# SAT Mathematics Level 2 Practice Test

**There are 50 questions on this test. You have 1 hour (60 minutes) to complete it.**

1. The measures of the angles of $\triangle QRS$ are $m\angle Q = 2x + 4$, $m\angle R = 4x - 12$, and $m\angle S = 3x + 8$. $QR = y + 9$, $RS = 2y - 7$, and $QS = 3y - 13$. The perimeter of $\triangle QRS$ is

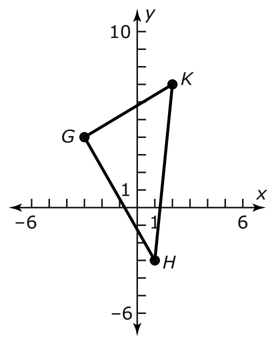
   (A) 11 (B) 20 (C) 44 (D) 55 (E) 68

2. Given $g(x) = \dfrac{3x+2}{5x-1}$, $g\left(\dfrac{-3}{4}\right) =$

   (A) $\dfrac{-1}{2}$ (B) $\dfrac{1}{9}$ (C) $\dfrac{1}{11}$ (D) $\dfrac{7}{16}$ (E) $\dfrac{1}{2}$

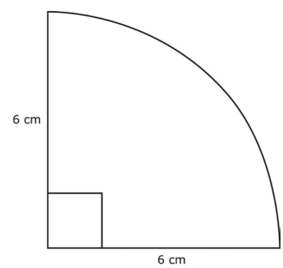
3. $\sqrt[3]{81x^7y^{10}} =$

   (A) $9x^3y^5\sqrt[3]{x}$ (B) $9x^2y^3\sqrt[3]{xy}$ (C) $3x^2y^3\sqrt[3]{9xy}$
   (D) $3x^2y^3\sqrt[3]{3xy}$ (E) $3x^3y^5\sqrt[3]{x}$




4. The vertices of $\triangle GHK$ above have coordinates $G(-3,4)$, $H(1,-3)$, and $K(2,7)$. The equation of the altitude to $\overline{HK}$ is

(A) $10x + y = -26$ (B) $10x + y = 7$ (C) $10x + y = 27$
(D) $x + 10y = 37$ (E) $x + 10y = 72$




5. When the figure above is spun around its vertical axis, the total surface area of the solid formed will be

(A) $144\pi$ (B) $108\pi$ (C) $72\pi$ (D) $36\pi$ (E) $9\pi + 12$

6. If $f(x) = 4x^2 - 1$ and $g(x) = 8x + 7$, $g \circ f(2) =$

(A) 15 (B) 23 (C) 127 (D) 345 (E) 2115

7. If $p$ and $q$ are positive integers with $pq = 36$, then $\frac{p}{q}$ cannot be

(A) $\frac{1}{4}$ (B) $\frac{4}{9}$ (C) 1 (D) 2 (E) 9

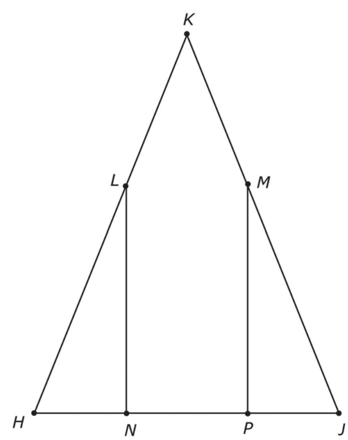
8. $\dfrac{\dfrac{2}{3}+\dfrac{1}{x-4}}{1-\dfrac{2}{3x-12}}=$

(A) $\dfrac{2x}{3x-2}$ (B) $\dfrac{2x-8}{3x-2}$ (C) $\dfrac{2x-8}{3x-12}$

(D) $\dfrac{2x-7}{3x-12}$ (E) $\dfrac{2x-5}{3x-14}$

9. If $\left(\dfrac{1}{125}\right)^{a^2+4ab}=\left(\sqrt[3]{625}\right)^{3a^2-10ab}$ and if $a$ and $b$ do not equal 0, $\dfrac{a}{b}=$

(A) $\dfrac{4}{21}$ (B) 2 (C) $\dfrac{76}{21}$ (D) 4 (E) $\dfrac{76}{3}$



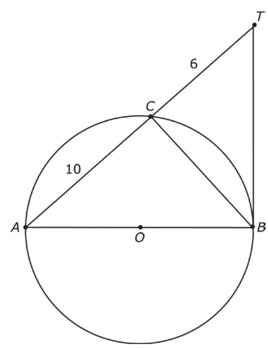

10. In isosceles $\triangle KHJ$, $\overline{HJ}=8$, $\overline{NL}\perp\overline{HJ}$, and $\overline{MP}\perp\overline{HJ}$. If $K$ is 10 cm from base $HJ$ and $KL=.4KH$, the area of $\triangle LNH$ is

(A) 4 (B) 4.8 (C) 6 (D) 7.2 (E) 16

11. The equation of the perpendicular bisector of the segment joining $A(-9,2)$ to $B(3,-4)$ is

(A) $y - 1 = \frac{-1}{2}(x - 3)$ (B) $y + 1 = \frac{-1}{2}(x + 3)$

(C) $y + 1 = 2(x + 3)$ (D) $y + 3 = 2(x + 1)$ (E) $y - 1 = 2(x - 3)$




12. Tangent $\overline{TB}$ and secant $\overline{TCA}$ are drawn to circle O. Diameter $\overline{AB}$ is drawn. If $TC = 6$ and $CA = 10$, then $CB =$

(A) $2\sqrt{6}$ (B) $4\sqrt{6}$ (C) $2\sqrt{15}$ (D) 10 (E) $2\sqrt{33}$

13. Let $p \,@\, q = \dfrac{p^q}{q - p}$. $(5 \,@\, 3) - (3 \,@\, 5) =$

(A) –184 (B) –59 (C) 0 (D) 59 (E) 184

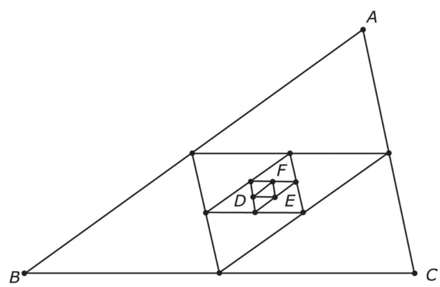
14. Grades for the test on proofs did not go as well as the teacher had hoped. The mean grade was 68, the median grade was 64, and the standard deviation was 12. The teacher curves the score by raising each score by a total of 7 points. Which of the following statements is true?

