geq 0$

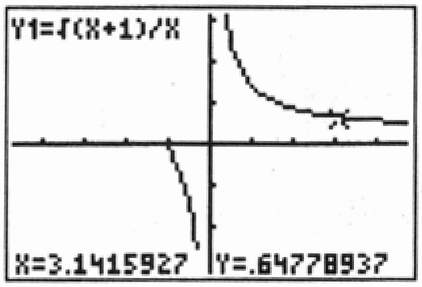
$x \geq -1$

But $x \neq 0$ because division by zero is disallowed.

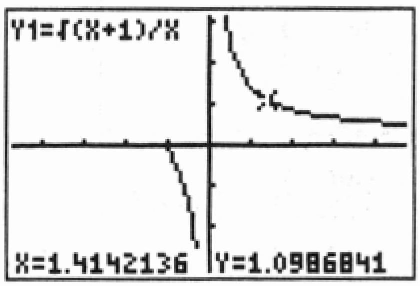
Domain: $\{x \in \mathbb{R} \mid x \geq -1, x \neq 0\}$

Range: $\mathbb{R}$

12.



$y \approx \mathbf{0.64778937}$



$y \approx \mathbf{1.0986841}$

13. $2\cos^2 \frac{5\pi}{4} - \sec^2 \frac{\pi}{4} = 2\left(-\frac{\sqrt{2}}{2}\right)^2 - \sqrt{2}^2$

$= 2\left(\frac{1}{2}\right) - 2 = \mathbf{-1}$

14. $\cot \frac{\pi}{6} + \sin -\frac{\pi}{3} = \frac{3}{\sqrt{3}} + \left(-\frac{\sqrt{3}}{2}\right)$

$= \sqrt{3} - \frac{\sqrt{3}}{2} = \mathbf{\frac{\sqrt{3}}{2}}$

15. $\sin \frac{\pi}{6} \cos -\frac{\pi}{3} = \frac{1}{2}\left(\frac{1}{2}\right) = \mathbf{\frac{1}{4}}$

16. $(\cot^2 x)(\sec^2 x)(\sin x)$

$= \frac{\cos^2 x}{\sin^2 x} \cdot \frac{1}{\cos^2 x} \cdot \sin x = \frac{1}{\sin x} = \mathbf{\csc x}$

17. $\frac{(\cot \theta)(\sec \theta)}{(\csc \theta)} = \frac{\frac{\cos \theta}{\sin \theta}\left(\frac{1}{\cos \theta}\right)}{\csc \theta} = \frac{\csc \theta}{\csc \theta} = \mathbf{1}$

18. Converse: If I live in Oklahoma, then I live in Norman.

Inverse: If I do not live in Norman, then I do not live in Oklahoma.

19. The product of the slopes of perpendicular lines is always -1 because perpendicular slopes are opposite reciprocals. Therefore $mn = \mathbf{-1}$.

20. $\sqrt{s} - \sqrt{s-8} = 2$

$\sqrt{s-8} = \sqrt{s} - 2$

$s - 8 = s - 4\sqrt{s} + 4$

$4\sqrt{s} = 12$

$s = \mathbf{9}$

21. $\sum_{i=-1}^{1} 3^i = \frac{1}{3} + 1 + 3 = \mathbf{\frac{13}{3}}$

22. $\frac{\sqrt{3} - \sqrt{2}}{\sqrt{3} + \sqrt{2}} = \left(\frac{\sqrt{3} - \sqrt{2}}{\sqrt{3} + \sqrt{2}}\right)\left(\frac{\sqrt{3} - \sqrt{2}}{\sqrt{3} - \sqrt{2}}\right)$

$= \frac{3 - 2\sqrt{6} + 2}{3 - 2} = \mathbf{5 - 2\sqrt{6}}$

23. $V = \pi r^2 h$

$9\pi = \pi r^2(1)$

$r = 3 \text{ cm}$

$SA = (\text{Perimeter}_{\text{Base}})h + 2\text{Area}_{\text{Base}}$

$= 2\pi rh + 2\pi r^2$

$= 2\pi(3)(1) + 2\pi(9)$

$= 6\pi + 18\pi$

$= \mathbf{24\pi \text{ cm}^2}$

24. The sum of the lengths of any two sides of any triangle must be greater than the length of the third side of the triangle.

Quantity A is greater: **A**

25. $2(5x - 10) = x^2 - 20$

$10x - 20 = x^2 - 20$

$x^2 - 10x = 0$

$x(x - 10) = 0$

$x = 0, 10$

If $x = 0$ then both the angle and the arc have negative measures, therefore the only acceptable answer is $x = \mathbf{10}$.

PROBLEM SET 7

1. $A = \dfrac{kE}{T}$

$5 = \dfrac{k(20)}{8}$

$k = 2$

$A = \dfrac{2(12)}{6} = \mathbf{4}$

2. $W = mF + b$

$170 = 10m + b$

$170 - 95 = (10m + b) - (5m + b)$

$75 = 5m$

$m = 15$

$b = 20$

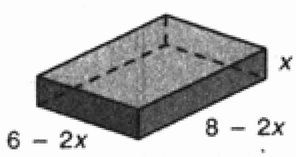
$W = 15F + 20$

$50 = 15F + 20$

$30 = 15F$

$F = \mathbf{2}$

3.



$V = lwh$

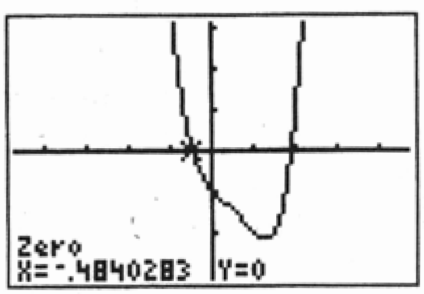
$V = (8 - 2x)(6 - 2x)x$

$V = (48 - 16x - 12x + 4x^2)x$

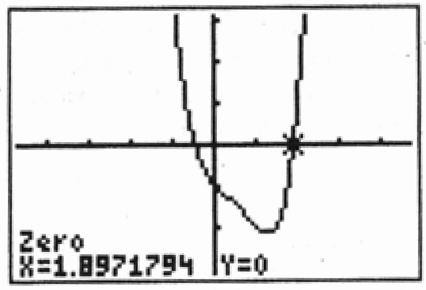
$V = (4x^2 - 28x + 48)x$

$\mathbf{V = 4x^3 - 28x^2 + 48x}$

4. This problem is equivalent to finding the zeros of the given quartic equation.



$x \approx \mathbf{-0.4840283}$

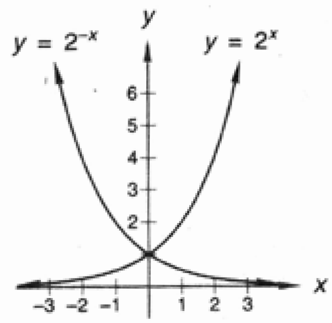


$x \approx \mathbf{1.8971794}$

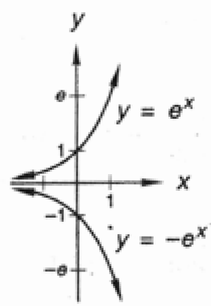
5. $P_1 = \left(\cos\dfrac{\pi}{6}, \sin\dfrac{\pi}{6}\right) = \left(\mathbf{\dfrac{\sqrt{3}}{2}, \dfrac{1}{2}}\right)$

$P_2 = \left(\cos -\dfrac{2\pi}{3}, \sin -\dfrac{2\pi}{3}\right) = \left(\mathbf{-\dfrac{1}{2}, -\dfrac{\sqrt{3}}{2}}\right)$

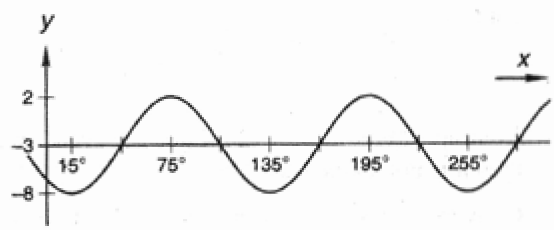
6.