I. The new mean is 75.

II. The new median is 71.

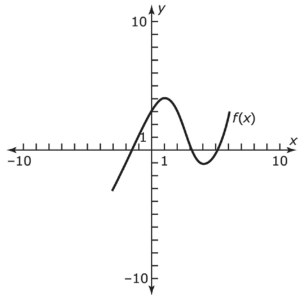
III. The new standard deviation is 7.

(A) I only (B) III only (C) I and II only
(D) I, II, and III (E) None of the statements are true

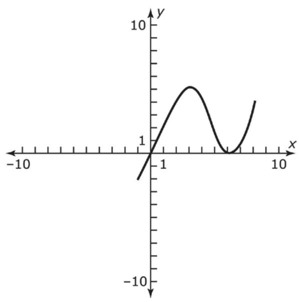


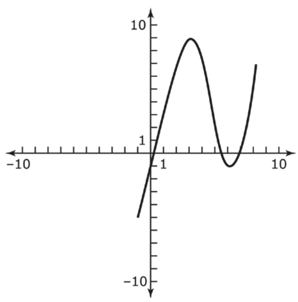

15. A set of triangles is formed by joining the midpoints of the larger triangles. If the area of $\triangle ABC$ is 128, then the area of $\triangle DEF$, the smallest triangle formed, is

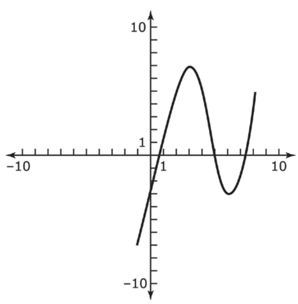
(A) $\frac{1}{8}$ (B) $\frac{1}{4}$ (C) $\frac{1}{2}$ (D) 1 (E) 4

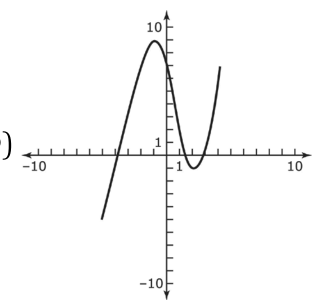


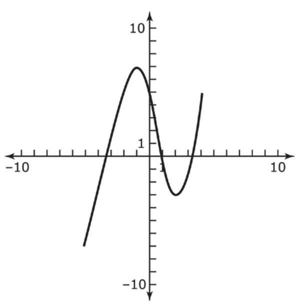

16. The graph of $y = f(x)$ is shown above. Which is the graph of $g(x) = 2f(x - 2) + 1$?

(A) 

(B) 

(C) 

(D) 

(E) 

17. The number of bacteria, measured in thousands, in a culture is modeled by the equation $b(t) = \dfrac{380e^{2.31t}}{175 + e^{3.21t}}$, where $t$ is the number of days since the culture was formed. According to this model, the culture can support a maximum population of

(A) 2.17 (B) 205 (C) 380 (D) 760 (E) $\infty$

18. A sphere with diameter 50 cm intersects a plane 14 cm from the center of the sphere. What is the number of square centimeters in the area of the circle formed?

(A) $49\pi$ (B) $196\pi$ (C) $429\pi$ (D) $576\pi$ (E) $2304\pi$

19. Given $g(x) = \dfrac{3x-1}{2x+9}$, $g(g(x)) =$

(A) $\dfrac{9x-4}{6x+7}$ (B) $\dfrac{7x-12}{24x+79}$ (C) $\dfrac{x-10}{21x+80}$

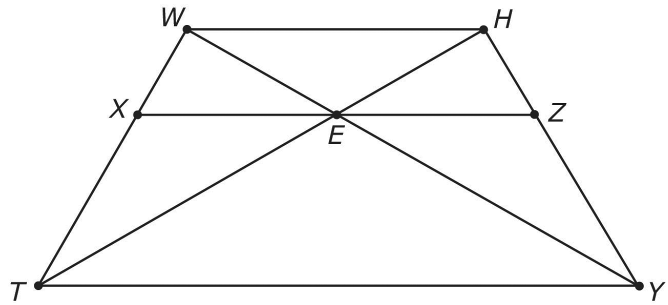
(D) $\dfrac{7x+6}{24x+79}$ (E) $\dfrac{9x^2-6x+1}{4x^2+36x+81}$

20. The area of $\triangle QED = 750$. $QE = 48$ and $QD = 52$. To the nearest degree, what is the measure of the largest possible angle of $\triangle QED$?

(A) 76 (B) 77 (C) 78 (D) 143 (E) 145

21. Given $\log_3(a) = c$ and $\log_3(b) = 2c$, $a =$

(A) $3c$ (B) $c + 3$ (C) $b^2$ (D) $\sqrt{b}$ (E) $\dfrac{b}{2}$




22. In isosceles trapezoid *WTYH*, $WH \parallel XZ \parallel TY$, $m\angle TWH = 120$, and $m\angle HWE = 30$. *XZ* passes through point *E*, the intersection of the diagonals. If *WH* = 30, determine the ratio of *XZ*:*TY*.

(A) 1:2 (B) 2:3 (C) 3:4 (D) 4:5 (E) 5:6

23. The lengths of the sides of a triangle are 25, 29, and 34. To the nearest tenth of a degree, the measure of the largest angle is

(A) 77.6° (B) 77.7° (C) 87.6° (D) 87.7° (E) 102.3°

24. One of the roots of a quadratic equation that has integral coefficients is $\frac{-4}{5} + \frac{3\sqrt{2}}{8}i$. Which of the following describes the quadratic equation?

(A) $800x^2 + 1280x + 737 = 0$ (B) $800x^2 - 1280x + 737 = 0$
(C) $800x^2 + 1280x + 287 = 0$ (D) $800x^2 - 1280x + 287 = 0$
(E) $800x^2 + 1280x - 287 = 0$

25. The parametric equations $x = \cos(2t) + 1$ and $y = 3\sin(t) + 2$ correspond to a subset of the graph

(A) $\frac{(x-1)^2}{1} + \frac{(y-2)^2}{9} = 1$ (B) $\frac{(x-1)^2}{1} - \frac{(y-2)^2}{9} = 1$

(C) $x - 2 = \frac{2}{9}(y-2)^2$ (D) $x - 2 = -\frac{2}{9}(y-2)^2$

(E) $x - 2 = -\frac{2}{3}(y-2)$

26. A county commissioner will randomly select 5 people to form a non-partisan committee to look into the issue of county services. If there are 8 Democrats and 6 Republicans to choose from, what is the probability that the Democrats will have the more members than the Republicans on this committee?