7.



8.



9. Centerline: 2 Phase: $-\dfrac{\pi}{2}$ or $\dfrac{\pi}{2}$

Amplitude: 3 Period: 2π

$\mathbf{y = 2 + 3\cos\left(x + \dfrac{\pi}{2}\right)}$ or

$\mathbf{y = 2 - 3\cos\left(x - \dfrac{\pi}{2}\right)}$

10. **False.** This is not contrary to the definition of a function. Different x-values can be mapped to the same y-value as long as the same x-value is not mapped to two different y-values.

11.
$$f(x) = x^2 - x$$
$$f(x + h) = (x + h)^2 - (x + h)$$
$$f(x + h) = \mathbf{x^2 + 2hx + h^2 - x - h}$$

12. **Domain:** $\mathbb{R}$

Range: $\{y \in \mathbb{R} \mid -1 \le y \le 1\}$

13. $\sin^2 -\frac{\pi}{4} \cos^2 \frac{3\pi}{4} = \left(-\frac{\sqrt{2}}{2}\right)^2\left(-\frac{\sqrt{2}}{2}\right)^2$

$= \left(\frac{1}{2}\right)\left(\frac{1}{2}\right) = \mathbf{\frac{1}{4}}$

14. $\tan -\frac{2\pi}{3} + 2 \sin \frac{\pi}{3} = \sqrt{3} + 2\left(\frac{\sqrt{3}}{2}\right)$

$= \sqrt{3} + \sqrt{3} = \mathbf{2\sqrt{3}}$

15. $\frac{\cos\theta \sin\theta}{\tan\theta} = \frac{\cos\theta\sin\theta}{\frac{\sin\theta}{\cos\theta}}$

$= \frac{\cos\theta\sin\theta\cos\theta}{\sin\theta} = \mathbf{\cos^2\theta}$

16. $(\cot\theta)(\sin\theta) - \cos\theta = \frac{\cos\theta}{\sin\theta}(\sin\theta) - \cos\theta$

$= \cos\theta - \cos\theta = \mathbf{0}$

17. Tangent is positive in **quadrants I and III.**

18. $\cot\theta = \frac{1}{\tan\theta} = \frac{1}{\frac{7}{3}} = \mathbf{\frac{3}{7}}$

19. Contrapositive: If $n + 2$ is not an even number, then n is not an odd number.

Converse: If $n + 2$ is an even number, then n is an odd number.

Inverse: If n is not an odd number, then $n + 2$ is not an even number.

20.
$$x^2 + y^2 = 9$$
$$1 + y^2 = 9$$
$$y^2 = 8$$
$$y = \mathbf{\pm 2\sqrt{2}}$$

21. $\frac{\frac{1}{x+h} - \frac{1}{x}}{h} = \frac{\frac{x}{x(x+h)} - \frac{x+h}{x(x+h)}}{h}$

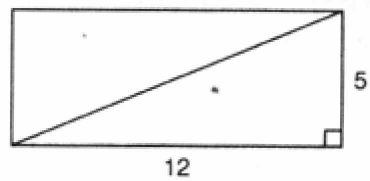
$= \frac{\frac{-h}{x(x+h)}}{h} = \mathbf{-\frac{1}{x(x+h)}}$

22. Both e and π are irrational, so they cannot be represented as a ratio of whole numbers.

Choice **B** is correct.

23. **No.** The input value of 1 is mapped to two different output values.

24.



$d^2 = 12^2 + 5^2$

$d = \mathbf{13}$

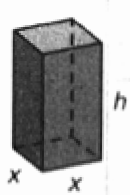
25. The sum of the measures of any two angles of any triangle is equal to the exterior angle of the triangle's third angle.

The quantities are equal: **C**

Problem Set 8

1.
$$D = mx + b$$
$$5 = 0m + b$$
$$b = 5$$
$$17 = 10m + 5$$
$$12 = 10m$$
$$m = \frac{6}{5}$$
$$D = \frac{6}{5}(4) + 5 = \frac{24}{5} + 5 = \mathbf{\frac{49}{5}}$$

2.



$$A = 4xh + 2x^2$$
$$500 = 4xh + 2x^2$$
$$500 - 2x^2 = 4xh$$
$$\frac{500 - 2x^2}{4x} = h$$
$$125x^{-1} - \frac{1}{2}x = h$$

$$V = x^2h$$

$$V = x^2\left(125x^{-1} - \frac{1}{2}x\right)$$

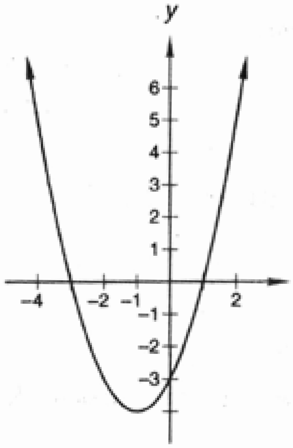
$$\mathbf{V = 125x - \frac{1}{2}x^3}$$

3. (a) $y = x^2 + 2x - 3$

$y = (x^2 + 2x + 1) - 3 - 1$

$\mathbf{y = (x + 1)^2 - 4}$

(b)

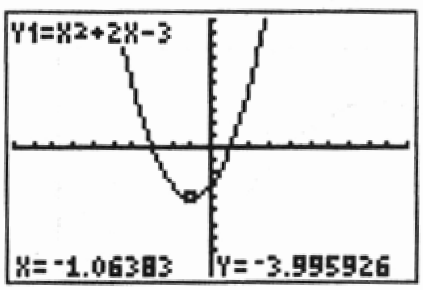


(c) The parabola opens **upward.**

(d) $\mathbf{x = -1}$

(e) **(–1, –4)**

4.



(–1.0638, –3.9959) in ZStandard
Answers may vary.

5. (a) $\sin^2\theta + \cos^2\theta = 1$

$$\frac{\sin^2\theta}{\sin^2\theta} + \frac{\cos^2\theta}{\sin^2\theta} = \frac{1}{\sin^2\theta}$$

$$\mathbf{1 + \cot^2\theta = \csc^2\theta}$$

(b) $\sin^2\theta + \cos^2\theta = 1$

$$\frac{\sin^2\theta}{\cos^2\theta} + \frac{\cos^2\theta}{\cos^2\theta} = \frac{1}{\cos^2\theta}$$

$$\mathbf{\tan^2\theta + 1 = \sec^2\theta}$$

6. $\sin^2\frac{\pi}{7} + \cos^2\frac{\pi}{7} = \mathbf{1}$

7. $\sec^2\frac{5\pi}{4} + 2\tan -\frac{\pi}{4} = \sqrt{2}^2 + 2(-1)$

$= 2 - 2 = \mathbf{0}$

8. $\sin -\theta = -\sin\theta = \mathbf{\frac{4}{5}}$

9. $\cos\left(\frac{\pi}{2} - \theta\right) = \sin\theta = \mathbf{-\frac{4}{5}}$

10. $\sec\left(\frac{\pi}{2} - \theta\right) = \csc\theta = \frac{1}{\sin\theta} = \mathbf{-\frac{5}{4}}$

11. $\frac{\sin^2 x + 2 + \cos^2 x}{3\csc^2 -x} = \frac{\sin^2 x + \cos^2 x + 2}{3(-\csc x)^2}$

$= \frac{1 + 2}{3\csc^2 x} = \frac{1}{\csc^2 x} = \sin^2 x$

12. $\left[\sec\left(\frac{\pi}{2} - x\right)\right](\sin -x) = \csc x\,(-\sin x)$

$= \frac{-\sin x}{\sin x} = -1$

13. $(\sin x)\left[\cos\left(\frac{\pi}{2} - x\right)\right] + (\cos -x)(\cos x)$

$= (\sin x)(\sin x) + (\cos x)(\cos x)$

$= \sin^2 x + \cos^2 x = 1$

14. $x^2 - 3x + 2 = 0$

$(x - 2)(x - 1) = 0$

$\mathbf{x = 2, 1}$

15. $\frac{3}{x} = \frac{7}{x + L}$

$7x = 3x + 3L$

$4x = 3L$

$\mathbf{x = \frac{3}{4}L}$

16. $\frac{a}{h} = \frac{4}{x + h}$

$4h = ax + ah$

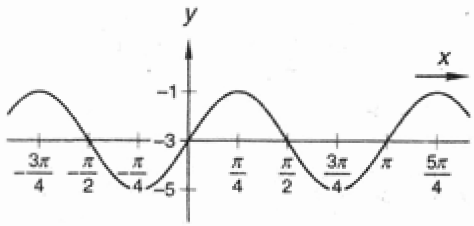
$4h - ah = ax$

$h(4 - a) = ax$

$\mathbf{h = \frac{ax}{4 - a}}$

17. $\left(\cos -\frac{\pi}{3}, \sin -\frac{\pi}{3}\right) = \left(\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$

18.



19. Centerline: −1 Period: 2π

Amplitude: 11 Phase: $\frac{\pi}{2}$ or $-\frac{\pi}{2}$

$y = \mathbf{1 + 11 \sin}\left(\theta - \frac{\pi}{2}\right)$ or

$y = \mathbf{1 - 11 \sin}\left(\theta + \frac{\pi}{2}\right)$

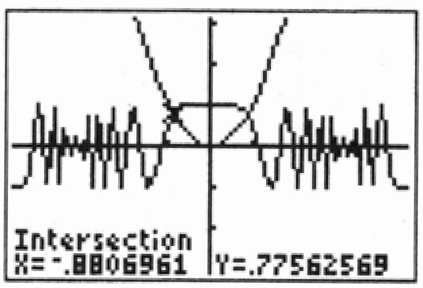
20. In both B and D each x-value is mapped to exactly one y-value.

Choices **B** and **D** are correct.

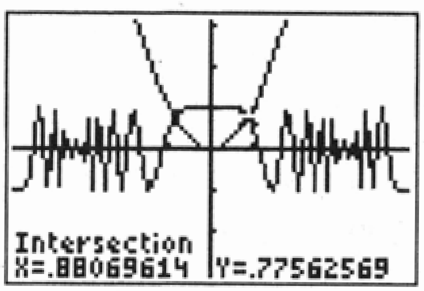
21. $\frac{(x + h)^2 - x^2}{h} = \frac{x^2 + 2hx + h^2 - x^2}{h}$

$= \frac{2hx + h^2}{h} = \frac{h(2x + h)}{h} = \mathbf{2x + h}$

22. Let `Y1=cos(X³)` and `Y2=X²`.



(−0.8806961, 0.77562569)



(0.88069614, 0.77562569)

23. $f(x) = 2(x + 3)(x + 2)$

$f(x) = 2(x^2 + 5x + 6)$

$\mathbf{f(x) = 2x^2 + 10x + 12}$

24. If $y > 0$, then $x > z$. If $y < 0$, then $x < z$.

Insufficient information: **D**

25. If $a + b = 10$, then $a^2 + 2ab + b^2 = 100$. Substituting $ab = 5$ gives $a^2 + 10 + b^2 = 100$ or $\mathbf{a^2 + b^2 = 90.}$

Problem Set 9

1. Originally, each well produces $\frac{10{,}000}{20} = 500$ barrels per day.

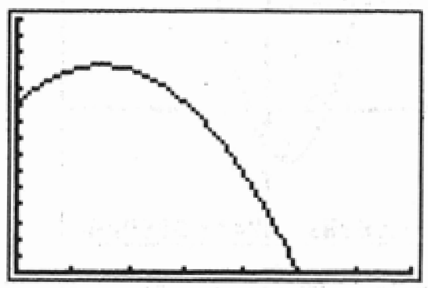
$20 + x =$ total number of wells

$500 - 10x =$ each well's production

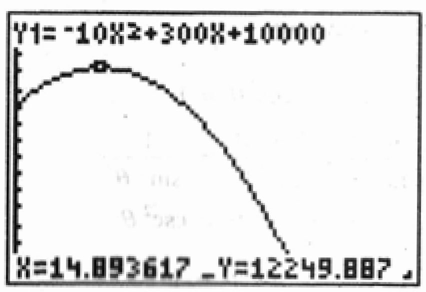
$V = (20 + x)(500 - 10x)$

$\mathbf{V = 10{,}000 + 300x - 10x^2}$

2. (a) Set `Xmin=0`, `Xmax=70`, `Xscl=10`, `Ymin=0`, `Ymax=15000`, `Yscl=1000`, and `Xres=1`.

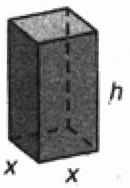


(b)



(c) **15 additional wells**

(d) **12,250 barrels of oil per day**

3. 

$$V = x^2h$$
$$125 = x^2h$$
$$h = \frac{125}{x^2}$$
$$h = 125x^{-2}$$

$$A = x^2 + x^2 + 4xh$$
$$C = 5x^2 + 2x^2 + 2(4xh)$$
$$C = 7x^2 + 8xh$$
$$C = 7x^2 + 8x(125x^{-2})$$
$$\mathbf{C = 7x^2 + 1000x^{-1}}$$

4. $y = x^2 - 3x + 4$

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

Vertex: $\left(\frac{3}{2}, \frac{7}{4}\right)$

Axis of symmetry: $x = \frac{3}{2}$

5. $x_m = \frac{-5 + 0}{2} = -2.5$ $\qquad y_m = \frac{-8 + 4}{2} = -2$

(−2.5, −2)

6. (a) $7.3 = 10^L$

$$L = \log 7.3 \approx 0.8633$$
$$7.3 = 10^{\log 7.3} \approx \mathbf{10^{0.8633}}$$

(b) $7.3 = e^L$

$$L = \ln 7.3 \approx 1.9879$$
$$7.3 = e^{\ln 7.3} \approx \mathbf{e^{1.9879}}$$

7. If $3^y = 4$, then $\log_3 4 = y$.

Choice **B** is correct.

8. $\dfrac{y^3 y^{3/4 - 2} z^2}{y^{(3-2)/3} z^{(3-2)/6}} = y^{3 + 3/4 - 2 - 1/3} z^{2 - 1/6}$

$= \mathbf{y^{17/12} z^{11/6}}$

9. (a) If $10^x = 3$, then $x =$ **log 3 ≈ 0.4771.**

(b) If $e^x = 5$, then $x =$ **ln 5 ≈ 1.6094.**

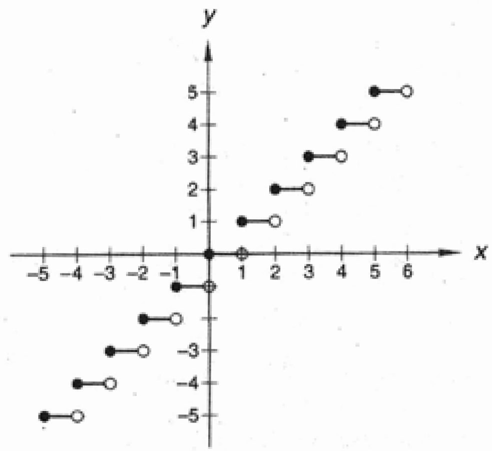
10. $\log_3 27 = 2b + 1$

$$3^{2b+1} = 27$$
$$3^{2b+1} = 3^3$$
$$2b + 1 = 3$$
$$2b = 2$$
$$b = \mathbf{1}$$

11. $\log_x (3x - 2) = 2$

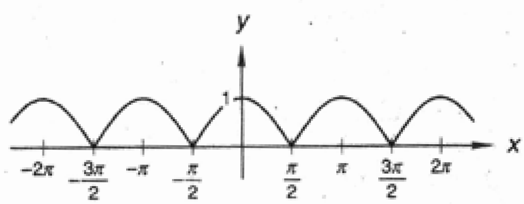
$$x^2 = 3x - 2$$
$$x^2 - 3x + 2 = 0$$
$$(x - 2)(x - 1) = 0$$
$$x = \mathbf{2, 1}$$

12. (a)

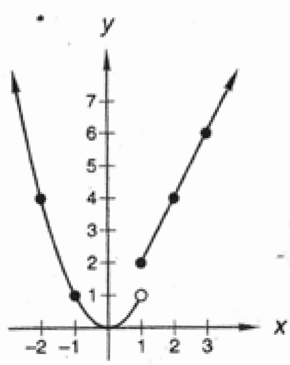


(b) **f(1.2) = 1; f(−1.2) = −2**

13.