(A) $\frac{686}{2002}$ (B) $\frac{1316}{2002}$ (C) $\frac{1876}{2002}$

(D) $\frac{2688}{24024}$ (E) $\frac{21336}{24024}$

27. Given the vectors $u = [-5, 4]$ and $v = [3, -1]$, $|2u - 3v| =$

(A) $[-19, 11]$ (B) $\sqrt{502}$ (C) $[19, 11]$

(D) $2\sqrt{41} - 3\sqrt{10}$ (E) $2\sqrt{65}$

28. $\triangle ABC$ has vertices $A(-11,4)$, $B(-3,8)$, and $C(3,-10)$. The coordinates of the center of the circle circumscribed about $\triangle ABC$ are

(A) $(-2,-3)$ (B) $(-3,-2)$ (C) $(3,2)$
(D) $(2,3)$ (E) $(-1,-1)$

29. Each side of the base of a square pyramid is reduced by 20%. By what percent must the height be increased so that the volume of the new pyramid is the same as the volume of the original pyramid?

(A) 20 (B) 40 (C) 46.875 (D) 56.25 (E) 71.875

30. $\dfrac{20\text{cis}\left(\dfrac{19\pi}{18}\right)}{5\text{cis}\left(\dfrac{2\pi}{9}\right)} =$

(A) $-2\sqrt{3} + 2i$ (B) $-2\sqrt{3} - 2i$ (C) $2\sqrt{3} + 2i$

(D) $-2 + 2i\sqrt{3}$ (E) $2 - 2i\sqrt{3}$

31. Given $\log_b(a) = x$ and $\log_b(c) = y$, $\log_{a^2}\left(\sqrt[3]{b^5c^4}\right) =$

(A) $\dfrac{\frac{5}{3}+y^4}{x^2}$ (B) $\dfrac{5+4y}{6x}$ (C) $\dfrac{20y}{3x}$

(D) $2x+4y$ (E) $2x+\dfrac{20y}{3}$

32. The asymptotes of a hyperbola have equations $y - 1 = \pm\frac{3}{4}(x + 3)$. If a focus of the hyperbola has coordinates (7,1), the equation of the hyperbola is

(A) $\dfrac{(x+3)^2}{16}-\dfrac{(y-1)^2}{9}=1$ (B) $\dfrac{(y-1)^2}{9}-\dfrac{(x+3)^2}{16}=1$

(C) $\dfrac{(x+3)^2}{64}-\dfrac{(y-1)^2}{36}=1$ (D) $\dfrac{(y-1)^2}{36}-\dfrac{(x+3)^2}{64}=1$

(E) $\dfrac{(x+3)^2}{4}-\dfrac{(y-1)^2}{3}=1$

33. An inverted cone (vertex is down) with height 12 inches and base of radius 8 inches is being filled with water. What is the height of the water when the cone is half filled?

(A) 6 (B) $6\sqrt[3]{4}$ (C) $8\sqrt[3]{6}$ (D) $9\sqrt[3]{4}$ (E) $9\sqrt[3]{6}$

34. Solve $\sin(t) = \cos(2t)$ for $-4\pi \le t \le -2\pi$.

(A) $\left\{\dfrac{-\pi}{6},\dfrac{-5\pi}{6},\dfrac{-\pi}{2}\right\}$ (B) $\left\{\dfrac{-\pi}{3},\dfrac{-5\pi}{3},\dfrac{-\pi}{2}\right\}$

(C) $\left\{\dfrac{-23\pi}{6},\dfrac{-19\pi}{6},\dfrac{-5\pi}{2}\right\}$ (D) $\left\{\dfrac{-23\pi}{3},\dfrac{-19\pi}{3},\dfrac{-5\pi}{2}\right\}$

(E) $\left\{\dfrac{-11\pi}{3},\dfrac{-7\pi}{3},\dfrac{-5\pi}{2}\right\}$

35. $|2x - 3||x - 1| < 2$ when

(A) $\frac{1}{5} < x < 5$ (B) $\frac{1}{5} < x < 2$ and $2 < x < 5$ (C) $x < \frac{1}{5}$ or $x > 5$

(D) $x < 5$ (E) $x > \frac{1}{5}$

36. $\sum_{k=0}^{\infty} 12\left(\frac{2}{3}\right)^k - \sum_{k=0}^{\infty} 18\left(\frac{-1}{2}\right)^k =$

(A) –5 (B) 5 (C) 24 (D) 27 (E) 30

37. If

$$\frac{3}{x} - \frac{4}{y} + \frac{2}{z} = 3$$

$$\frac{2}{x} - \frac{8}{y} - \frac{1}{z} = -8$$

$$\frac{4}{x} - \frac{6}{y} - \frac{3}{z} = 1$$

then $\frac{1}{x - y + z} =$

(A) $\frac{2}{25}$ (B) $\frac{30}{31}$ (C) $\frac{31}{30}$ (D) $\frac{19}{2}$ (E) $\frac{25}{2}$

38. Which of the following statements is true about the function $f(x) = 3 - 2\cos\left(\frac{3\pi}{5}x - \frac{3\pi}{10}\right)$?

I. The graph has an amplitude of 2.

II. The graph is shifted to the right 2.

III. The function satisfies the equation $f\left(\frac{5}{2}\right) = f\left(\frac{31}{6}\right)$.

(A) I only (B) II only (C) III only
(D) I and II only (E) I and III only

39. All of the following solve the equation $z^5 = 32i$ EXCEPT

(A) $2\text{cis}\left(\frac{\pi}{2}\right)$ (B) $2\text{cis}\left(\frac{9\pi}{10}\right)$ (C) $2\text{cis}\left(\frac{11\pi}{10}\right)$

(D) $2\text{cis}\left(\frac{13\pi}{10}\right)$ (E) $2\text{cis}\left(\frac{17\pi}{10}\right)$

40. Given $a_1 = 4$, $a_2 = -2$, and $a_n = 2a_{n-2} - 3a_{n-1}$, what is the smallest value of $n$ for which $|a_n| > 1{,}000{,}000$?

(A) 11 (B) 12 (C) 13 (D) 14 (E) 15

41. Which of the following statements is true about the graph of the function $f(x) = \dfrac{(2x-3)(x+2)(2x-1)}{4x^2-9}$?

I. $f(x) = \dfrac{9}{4}$ has two solutions.

II. $f(x) = \dfrac{7}{6}$ has two solutions.

III. The range of the function is the set of real numbers.

(A) III only (B) I and II only (C) II and III only
(D) I and III only (E) I, II, and III

42. Given $g(x) = 9\log_8(x-3) - 5$, $g^{-1}(13) =$

(A) $3\frac{1}{3}$ (B) 6 (C) 61 (D) 67 (E) 259

43. Isosceles $\triangle QRS$ has dimensions $QR = QS = 60$ and $RS = 30$. The centroid of $\triangle QRS$ is located at point $T$. What is the distance from $T$ to $\overline{QR}$?