14.



15. "x is less than 0.001 away from 3."

$\{x \in \mathbb{R} \mid \mathbf{2.999 < x < 3.001}\}$

16. $f(x) = \begin{cases} -2 & \text{when } x < 0 \\ x - 1 & \text{when } 0 \le x \le 3 \\ 1 & \text{when } x > 3 \end{cases}$

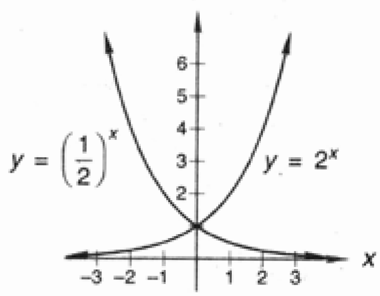
17. Centerline: -5 Period: 3π $C = \frac{2}{3}$

Amplitude: 4 Phase: $-\frac{5\pi}{4}, \frac{\pi}{4}$

$$y = -5 + 4\sin\left[\frac{2}{3}\left(x + \frac{5\pi}{4}\right)\right] \text{ or}$$

$$y = -5 - 4\sin\left[\frac{2}{3}\left(x - \frac{\pi}{4}\right)\right]$$

18.



19. $(\tan -x)\left[\sec^2\left(\frac{\pi}{2} - x\right)\right](\sin -x)$

$= -\tan x \csc^2 x (-\sin x)$

$= \frac{\sin x}{\cos x} \cdot \frac{1}{\sin^2 x} \cdot \sin x$

$= \frac{1}{\cos x} = \mathbf{\sec x}$

20. $\frac{6}{L} = \frac{15}{x + L}$

$15L = 6x + 6L$

$9L = 6x$

$\mathbf{L = \frac{2}{3}x}$

21. $y_1 = \sin\frac{\pi}{6} = \mathbf{\frac{1}{2}}$

$y_2 = \sin 210° = \mathbf{-\frac{1}{2}}$

$y_3 = \sin\left(-\frac{\pi}{3}\right) = \mathbf{-\frac{\sqrt{3}}{2}}$

22. The mapping of f **is not a function.** Each value of x is mapped to two different values: the positive and negative square root of x.

23. $f(x + h) - f(x) = (x + h)^2 - x^2$

$= x^2 + 2hx + h^2 - x^2$

$= \mathbf{2hx + h^2}$

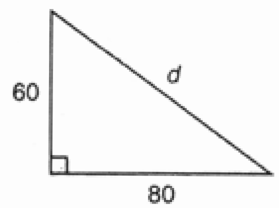
24. $\frac{\sum_{i=1}^{10} i}{10} = \frac{55}{10} = \mathbf{5.5}$

25. This is a geometric representation of the Pythagorean Theorem; the sum of the squares of the lengths of the legs of a right triangle is equal to the square of the length of the hypotenuse of the triangle.

The quantities are equal: **C**

PROBLEM SET 10

1.

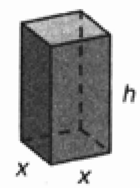


$d^2 = 60^2 + 80^2$

$d^2 = 10{,}000$

$d = \mathbf{100\ miles}$

2. (a)



$V = x^2h$

$100 = x^2h$

$h = \frac{100}{x^2}$

$h = 100x^{-2}$

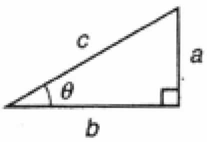
$A = 2x^2 + 4xh$

$A = 2x^2 + 4x(100x^{-2})$

$\mathbf{A = 2x^2 + 400x^{-1}}$

(b) x must be greater than zero because it is the length of a side.

$\mathbf{\{x \in \mathbb{R} \mid x > 0\}}$

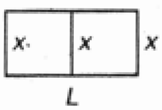
3. 

$$\sin^2\theta + \cos^2\theta = \left(\frac{a}{c}\right)^2 + \left(\frac{b}{c}\right)^2$$
$$= \frac{a^2 + b^2}{c^2} = \frac{c^2}{c^2} = 1$$

Therefore, $\mathbf{\sin^2\theta + \cos^2\theta = 1.}$

$$\sin^2\theta + \cos^2\theta = 1$$
$$\frac{\sin^2\theta}{\sin^2\theta} + \frac{\cos^2\theta}{\sin^2\theta} = \frac{1}{\sin^2\theta}$$
$$\mathbf{1 + \cot^2\theta = \csc^2\theta}$$

$$\sin^2\theta + \cos^2\theta = 1$$
$$\frac{\sin^2\theta}{\cos^2\theta} + \frac{\cos^2\theta}{\cos^2\theta} = \frac{1}{\cos^2\theta}$$
$$\mathbf{\tan^2\theta + 1 = \sec^2\theta}$$

4. 

$$F = 3x + 2L$$
$$100 = 3x + 2L$$
$$100 - 3x = 2L$$
$$L = 50 - \frac{3}{2}x$$

$$A = xL$$
$$A = x\left(50 - \frac{3}{2}x\right)$$
$$\mathbf{A = 50x - \frac{3}{2}x^2}$$

5. According to the Remainder Theorem $f(1)$ is the value of the remainder when the polynomial is divided by $x - 1$.

$$f(x) = x^5 - 2x^4 + x^3 - x^2 + 3x + 1$$
$$f(1) = 1 - 2 + 1 - 1 + 3 + 1 = 3$$

The remainder is **3.**

6. (a)

−1	1	0	−2	2	1
	↓	−1	1	1	−3
	1	−1	−1	3	[−2]

$f(-1) = \mathbf{-2}$

(b)

1	1	0	−2	2	1
	↓	1	1	−1	1
	1	1	−1	1	[2]

$f(1) = \mathbf{2}$

(c)

3	1	0	−2	2	1
	↓	3	9	21	69
	1	3	7	23	[70]

$f(3) = \mathbf{70}$

7. Possible rational zeros:

$$\frac{\pm 1, \pm 2, \pm 4}{\pm 1} = \mathbf{\pm 1, \pm 2, \pm 4}$$

8.