(A) $2\sqrt{15}$ (B) $\frac{5}{2}\sqrt{15}$ (C) $3\sqrt{15}$

(D) $\frac{7}{2}\sqrt{15}$ (E) $5\sqrt{15}$

44. Diagonals $\overline{AC}$ and $\overline{BD}$ of quadrilateral $ABCD$ are perpendicular. $AD = DC = 8$, $AC = BC = 6$, $m\angle ADC = 60°$. The area of $ABCD$ is

(A) $4\sqrt{5}+8\sqrt{3}$ (B) $16\sqrt{3}$ (C) $32\sqrt{3}$

(D) $8\sqrt{5}+16\sqrt{3}$ (E) 48

45. $\cos\left(2\csc^{-1}\left(\frac{x+4}{5}\right)\right) =$

(A) $\frac{x^2+8x-16}{x+4}$ (B) $\frac{x^2+8x-16}{(x+4)^2}$ (C) $\frac{x^2+8x-34}{x+4}$

(D) $\frac{x^2+8x-34}{(x+4)^2}$ (E) $\frac{-16-8x-x^2}{(x+4)^2}$

46. Which of the following statements is true about the expression $(a+b)^n - (a-b)^n$?

I. It has $\frac{n}{2}$ terms if $n$ is even.

II. It has $\frac{n+1}{2}$ terms if $n$ is odd.

III. The exponent on the last term is always $n$.

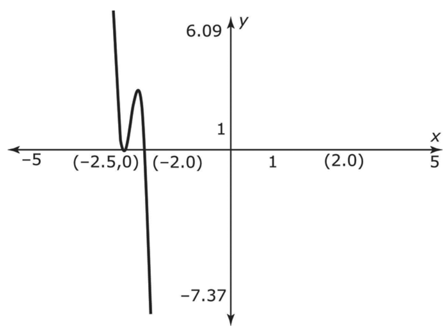
(A) I only (B) II only (C) I and II only
(D) I and III only (E) II and III only

47. In $\triangle VWX$, $\sin(X) = \frac{8}{17}$ and $\cos(W) = \frac{-3}{5}$. Find $\cos\left(\frac{V}{2}\right) =$

(A) $\frac{-77}{85}$ (B) $\frac{-2}{\sqrt{85}}$ (C) $\frac{2}{\sqrt{85}}$ (D) $\frac{9}{\sqrt{85}}$ (E) $\frac{77}{85}$

48. The intersection of the hyperbola $\frac{(x+1)^2}{8} - \frac{(y-1)^2}{9} = 1$ and the ellipse $\frac{(x+1)^2}{32} + \frac{(y-1)^2}{18} = 1$ is

(A) (3,4), (3,–4), (–5,4), (–5,–4)
(B) (3,2), (3,–2), (–5,2), (–5,–2)
(C) (3,4), (3,–2), (–5,4), (–5,–2)
(D) (–3,4), (–3,–2), (5,4), (5,–2)
(E) (3,–4), (3,2), (–5,–4), (–5,2)




49. The equation $8x^6 + 72x^5 + bx^4 + cx^3 - 687x^2 - 2160x - 1700 = 0$, as shown in the figure, has two complex roots. The product of these complex roots is

(A) –4 (B) $\frac{17}{2}$ (C) 9 (D) $\frac{-687}{2}$ (E) $\frac{425}{2}$

50. If $\sin(A) = \frac{-8}{17}$, $\frac{3\pi}{2} < A < 2\pi$, and $\cos(B)\ 0 = \frac{-24}{25}$, $\pi < B < \frac{3\pi}{2}$, $\cos(2A + B) =$

(A) $\frac{-5544}{7225}$ (B) $\frac{-2184}{7225}$ (C) $\frac{-3696}{7225}$ (D) $\frac{2184}{7225}$

(E) $\frac{5544}{7225}$

## Level 2 Practice Test Solutions

1. (D) The sum of the measures of the angles of a triangle is 180, so $2x + 4 + 4x - 12 + 3x + 8 = 180$. Combine and solve: $9x = 180$, or $x = 20$. $m\angle Q = 44$, $m\angle R = 68$, and $m\angle S = 68$. $\triangle QRS$ is isosceles, and $QR = QS$. Solve $y + 9 = 3y - 13$ to get $y = 11$. The sum of the sides is $6y - 11$, so the perimeter is $6(11) - 11 = 55$.

2. (B) $g\left(\frac{-3}{4}\right) = \dfrac{3\left(\frac{-3}{4}\right)+2}{5\left(\frac{-3}{4}\right)-1} = \left(\dfrac{3\left(\frac{-3}{4}\right)+2}{5\left(\frac{-3}{4}\right)-1}\right)\dfrac{4}{4} = \dfrac{-9+8}{-15-4} = \dfrac{-1}{-19} = \dfrac{1}{19}$.

3. (D) $\sqrt[3]{81x^7y^{10}} = (\sqrt[3]{27x^6y^9})(\sqrt[3]{3xy}) = 3x^2y^3\sqrt[3]{3xy}$.

4. (B) The slope of $\overline{HK}$ is 10, so the slope of the altitude is $\frac{-1}{10}$. In standard form, this makes the equation $10x + y = C$. Substitute the coordinates of G to get $10x + y = -26$.

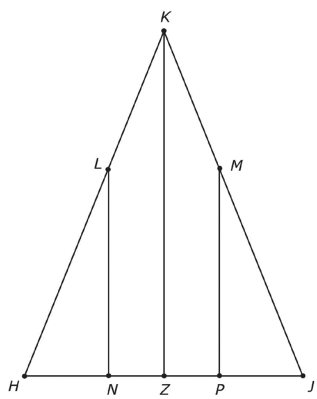
5. (B) The figure formed when the figure is rotated about the vertical axis is a hemisphere. The total surface area of the figure is the area of the hemisphere ($2\pi r^2$) plus the area of the circle that serves as the base ($\pi r^2$). With $r = 6$, the total surface area is $108\pi$ sq cm.

6. (C) $f(2) = 4(2)^2 - 1 = 4(4) - 1 = 15$. The composition of functions $g(f(2)) = g(15) = 8(15) + 7 = 127$.

7. (D) The factors of 36 are 1, 2, 3, 4, 6, 9, 12, 18, and 36. $\frac{3}{12} = \frac{1}{4}$, $\frac{6}{6} = 1$, and $\frac{18}{2} = 9$. The ratio of the factors cannot be 2.