1	1	−1	−4	4
	↓	1	0	−4
	1	0	−4	[0]

$$f(x) = (x - 1)(x^2 - 4)$$
$$= (x - 1)(x + 2)(x - 2)$$

Roots: **1, 2, −2**

9. Set `Y1=X^4-22X³+πX²-X+√(2)` and then use the `1:value` feature in the `CALCULATE` menu.

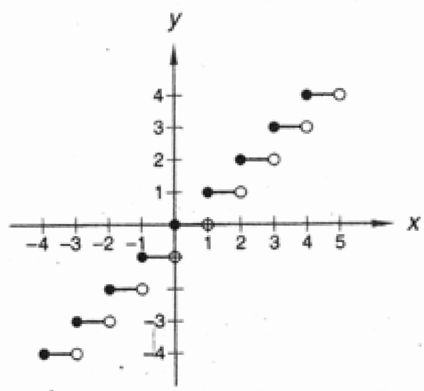
(a) If $x = \frac{1}{3}$, then $y \approx \mathbf{0.6275}$

(b) If $x = \sqrt{3}$, then $y \approx \mathbf{-96.2084}$

(c) If $x = \frac{\pi}{2}$, then $y \approx \mathbf{-71.5842}$

10. $47° \times \frac{\pi}{180°} \approx \mathbf{0.8203}$

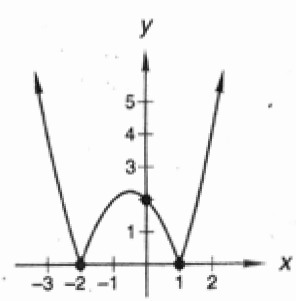
11. (a)



(b) $y = |x^2 + x - 2|$
$y = |(x + 2)(x - 1)|$

Zeros: −2, 1

y-intercept: $y = 2$



12. $2x + 1 = \log_{1/3} 9$

$$\left(\frac{1}{3}\right)^{2x+1} = 9$$

$$(3^{-1})^{2x+1} = 3^2$$

$$3^{-2x-1} = 3^2$$

$$-2x - 1 = 2$$

$$-2x = 3$$

$$x = \mathbf{-\frac{3}{2}}$$

13. $\ln b^3 = 2$

$$b^3 = e^2$$

$$(b^3)^{1/3} = (e^2)^{1/3}$$

$$b = \mathbf{e^{2/3} \approx 1.9477}$$

14. (a) $10^x = 4$

$$\log 10^x = \log 4$$

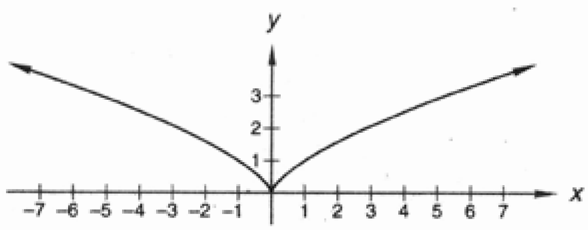
$$x = \mathbf{\log 4 \approx 0.6021}$$

(b) $e^x = 4$

$$\ln e^x = \ln 4$$

$$x = \mathbf{\ln 4 \approx 1.3863}$$

15.



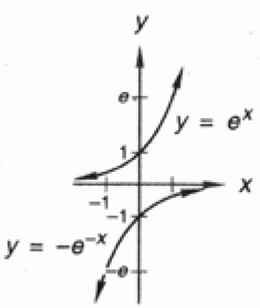
16. Centerline: 5 Period: π

Amplitude: 4 Phase: $\frac{3\pi}{8}, -\frac{\pi}{8}$

$$\mathbf{y = 5 + 4\sin\left[2\left(x - \frac{3\pi}{8}\right)\right]} \text{ or}$$

$$\mathbf{y = 5 - 4\sin\left[2\left(x + \frac{\pi}{8}\right)\right]}$$

17.



18. $|2x - 3| < 4$

$$\left|2\left(x - \frac{3}{2}\right)\right| < 4$$

$$2\left|x - \frac{3}{2}\right| < 4$$

$$\left|x - \frac{3}{2}\right| < 2$$

"x is less than 2 away from $\frac{3}{2}$."

19. $\mathbf{\sec\alpha = \frac{\sqrt{a^2 + b^2}}{b}}$

20. $\frac{\sin^2 -\theta + \cos^2 -\theta + 2}{3\tan -\theta} = \frac{1 + 2}{3\tan -\theta}$

$$= \frac{1}{\tan -\theta} = \frac{1}{-\tan\theta} = \mathbf{-\cot\theta}$$

21. $\sin x - \sin x \cos^2 x = \sin x\,(1 - \cos^2 x)$

$$= \sin x\,(\sin^2 x) = \mathbf{\sin^3 x}$$

22. $f(x) = c(x - 2)(x + 3)$

$$6 = c(3 - 2)(3 + 3)$$

$$6 = 6c$$

$$c = 1$$

$$f(x) = (x - 2)(x + 3)$$

$$\mathbf{f(x) = x^2 + x - 6}$$

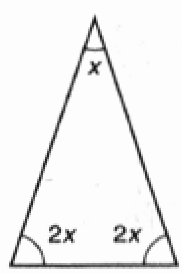
23. $\frac{f(x + \Delta x) - f(x)}{\Delta x} = \frac{(x + \Delta x)^2 - x^2}{\Delta x}$

$$= \frac{x^2 + 2x(\Delta x) + (\Delta x)^2 - x^2}{\Delta x}$$

$$= \frac{2x(\Delta x) + (\Delta x)^2}{\Delta x} = \frac{\Delta x(2x + \Delta x)}{\Delta x}$$

$$= \mathbf{2x + \Delta x}$$

24.



$$2x + 2x + x = 180°$$

$$5x = 180°$$

$$x = \mathbf{36°}$$

25. $4x + 60 = (5x - 40) + 3x$

$$4x + 60 = 8x - 40$$

$$100 = 4x$$

$$x = \mathbf{25}$$

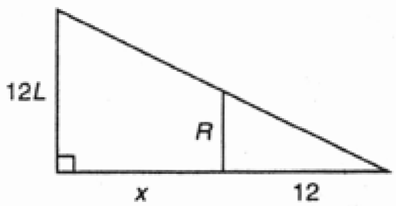
PROBLEM SET 11

1. $S = \dfrac{k}{X^2}$

$8 = \dfrac{k}{5^2}$

$k = 200$

$S = \dfrac{200}{X^2} = \dfrac{200}{2^2} = \mathbf{50}$

2. 

$\dfrac{R}{12} = \dfrac{12L}{x + 12}$

$144L = Rx + 12R$

$Rx = 144L - 12R$

$x = \dfrac{144L - 12R}{R}$

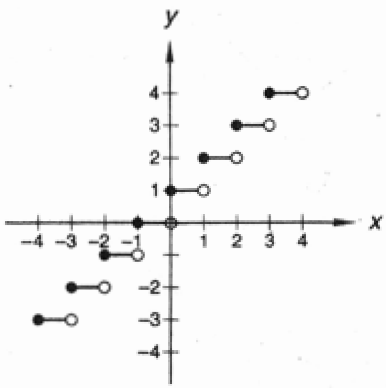
$x = 144LR^{-1} - 12$

Shadow $= x + 12 = (144LR^{-1} - 12) + 12$

$= \mathbf{144LR^{-1}}$ **in.**

3. (a) $\lim_{x \to 0^+} f(x) = \mathbf{2}$ (b) $\lim_{x \to 0^-} f(x) = \mathbf{1}$

(c) $\lim_{x \to -1^-} f(x) = \mathbf{-1}$ (d) $\lim_{x \to -1^+} f(x) = \mathbf{0}$

4. 