8. (E) Multiply by the common denominator to change the problem into a simple fraction rather than a complex fraction. $\left(\dfrac{\dfrac{2}{3}+\dfrac{1}{x-4}}{1-\dfrac{2}{3x-12}}\right)\left(\dfrac{3(x-4)}{3(x-4)}\right)=\dfrac{2(x-4)+3}{3x-12-2}=\dfrac{2x-5}{3x-14}$.

9. (A) Rewrite the equation with a common base. $\left(\frac{1}{125}\right)^{a^2+4ab}=\left(\sqrt[3]{625}\right)^{3a^2-10ab}$ becomes $\left(5^{-3}\right)^{a^2+4ab}=\left(5^{4/3}\right)^{3a^2-10ab}$. Set the exponents equal to get $-3(a^2+4ab)=\frac{4}{3}(3a^2-10ab)$. Gather like terms $\frac{4}{3}ab=7a^2$ so that $\frac{a}{b}=\frac{4}{21}$.




10. (D) $\overline{NL}$ is parallel to the altitude from $K$ to $\overline{HJ}$. As a consequence, $\triangle NLH \sim \triangle KZH$, and $LN = .6KZ$ and $HN = .6HZ$. With $LN = 6$ and $HN = .6(4) = 2.4$, the area of $\triangle NLH$ is $.5(6)(2.4) = 7.2$.

11. (C) The slope of $\overline{AB}$ is $\frac{-4-2}{3-(-9)}=\frac{-6}{12}=\frac{-1}{2}$. The slope of the perpendicular line is 2. The midpoint of $\overline{AB}$ is $(-3,-1)$, so the equation of the perpendicular bisector is $y + 1 = 2(x + 3)$.

12. (C) $TB^2 = (TC)(TA)$, so $TB^2 = (6)(16)$ and $TB = 2\sqrt{6}$. $\angle ACB$ is inscribed in a semicircle, so $\angle ACB$ is a right angle. Consequently, $\angle TCB$ is a right angle and $\triangle TCB$ a right triangle. Using the Pythagorean Theorem, $TC^2 + CB^2 = TB^2$ yields $36 + CB^2 = 96$. $CB^2 = 60$, so $CB = \sqrt{60} = 2\sqrt{15}$.

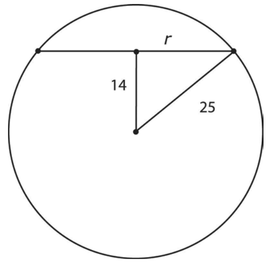
13. (A) $5 \text{ @ } 3 = \frac{5^3}{3-5} = \frac{-125}{2}$ and $3 \text{ @ } 5 = \frac{3^5}{5-3} = \frac{243}{2}$. $\frac{-125}{2} - \frac{243}{2} = -184$.

14. (C) Adding a constant to a set of data shifts the center of the data but does not alter the spread of the data.

15. (C) The segment joining the midpoints of two sides of a triangle is half as long as the third side. $\overline{DE}$ is the consequence of the 4th set of midpoints, so $\frac{DE}{BC} = \left(\frac{1}{2}\right)^4 = \frac{1}{16}$. The ratio of the areas is the square of the ratio of corresponding sides so $\frac{area\triangle FDE}{area\triangle ABC} = \left(\frac{1}{16}\right)^2 = \frac{1}{256}$. The area of $\triangle FDE = \frac{area\triangle ABC}{256} = \frac{128}{256} = \frac{1}{2}$.

16. (B) The function $g(x) = 2f(x-2) + 1$ moves the graph of $f(x)$ right 2, stretches the $y$-coordinates from the $x$-axis by a factor of 2, and moves the graph up 1 unit. Use the points (0,3), (3,0), and (5,0) from $f(x)$ to follow the motions.

17. (C) The end behavior of a rational function is not impacted by any constants that are added or subtracted to a term. Consequently, the 175 in the denominator of $b(t)$ will have no impact on the value of $b(t)$ *when the values of* t *get sufficiently large*. The function $b(t)$ reduces to 380 when $t$ is sufficiently large. (Graphing this function with your graphing calculator gives a very clear picture of the maximum value of the function.)



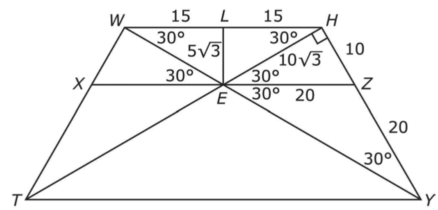

18. (C) The radius of the sphere is 25. The distance from the center of the sphere to the intersecting plane lies along the perpendicular. Use the Pythagorean Theorem to get $r^2 + 14^2 = 25^2$ or $r^2 = 429$. The area of the circle formed by the plane and sphere is $\pi r^2$, or $429\pi$.

19. (B) $g(g(x)) = \dfrac{3\left(\dfrac{3x-1}{2x+9}\right)-1}{2\left(\dfrac{3x-1}{2x+9}\right)+9} = \left(\dfrac{3\left(\dfrac{3x-1}{2x+9}\right)-1}{2\left(\dfrac{3x-1}{2x+9}\right)+9}\right)\left(\dfrac{2x+9}{2x+9}\right) =$

$\dfrac{3(3x-1)-(2x+9)}{2(3x-1)+9(2x+9)} = \dfrac{9x-3-2x-9}{6x-2+18x+81} = \dfrac{7x-12}{24x+79}$.

20. (D) The area of a triangle is given by the formula $A = \dfrac{1}{2}ab\sin(\theta)$. Substituting the given information, $750 = \dfrac{1}{2}(48)(52)\sin(\theta)$. Solving this equation for Q yields that Q = 37° or 143°. If $m\angle Q = 37°$, then $\angle E$ would be the largest angle of the triangle, and that measure, found using the Law of Cosines, would be 78°, less than 143°.

21. (D) $\log_3(a) = c$ and $\log_3(b) = 2c$ are equivalent to $a = 3^c$ and $b = 3^{2c} = (3^c)^2 = a^2$. Therefore, $a = \sqrt{b}$ .




22. (B) Drop the altitude from $E$ to $\overline{WH}$ with the foot of the altitude being $L$. $LH = 15$. Use the 30-60-90 relationship to determine that $LE = 5\sqrt{3}$ and $EH = 10\sqrt{3}$. $\triangle EHZ$ is also 30-60-90, so $HZ = 10$ and $EZ = 20$. $\triangle EYZ$ is an isosceles triangle, making $ZY = 20$. In $\triangle THY$, $\overline{EZ} \parallel \overline{TY}$, so $\frac{HZ}{HY} = \frac{EZ}{TY} = \frac{1}{3}$. Therefore, $\frac{XZ}{TY} = \frac{2}{3}$.