(a) $\lim_{x \to 1^+} g(x) = \mathbf{2}$ (b) $\lim_{x \to 1^-} g(x) = \mathbf{1}$

5. (a)

-1	2	-4	3	-2	1	-1
	↓	-2	6	-9	11	-12
	2	-6	9	-11	12	$\boxed{-13}$

$f(-1) = \mathbf{-13}$

(b)

2	2	-4	3	-2	1	-1
	↓	4	0	6	8	18
	2	0	3	4	9	$\boxed{17}$

$f(2) = \mathbf{17}$

(c)

-2	2	-4	3	-2	1	-1
	↓	-4	16	-38	80	-162
	2	-8	19	-40	81	$\boxed{-163}$

$f(-2) = \mathbf{-163}$

6. (a) Possible rational roots: $\dfrac{\pm 1, \pm 3}{\pm 1, \pm 2, \pm 3, \pm 6}$

$= \mathbf{\pm 1, \pm\frac{1}{2}, \pm\frac{1}{3}, \pm\frac{1}{6}, \pm 3, \pm\frac{3}{2}}$

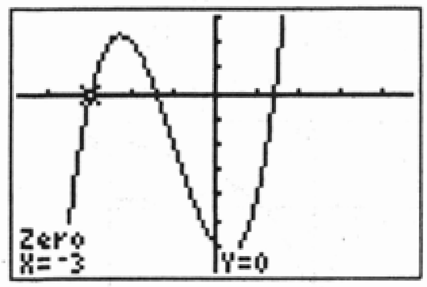
(b)

3	6	-19	2	3
	↓	18	-3	-3
	6	-1	-1	$\boxed{0}$

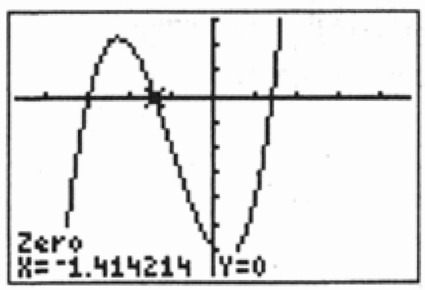
$h(x) = (x - 3)(6x^2 - x - 1)$

$= (x - 3)(3x + 1)(2x - 1)$

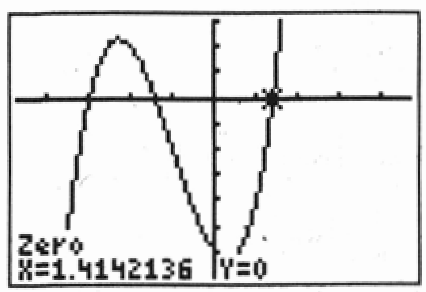
Rational zeros: $\mathbf{3, -\frac{1}{3}, \frac{1}{2}}$

7. 

$x = \mathbf{-3}$



$x \approx \mathbf{-1.414214}$



$x \approx \mathbf{1.4142136}$

8. $1 = \log_x (2x - 7)$

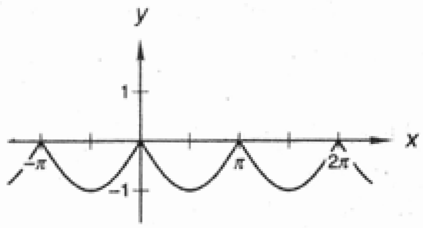
$x^1 = 2x - 7$

$x = \mathbf{7}$

9. $e^x = 10$

$x = \mathbf{\ln 10 \approx 2.3025}$

10.



11. $r^2 = (-2 - 1)^2 + (6 - 2)^2$

$r^2 = (-3)^2 + 4^2$

$r^2 = 9 + 16$

$r^2 = 25$

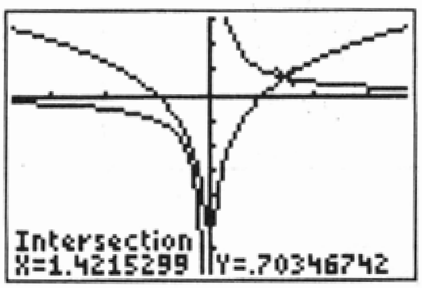
$r = 5$

$\mathbf{5^2 = (x - 1)^2 + (y - 2)^2}$

12. If $y = x^2$ and $|x| < 2$, then $0 \le y < 4$.

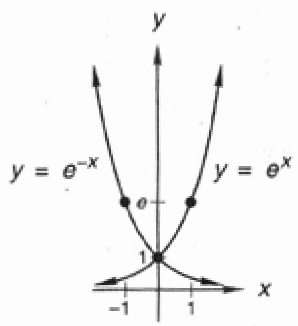
Range: $\{y \in \mathbb{R} \mid 0 \le y < 4\}$

13. Let Y1=1/X and Y2=ln(X²).



(1.4215299, 0.70346742)

14.



15. $-(\sin -x)(\sec x)\left[\cot\left(\frac{\pi}{2} - x\right)\right] + 1$

$= \sin x \left(\frac{1}{\cos x}\right) \tan x + 1$

$= \left(\frac{\sin x}{\cos x}\right) \tan x + 1 = \tan^2 x + 1 = \sec^2 x$

16. $\frac{\sin x - \sin x \cos^2 x}{\sec^2 x - 1} = \frac{\sin x (1 - \cos^2 x)}{\tan^2 x}$

$= \frac{\sin x \sin^2 x}{\tan^2 x} = \frac{\sin^3 x \cos^2 x}{\sin^2 x}$

$= \mathbf{\sin x \cos^2 x}$

17. $y = x^2 - 2x + 4$

$y = (x^2 - 2x + 1) + 4 - 1$

$y = (x - 1)^2 + 3$

Vertex: **(1, 3)**

18. $\frac{6}{L} = \frac{H}{L + x}$

$6L + 6x = HL$

$HL - 6L = 6x$

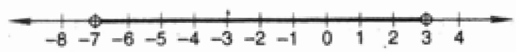
$L(H - 6) = 6x$

$\mathbf{L = \frac{6x}{H - 6}}$

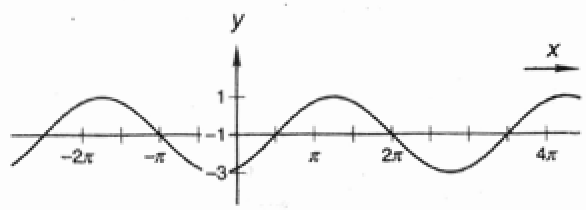
19. $|3x + 6| < 15$

$|x + 2| < 5$

"x is less than 5 away from −2."



20. Period $= \frac{2\pi}{\frac{2}{3}} = 3\pi$



21. $f(x) = c(x + 1)(x - 2)$

$f(0) = -4 = c(1)(-2)$

$-4 = -2c$

$c = 2$

$f(x) = 2(x + 1)(x - 2)$

$\mathbf{f(x) = 2x^2 - 2x - 4}$

22. $x^2 - 1 \ge 0$

$x^2 \ge 1$

$|x| \ge 1$

Domain: $\{x \in \mathbb{R} \mid |x| \ge 1\}$

Range: $\{y \in \mathbb{R} \mid y \ge 0\}$

23. $$\frac{f(x+\Delta x)-f(x)}{\Delta x} = \frac{\dfrac{1}{x+\Delta x}-\dfrac{1}{x}}{\Delta x}$$

$$= \frac{\dfrac{x-(x+\Delta x)}{x(x+\Delta x)}}{\Delta x} = \frac{\dfrac{-\Delta x}{x(x+\Delta x)}}{\Delta x}$$

$$= \mathbf{\frac{-1}{x(x+\Delta x)}}$$

24. $$s = \frac{1}{2}(5+6+7) = \frac{1}{2}(18) = 9$$

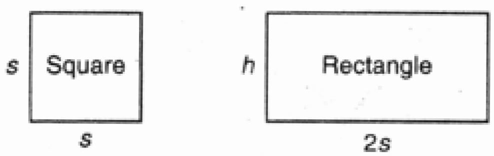
$$A = \sqrt{9(9-5)(9-6)(9-7)}$$
$$= \sqrt{216} = \mathbf{6\sqrt{6}\ units^2} \approx \mathbf{14.6969\ units^2}$$

25. The sum of the lengths of any two sides of any triangle must be greater than the length of the third side of the triangle.

Quantity B is greater: **B**

PROBLEM SET 12

1. Let s = side of square and h = height of rectangle.



Area:

$$8s^2 = 2sh$$
$$8s^2 = 2s(8)$$
$$s^2 = 2s$$
$$s^2 - 2s = 0$$
$$s(s-2) = 0$$
$$s = 0, 2$$

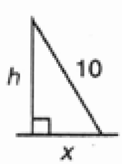
Perimeter:

$$4s + 16 = 2(2s + h)$$
$$2s + 8 = 2s + h$$
$$h = 8$$

Square: 2 × 2

Rectangle: 4 × 8

2.



$$10^2 = h^2 + x^2$$
$$h^2 = 100 - x^2$$
$$\mathbf{h = \sqrt{100 - x^2}\ feet}$$

3. For the key trigonometric identities, see section 12.A in the textbook.

$$\sin(A+B) = \sin A\cos B + \cos A\sin B$$
$$\sin(A+A) = \sin A\cos A + \cos A\sin A$$
$$\mathbf{\sin(2A) = 2\sin A\cos A}$$

$$\cos(A+B) = \cos A\cos B - \sin A\sin B$$
$$\cos(A+A) = \cos A\cos A - \sin A\sin A$$
$$\mathbf{\cos(2A) = \cos^2 A - \sin^2 A}$$

$$\cos(2A) = \cos^2 A - (1-\cos^2 A)$$
$$\mathbf{\cos(2A) = 2\cos^2 A - 1}$$

$$\cos(2A) = (1-\sin^2 A) - \sin^2 A$$
$$\mathbf{\cos(2A) = 1 - 2\sin^2 A}$$

4. $$\cos\alpha = \frac{1}{5}$$

$$\cos(2\alpha) = 2\cos^2\alpha - 1 = 2\left(\frac{1}{5}\right)^2 - 1$$

$$= \frac{2}{25} - 1 = \mathbf{-\frac{23}{25}}$$

5. (a) $$\tan(A+B) = \frac{\sin(A+B)}{\cos(A+B)}$$

$$\tan(A+B) = \frac{\sin A\cos B + \cos A\sin B}{\cos A\cos B - \sin A\sin B}$$

$$\tan(A+B) = \frac{\dfrac{\sin A\cos B}{\cos A\cos B} + \dfrac{\cos A\sin B}{\cos A\cos B}}{\dfrac{\cos A\cos B}{\cos A\cos B} - \dfrac{\sin A\sin B}{\cos A\cos B}}$$

$$\mathbf{\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A\tan B}}$$

(b) $$\tan(A-B) = \frac{\sin(A-B)}{\cos(A-B)}$$

$$\tan(A-B) = \frac{\sin A\cos B - \cos A\sin B}{\cos A\cos B + \sin A\sin B}$$

$$\tan(A-B) = \frac{\dfrac{\sin A\cos B}{\cos A\cos B} - \dfrac{\cos A\sin B}{\cos A\cos B}}{\dfrac{\cos A\cos B}{\cos A\cos B} + \dfrac{\sin A\sin B}{\cos A\cos B}}$$

$$\mathbf{\tan(A-B) = \frac{\tan A - \tan B}{1 + \tan A\tan B}}$$

6. $\tan 75° = \tan(45° + 30°)$

$$= \frac{\tan 45° + \tan 30°}{1 - \tan 45° \tan 30°}$$

$$= \frac{1 + \frac{\sqrt{3}}{3}}{1 - 1\left(\frac{\sqrt{3}}{3}\right)} = \frac{\frac{3 + \sqrt{3}}{3}}{\frac{3 - \sqrt{3}}{3}}$$

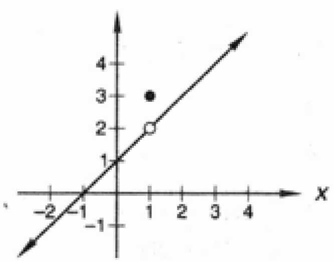
$$= \frac{3 + \sqrt{3}}{3 - \sqrt{3}} = \frac{3 + \sqrt{3}}{3 - \sqrt{3}}\left(\frac{3 + \sqrt{3}}{3 + \sqrt{3}}\right)$$

$$= \frac{9 + 6\sqrt{3} + 3}{9 - 3} = \frac{12 + 6\sqrt{3}}{6} = \mathbf{2 + \sqrt{3}}$$

7. $(\sin x + \cos x)^2 = \sin^2 x + 2 \sin x \cos x + \cos^2 x$

$= (\sin^2 x + \cos^2 x) + 2 \sin x \cos x = 1 + \sin(2x)$

8.



9. (a) $\lim_{x \to 1^+} f(x) = \mathbf{2}$

(b) $\lim_{x \to 1^-} f(x) = \mathbf{2}$

10. Possible rational roots:

$$\frac{\pm 1, \pm 2, \pm 4}{\pm 1, \pm 2} = \pm 1, \pm \frac{1}{2}, \pm 2, \pm 4$$

−1	2	−7	−5	4
	↓	−2	9	−4
	2	−9	4	0

$y = 2x^3 - 7x^2 - 5x + 4$

$= (x + 1)(2x^2 - 9x + 4)$

$= (x + 1)(2x - 1)(x - 4)$

Roots: $\mathbf{-1, \frac{1}{2}, 4}$

11. $\log_4(3x + 1) = \frac{1}{2}$

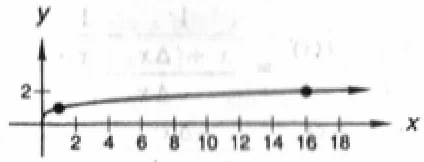
$3x + 1 = 4^{1/2}$

$3x + 1 = 2$

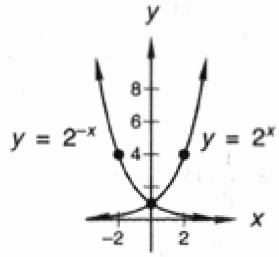
$3x = 1$

$x = \mathbf{\frac{1}{3}}$

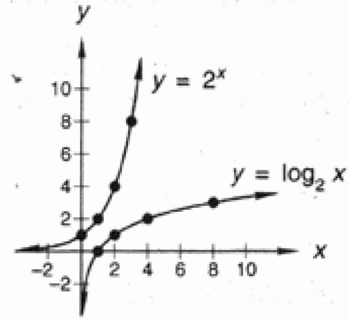
12.



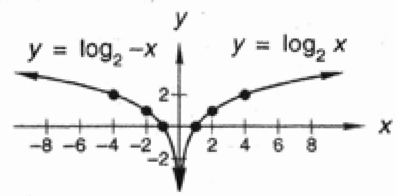
13.



14.



15.



16. $\left[\sin\left(\frac{\pi}{2} - x\right)\right](\csc -x)(\sin x)(\cos -x)$

$= \cos x(-\csc x) \sin x \cos x = \cos x(-1) \cos x$

$= \mathbf{-\cos^2 x}$ or $\mathbf{\sin^2 x - 1}$

17. $f(x) = c(x + 1)(x - 2)$

$f(0) = -2 = c(1)(-2)$

$-2 = -2c$

$c = 1$

$f(x) = (x + 1)(x - 2)$

$\mathbf{f(x) = x^2 - x - 2}$

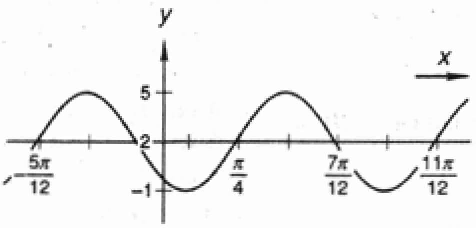
18. $\frac{y}{10 - x} = \frac{5}{10}$

$10y = 5(10 - x)$

$2y = 10 - x$

$\mathbf{y = 5 - \frac{1}{2}x}$

19. Period $= \dfrac{2\pi}{3}$



20. $\dfrac{f(x+h)-f(x)}{h} = \dfrac{2(x+h)^2 - 2x^2}{h}$

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

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

$= \mathbf{4x + 2h}$

21. (a) $\cos(2A) = 2\cos^2 A - 1$

$2\cos^2 A = 1 + \cos(2A)$

$\cos^2 A = \dfrac{1}{2} + \dfrac{1}{2}\cos(2A)$

Let $A = \dfrac{x}{2}$.