23. (B) With SSS information, use the Law of Cosines to determine the measure of the largest angle (which is located opposite the longest side). $34^2 = 25^2 + 29^2 - 2(25)(29)\cos(\theta)$. $2(25)(29)\cos(\theta) = 25^2 + 29^2 - 34^2$, so that $\cos(\theta) = \frac{25^2 + 29^2 - 34^2}{2(25)(29)}$ or $\cos(\theta) = \frac{31}{145}$ and $\theta = 77.7°$.

24. (A) If $\frac{-4}{5} + \frac{3\sqrt{2}}{8}i$ is a root of the equation, then its conjugate $\frac{-4}{5} - \frac{3\sqrt{2}}{8}i$ is also. The sum of the roots is $\frac{-8}{5} = \frac{-b}{a}$ and the product of the roots is $\left(\frac{-4}{5}\right)^2 - \left(\frac{3\sqrt{2}}{8}i\right)^2 = \frac{16}{25} + \frac{18}{64} = \frac{737}{800}$. Getting a common denominator for the sum of the roots gives $\frac{-1280}{800} = \frac{-b}{a}$. With $a = 800$, $b = 1280$, and $c = 737$, the equation is $800x^2 + 1280x + 737 = 0$.

25. (D) $\cos(2t) = x - 1$ and $\sin(t) = \frac{y-2}{3}$. Use the identity $\cos(2t) = 1 - 2\sin^2(t)$ to get $x - 1 = 1 - 2\left(\frac{y-2}{3}\right)^2$ or $x - 2 = -\frac{2}{9}(y-2)^2$.

26. (B) There is no indication in the problem that titles are associated with any of the positions on the committee, so this problem represents a combination (order is not important). There are 14 people to choose from, so the number of combinations is ${}_{14}C_5 = 2002$. A committee with more Democrats than Republicans could have 5 Democrats and 0 Republicans, 4 Democrats and 1 Republican, or 3 Democrats and 2 Republicans. The number of ways this can happen is $({}_8C_5)({}_6C_0) + ({}_8C_4)({}_6C_1) + ({}_8C_2)({}_6C_2) = 1316$. Therefore, the probability that the Democrats will have more members on the committee than the Republicans is $\frac{1316}{2002}$.

27. (B) $2u - 3v = [2(-5) - 3(3), 2(4) - 3(-1)] = [-19, 11]$. $|2u - 3v|$, the distance from the origin to the end of the vector, $= \sqrt{(-19)^2 + 11^2} = \sqrt{502}$.

28. (B) The circumcenter of a triangle is the intersection of the perpendicular bisectors of the sides of the triangle. The slope of $\overline{AB}$ is $\frac{1}{2}$, and its midpoint is (–7,6). The equation of the perpendicular bisector to $\overline{AB}$ is $y = -2x - 8$. The slope of $\overline{AC}$ is –1, and its midpoint is (–4,–3). The equation of the perpendicular bisector of $\overline{AC}$ is $y = x + 1$. The intersection of $y = -2x - 8$ and $y = x + 1$ is (–3,–2).

29. (D) The volume of the original pyramid is $\frac{1}{3}s^2h$. The volume of the new pyramid is $\frac{1}{3}(8s)^2H$, where $H$ is the new height. Set these expressions equal to get $\frac{1}{3}s^2h = \frac{1}{3}(8s)^2H$. Solve for $H$: $1.5625h$. The height needs to be increased by 56.25% to keep the volume the same.

30. (A) $\dfrac{20\text{cis}\left(\frac{19\pi}{18}\right)}{5\text{cis}\left(\frac{2\pi}{9}\right)} = 4\text{cis}\left(\frac{15\pi}{18}\right) = 4\text{cis}\left(\frac{5\pi}{6}\right) = 4\cos\left(\frac{5\pi}{6}\right) + 4i\sin\left(\frac{5\pi}{6}\right)$
$= 4\left(\frac{-\sqrt{3}}{2}\right) + 4i\left(\frac{1}{2}\right) = -2\sqrt{3} + 2i.$

31. (B) Use the change-of-base formula to rewrite $\log_{a^2}\left(\sqrt[3]{b^5c^4}\right)$ as $\dfrac{\log_b\left(\sqrt[3]{b^5c^4}\right)}{\log_b\left(a^2\right)}$. Apply the properties of logarithms to simplify the numerator and denominator of the fraction. $\dfrac{\frac{1}{3}\log_b\left(b^5c^4\right)}{2\log_b(a)} = \dfrac{\frac{1}{3}\log_b\left(b^5\right)+\frac{1}{3}\log_b\left(c^4\right)}{2\log_b(a)}$
$= \dfrac{\frac{5}{3}\log_b(b)+\frac{4}{3}\log_b(c)}{2\log_b(a)} = \dfrac{\frac{5}{3}+\frac{4}{3}y}{2x} = \dfrac{5+4y}{6x}$, recalling that $\log_b(b) = 1$.

32. (C) The center of the hyperbola is (–3,1). Because the focus is at (7,1), the hyperbola is horizontal and takes the form $\dfrac{(x+3)^2}{a^2} - \dfrac{(y-1)^2}{b^2} = 1$. The focus is 10 units from the center of the hyperbola. The equation of the asymptotes for a horizontal hyperbola (found by replacing the 1 with a zero) become $y - 1 = \pm\dfrac{b}{a}(x + 3)$. The ratio $\dfrac{b}{a}$ must equal $\dfrac{3}{4}$, and $a^2 + b^2 = 10^2$, so $a = 8$ and $b = 6$, giving the equation $\dfrac{(x+3)^2}{64} - \dfrac{(y-1)^2}{36} = 1$.

33. (B) The volume of the original cone is $\frac{1}{3}\pi(8)^2 12 = 128\pi$ and the volume at the time in question is half this amount. The ratio of the radius of the circle at the water's surface to the height of the water is 2:3. At any given time, the volume of the water, in terms of the height of the water, is $\frac{1}{3}\pi(r)^2h = \frac{1}{3}\pi\left(\frac{2}{3}h\right)^2$ and $h = \frac{4}{27}\pi h^3$. Setting this equal to

one-half the original volume, the equation is $\frac{4}{27}\pi h^3 = 64\pi$. Multiply by $\frac{27}{4\pi}$ to get $h^3 = 864 = 9 \cdot 96 = 27 \cdot 32 = 27 \cdot 8 \cdot 4$. Therefore, $h = 6\sqrt[3]{4}$.