$\cos^2 \dfrac{x}{2} = \dfrac{1}{2} + \dfrac{1}{2}\cos x$

$\mathbf{\cos \dfrac{x}{2} = \pm\sqrt{\dfrac{1}{2} + \dfrac{1}{2}\cos x}}$

(b) $\cos(2A) = 1 - 2\sin^2 A$

$2\sin^2 A = 1 - \cos(2A)$

$\sin^2 A = \dfrac{1}{2} - \dfrac{1}{2}\cos(2A)$

Let $A = \dfrac{x}{2}$.

$\sin^2 \dfrac{x}{2} = \dfrac{1}{2} - \dfrac{1}{2}\cos x$

$\mathbf{\sin \dfrac{x}{2} = \pm\sqrt{\dfrac{1}{2} - \dfrac{1}{2}\cos x}}$

22. $1 - x \geq 0$

$1 \geq x$

$\{x \in \mathbb{R} \mid x \leq 1\}$

23. If the sides opposite two angles of a triangle do not have equal lengths, then the two angles do not have equal measures.

24. $\dfrac{1}{2}x = 75$

$\mathbf{x = 150°}$

$\dfrac{1}{2}z = 35$

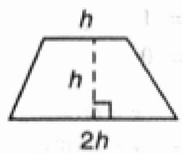
$\mathbf{z = 70°}$

$x + y + z = 360°$

$y = 360° - 150° - 70°$

$\mathbf{y = 140°}$

25.



$A = \left(\dfrac{B_1 + B_2}{2}\right)h$

$12 = \left(\dfrac{h + 2h}{2}\right)h$

$12 = \dfrac{3}{2}h^2$

$h^2 = 8$

$h = \mathbf{2\sqrt{2}\ units} \approx \mathbf{2.8284\ units}$

Problem Set 13

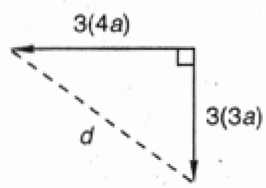
1. $\dfrac{S}{D^2 W} = \dfrac{S}{D^2 W}$

$\dfrac{40}{M^2 P} = \dfrac{S}{3^2 A}$

$S(M^2 P) = 40(9A)$

$S = \mathbf{\dfrac{360A}{M^2 P}}$

2.



$d^2 = [3(4a)]^2 + [3(3a)]^2$

$d^2 = 144a^2 + 81a^2$

$d^2 = 225a^2$

$d = \mathbf{15a\ miles}$

3. $\sin^{-1}\left(-\dfrac{\sqrt{2}}{2}\right) = \mathbf{-\dfrac{\pi}{4}}$

4. $\cos^{-1}\dfrac{\sqrt{3}}{2} = \mathbf{\dfrac{\pi}{6}}$

5. $\csc x = -2$

$$\sin x = -\frac{1}{2}$$

$$x = \mathbf{210°, 330°}$$

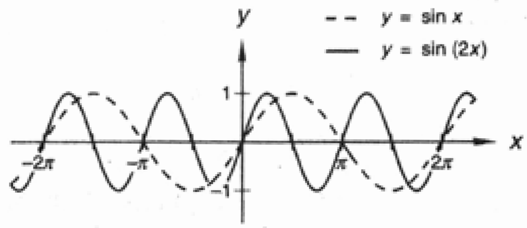
6. $\cos^2 x = 1$

$$\cos x = \pm 1$$

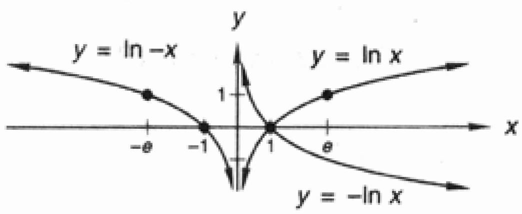
$$x = \mathbf{0, \pi}$$

7.
$$\sin^2 x + 2\cos x - 2 = 0$$
$$(1 - \cos^2 x) + 2\cos x - 2 = 0$$
$$\cos^2 x - 2\cos x + 1 = 0$$
$$(\cos x - 1)(\cos x - 1) = 0$$
$$\cos x = 1$$
$$x = \mathbf{0}$$

8.



9.



10.
$$\frac{\sin(x + \Delta x) - \sin x}{\Delta x}$$
$$= \frac{\sin x \cos \Delta x + \cos x \sin \Delta x - \sin x}{\Delta x}$$
$$= \frac{\sin x \cos \Delta x - \sin x}{\Delta x} + \frac{\cos x \sin \Delta x}{\Delta x}$$
$$= \frac{\sin x(\cos \Delta x - 1)}{\Delta x} + \frac{\cos x \sin \Delta x}{\Delta x}$$
$$= \sin x\left(\frac{\cos \Delta x - 1}{\Delta x}\right) + \cos x\left(\frac{\sin \Delta x}{\Delta x}\right)$$

11. For the key trigonometric identities, see section 12.A in the textbook.

$$\cos(A + B) = \cos A \cos B - \sin A \sin B$$
$$\cos(A + A) = \cos A \cos A - \sin A \sin A$$
$$\mathbf{\cos(2A) = \cos^2 A - \sin^2 A}$$

$$\cos(2A) = \cos^2 A - (1 - \cos^2 A)$$
$$\mathbf{\cos(2A) = 2\cos^2 A - 1}$$

$$\cos(2A) = (1 - \sin^2 A) - \sin^2 A$$
$$\mathbf{\cos(2A) = 1 - 2\sin^2 A}$$

12. (a)
$$\tan(A + B) = \frac{\sin(A + B)}{\cos(A + B)}$$
$$\tan(A + B) = \frac{\sin A \cos B + \cos A \sin B}{\cos A \cos B - \sin A \sin B}$$
$$\tan(A + B) = \frac{\dfrac{\sin A \cos B}{\cos A \cos B} + \dfrac{\cos A \sin B}{\cos A \cos B}}{\dfrac{\cos A \cos B}{\cos A \cos B} - \dfrac{\sin A \sin B}{\cos A \cos B}}$$
$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

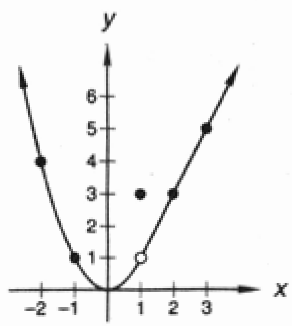
(b) $\tan(2A) = \tan(A + A)$

$$= \frac{\tan A + \tan A}{1 - \tan A \tan A} = \frac{2\tan A}{1 - \tan^2 A}$$

Since $\tan A = \frac{1}{2}$

$$\tan(2A) = \frac{2\left(\frac{1}{2}\right)}{1 - \left(\frac{1}{2}\right)^2} = \frac{1}{1 - \frac{1}{4}} = \mathbf{\frac{4}{3}}$$

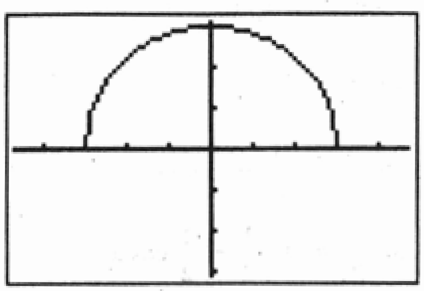
13.



14. (a) $\lim_{x \to 1^+} f(x) = \mathbf{1}$ (b) $\lim_{x \to 1^-} f(x) = \mathbf{1}$

(c) $f(1) = \mathbf{3}$

15. (a)



(b) $y = \sqrt{9 - x^2}$ describes only the positive square root, which coincides with the portions of the graph of a circle of radius 3 that lie on or above the x-axis.

(c) To graph a complete circle on a graphing calculator we need to graph it in two parts:

Y1=√(9−X²) and Y2=−√(9−X²)

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