34. (C) $\cos(2t) = 1 - 2\sin^2(t)$. Substituting this into the equation gives $\sin(t) = 1 - 2\sin^2(t)$ or $2\sin^2(t) + \sin(t) - 1 = 0$. Factor and solve: $(2\sin(t) - 1)(\sin(t) + 1) = 0$ so $\sin(t) = \frac{1}{2}, -1$. In the interval $0 \le t \le 2\pi$, the answer to this problem would be $\left\{\frac{\pi}{6}, \frac{5\pi}{6}, \frac{3\pi}{2}\right\}$. Subtract $4\pi$ from each of these answer to satisfy the domain restriction of the problem, $\left\{\frac{-23\pi}{6}, \frac{-19\pi}{6}, \frac{-5\pi}{2}\right\}$.

35. (B) Sketch the graph of $y = |2x - 3|x - 1| - 2$ on your graphing calculator and see that $y(2) = 0$, so this point needs to be eliminated from the interval from $\frac{1}{5} < x < 5$.

Algebraically: Determine those values for which $|2x - 3|x - 1| = 2$ and then analyze the inequality. $|2x - 3|x - 1| = 2$ requires that $2x - 3|x - 1| = 2$ or $2x - 3|x - 1| = -2$.

If $2x - 3|x - 1| = 2$ then $2x - 2 = 3|x - 1|$. If $x > 1$, this equation becomes $2x - 2 = 3x - 3$ or $x = 1$. If $x < 1$, the equation becomes $2x - 2 = -3x + 3$ or $x = 1$.

If $2x - 3|x - 1| = -2$, then $2x + 2 = 3|x - 1|$. If $x > 1$, this equation becomes $2x + 2 = 3x - 3$ or $x = 5$. If $x < 1$, the equation becomes $2x + 2 = -3x + 3$ or $x = \frac{1}{5}$.

Given $|2x - 3|x - 1| = 2$ when $x = \frac{1}{5}$, 1, and 5, you can check that $x = 0$ fails to solve the inequality, $x = 2$ satisfies the inequality, and that $x = 6$ fails to solve the inequality. Therefore, all values between $\frac{1}{5}$ and 5, with the exception of $x = 1$, satisfy the inequality.

36. (C) $\sum_{k=0}^{\infty} 12\left(\frac{2}{3}\right)^k$ is an infinite geometric series with $|r| < 1$ and first term equal to 12. The sum of the series is $\frac{12}{1-\frac{2}{3}} = 36$. In the same way, $\sum_{k=0}^{\infty} 18\left(\frac{-1}{2}\right)^k = \frac{18}{1-\left(-\frac{1}{2}\right)} = 12$. The difference in these values is 24.

37. (B) Use matrices to solve the equation $[A]^{-1}[B] = [C]$ where $[A] = \begin{bmatrix} 3 & -4 & 2 \\ 2 & 8 & -1 \\ 4 & -6 & -3 \end{bmatrix}$ and $[B] = \begin{bmatrix} 33 \\ -8 \\ 11 \end{bmatrix}$. $[C] = \begin{bmatrix} 5 \\ -2/3 \\ 6 \end{bmatrix}$ so $\frac{1}{x} = 5$, $\frac{1}{y} = \frac{-2}{3}$, and $\frac{1}{z} = 6$. $x - y + z = \frac{1}{5} - \left(\frac{-3}{2}\right) + \frac{1}{6} = \frac{31}{30}$. Therefore, $\frac{1}{x-y+z} = \frac{30}{31}$.

38. (E) $f(x) = 3 - 2\cos\left(\frac{3\pi}{5}x - \frac{3\pi}{10}\right) = -2\cos\left(\frac{3\pi}{5}\left(x - \frac{1}{2}\right)\right) + 3$. The amplitude of the function is $|-2| = 2$, the graph is shifted to the right $\frac{1}{2}$, and the period of the function is $\frac{2\pi}{\frac{3\pi}{5}} = \frac{10}{3}$. $f\left(\frac{5}{2}\right) = f\left(\frac{31}{6}\right) = \frac{\sqrt{5}}{2} + \frac{7}{2}$.

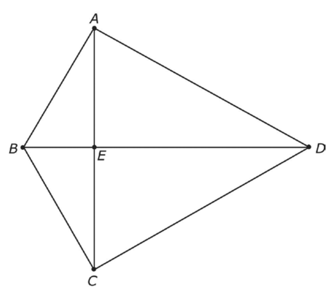
39. (C) The polar coordinate form for $32i$ is $32\text{cis}\left(\frac{\pi}{2}\right)$. DeMoivre's Theorem states that if $z = r\text{cis}(\theta)$, then $z^n = r^n\text{cis}(n\theta)$. The radius is 2 for all the choices, so the leading coefficient is not the issue. Of the five choices, only $2\text{cis}\left(\frac{11\pi}{10}\right)$ fails to be co-terminal with $\frac{\pi}{10} + \frac{2n\pi}{5}$.

40. (D) The terms of the sequence generated by this recursion formula are: 4, –3, 17, 43, –95, –319, 767, 2491, –5939, –19351, 46175, 150403, –358859, –1168927, 2789063, 9084907.

41. (D) The denominator of the function factors to $(2x + 3)(2x - 3)$, so the function reduces. The graph of $f(x)$ has a hole at the point $\left(\frac{3}{2}, \frac{7}{6}\right)$. $f(2.5) = 2.25$, so statement I is correct, and inspection of the graph of $f(x)$ on your graphing calculator will verify that statement III is also true.

42. (D) $g^{-1}(13) = a$ means that $g(a) = 13$. This leads to the equation $9\log_8(x - 3) - 5 = 13$. Add 5 and divide by 9 to get $\log_8(x - 3) = 2$. Rewrite the logarithmic equation as an exponential equation: $x - 3 = 8^2 = 64$ so $x = 67$.

43. (C) The centroid is the intersection of the medians of the triangle. The median from Q to $\overline{RS}$ is also the altitude to $\overline{RS}$. Use the Pythagorean Theorem to show that this altitude has length $\sqrt{60^2 - 15^2} = 15\sqrt{15}$. The centroid lies $\frac{2}{3}$ of the way along the median, so $T$ is $5\sqrt{15}$ units from $\overline{RS}$. $\triangle RST$, $\triangle QST$, and $\triangle QRT$ are all equal in area. The area of $\triangle RST$ is $\frac{1}{2}(5\sqrt{15})(30) = 75\sqrt{15}$. The area of $\triangle QRT = \frac{1}{2}h(60) = 30h = 75\sqrt{15}$ so $h = \frac{75}{30}\sqrt{15} = \frac{5}{2}\sqrt{15}$.




44. (D) The altitude to the base of an isosceles triangle also bisects the vertex angle, so $m\angle ADE = 30$. With the hypotenuse of the triangle having a length of 8, $AE = 4$ and $DE = 4\sqrt{3}$. $\triangle AEC$ is a right angle with leg 4 and hypotenuse 6. Use the Pythagorean Theorem to determine that $BE = 2\sqrt{5}$. The area of a quadrilateral with perpendicular diagonals

is equal to half the product of the diagonals, so the area of $ABCD$ is $\frac{1}{2}(8)(2\sqrt{5}+4\sqrt{3}) = 8\sqrt{5}+16\sqrt{3}$.

45. (D) $\theta = \csc^{-1}\left(\frac{x+4}{5}\right)$ implies that $\csc(\theta) = \frac{x+4}{5}$ and that $\sin(\theta) = \frac{5}{x+4}$. Use the Pythagorean Theorem to determine that the remaining leg of the right triangle has length $\sqrt{(x+4)^2-5^2}$ = $\sqrt{x^2+8x-9}$ so that $\cos(\theta) = \frac{\sqrt{x^2+8x-9}}{x+4}$. $\cos(2\theta) = \cos^2(\theta) - \sin^2(\theta)$ $= \left(\frac{\sqrt{x^2+8x-9}}{x+4}\right)^2 - \left(\frac{5}{x-4}\right)^2 = \frac{x^2+8x-9}{(x+4)^2} - \frac{25}{(x+4)^2} = \frac{x^2+8x-34}{(x+4)^2}$.

46. (C) Both $(a+b)^n$ and $(a-b)^n$ contain $n+1$ terms when they are expanded. All the odd terms in $(a-b)^n$ will be positive, and the even terms will be negative.

If $n$ is even, there will be $\frac{n}{2}+1$ odd terms and $\frac{n}{2}$ even terms in the expansion of $(a-b)^n$. The odd terms will subtract out, leaving $\frac{n}{2}$ terms. The last terms in the expansions of both binomials, $b^n$, will subtract out of the answer.

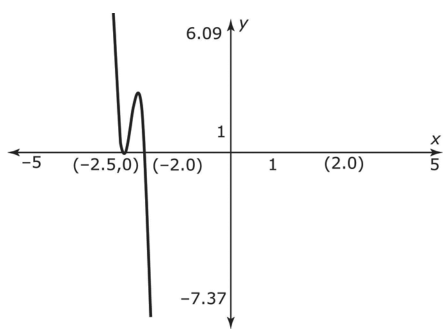
If $n$ is odd, there will be an equal number of even and odd terms. The odd terms will subtract out leaving $\frac{n}{2}$ terms in the difference.

47. (D) With $\sin(X) = \frac{8}{17}$ and $\cos(W) = \frac{-3}{5}$, $\cos(X) = \frac{15}{17}$ and $\sin(W) = \frac{4}{5}$. $V+W+X = 180$, so $V = 180-(W+X)$ and $\cos(V) =$ $\cos(180-(W+X)) = -\cos(W+X)$. $-\cos(W+X) = \sin(W)\sin(X) -$

$\cos(W)\cos(X) = \left(\frac{4}{5}\right)\left(\frac{8}{17}\right) - \left(\frac{-3}{5}\right)\left(\frac{15}{17}\right) = \frac{77}{85}$. $\cos\left(\frac{V}{2}\right) = \sqrt{\frac{1+\frac{77}{85}}{2}} = \sqrt{\frac{162}{170}} = \sqrt{\frac{81}{85}} = \frac{9}{\sqrt{85}}$.

Let $a = \sin^{-1}\left(\frac{8}{17}\right)$ and $b = \cos^{-1}\left(\frac{-3}{5}\right)$. Compute $\cos(.5(180 - (a + b))) = .976187$ and compare this decimal to the choices available.

48. (C) Multiply both sides of the equation $\frac{(x+1)^2}{32} + \frac{(y-1)^2}{18} = 1$ by 2 to get $\frac{(x+1)^2}{16} + \frac{(y-1)^2}{9} = 2$. Add this to $\frac{(x+1)^2}{8} - \frac{(y-1)^2}{9} = 1$ to get $\frac{3(x+1)^2}{16} = 3$ so that $(x + 1)^2 = 16$, $x + 1 = \pm 4$ and $x = 3$ or $-5$. Substitute $x = 3$ into the equation $\frac{(x+1)^2}{16} + \frac{(y-1)^2}{9} = 2$ to get $\frac{(y-1)^2}{9} = 1$. Solve so that $(y - 1)^2 = 9$ or $y - 1 = \pm 3$ and $y = 4$ or $-2$. Check that these are the same values of $y$ you get when $x = -5$. The coordinates of the four points of intersection for these two graphs are (3,4), (3,–2), (–5,4), and (–5,–2).




49. (B) The graph of the function shows that $x = -2.5$ is a double root, and $x = -2$ and $x = 2$ are single roots. This implies that $(2x + 5)^2(x + 2)(x - 2)$ is a factor of $8x^6 + 72x^5 + bx^4 + cx^3 - 687x^2 - 2160x - 1700 = 0$. When expanded, $(2x + 5)^2(x + 2)(x - 2)$ is a

fourth-degree polynomial with a leading coefficient of 4 and ends with a constant of –100. This means that the remaining quadratic factor must be of the form $2x^2 + bx + 17$ in order for the leading coefficient to be 8 and the constant to be –1700. The product of the complex roots from the quadratic is $\frac{c}{a} = \frac{17}{2}$.

50. (A) $\sin(A) = \frac{-8}{17}$, $\frac{3\pi}{2} < A < 2\pi$, gives $\cos(A) = \frac{15}{17}$ while $\cos(B) = \frac{-24}{25}$, $\pi < B < \frac{3\pi}{2}$, gives $\sin(B) = \frac{-7}{25}$. $\cos(2A) = \cos^2(A) - \sin^2(A) = \left(\frac{15}{17}\right)^2 - \left(\frac{-8}{17}\right)^2 = \frac{161}{289}$ and $\sin(2A) = 2\sin(A)\cos(A) = 2\left(\frac{15}{17}\right)\left(\frac{-8}{17}\right) = \frac{-240}{289}$.

$\cos(2A + B) = \cos(2A)\cos(B) - \sin(2A)\sin(B) = \left(\frac{161}{289}\right)\left(\frac{-24}{25}\right) - \left(\frac{-240}{289}\right)\left(\frac{-7}{25}\right) = \frac{-5544}{7225}$.

An alternative solution: Use your calculator to store angle $A$ and angle $B$. $\angle A$ is a fourth quadrant angle and is equal to $2\pi - \sin^{-1}(8/17)$ [note that $\sin^{-1}(8/17)$ is the reference (acute) angle]. $\angle B = \pi + \cos^{-1}(24/25)$. Store each of these expressions into your calculator's memory and have the calculator compute $\cos(2A + B)$. There is a good chance that your calculator will not be able to convert the decimal response to a fraction, but you can change the fractions from the choices to decimals.