# A Collection of UIL Math Problems

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# Contents

# 1 Algebra

## Problems

1. Evaluate: $1 \times (2+3)^{-1} - 4 \div \frac{5}{6} + 7 \times (8)^0$

2. If $x$ is $40\%$ less than $y$ and $y$ is $30\%$ more than $z$, then $x$ is ______than $z$.

3. Mora Doe goes to the 25% off book sale. She buys 4 romantic novels which cost $11.95 each before the sale and includes tax. She gave the clerk 2 twenty-dollar bills. How much change should Mora receive?

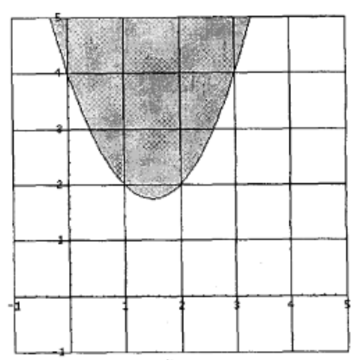
4. If $9x^2 - 12x + 4 = (ax - b)^2$ then $a + b =$ ______.

5. Harry Hare drove 210 km to Myrtle Turtle's house. Part of the 4 hour trip was in town at 30 km/h and the rest was on a major highway at 60 km/h. How many km did Harry drive on the major highway?

6. Simplify: $\log_b(3xy) - \log_b(\frac{3x}{2y}) + \log_b(3y^2)$

7. Line $m$ goes through points $(1, -1)$ and $(-3, 1)$. Line $n$ goes through points $(1, 1)$ and $(x, y)$. Which of the following points lies on line $n$ if $m \perp n$?

8. Which of the equations will produce the shaded portion of the graph shown?



9. The first five terms of an infinite arithmetic sequence is $6\frac{1}{4}, A, B, C, 12\frac{1}{2}, \ldots$. Find $A + B + C$.

10. The numbers of integers that satisfy the inequality new $\frac{3}{7} < \frac{n}{14} < \frac{2}{3}$ is:

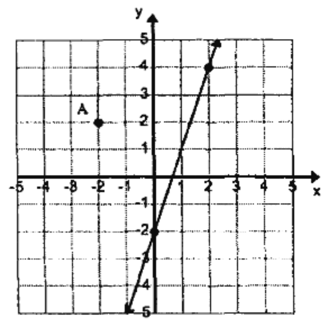
11. Define $n\star$ to be $n^n$. Compute $(2\star)\star$.

12. Evaluate: $\frac{3}{8} \div .75 \times \frac{1}{2} - .25 + \frac{1}{16}$

13. A legend on a map shows 2.5 cm representing 200 miles. The distance on the map from El Paso to Texarkana is 9.8 cm. According to the map, how far is it from El Paso to Texarkana?

14. Phil Errup's car has a gas tank with a capacity of 18 gallons. The gauge shows that it is $\frac{1}{4}$ full. How many gallons will need to be added to the tank so that it is 75% full?

15. Find the equation of the line shown.



**16.** Let $p$ and $q$ be the roots of $8x^2 + 2x - 15 = 0$. Find $p^3 + 3p^2q + 3pq^2 + q^3$.

**17.** One of the factors of $x^3 - 3x^2 - 3x + 18$ is:

**(A)** $x + 2$ **(B)** $x + 3$ **(C)** $x + 6$ **(D)** $x - 2$ **(E)** $x - 9$

**18.** The roots of the equation $x^3 - 5x^2 + cx + 24 = 0$ are $3, 4$, and $R$. Find $c$.

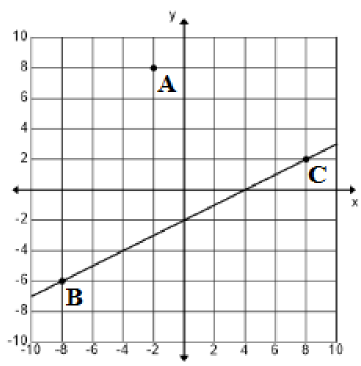
**19.** Let $f(x) = 2x + 5$ and $g(x) = 3x - 4$ and $h(x) = 6x$. Find $f(g(h(-1)))$.

**20.** The coefficient of the 2nd term of the expansion of $(3x - 4)^5$ is:

**21.** Solve for $k$ if $3k - 4 = 28 - 5k$

**22.** Joe's dad sent him to the Burger Barn with three twenty-dollar bills and one five-dollar bill. He ordered 6 cheeseburgers for \$4.85 each, one basket of fries for \$5.75, 6 large cokes for \$2.19 each and 6 lemon pies for \$1.25 each. The tax rate is 8.25%. How much change did he receive?

**23.** Consider a line that is perpendicular to $\overline{BC}$ and also contains point $A$. If the $x$-intercept of ths line is $(a, 0)$, then $a =$ ______.



**24.** The Reagan High math/science team brought in the Quebe Sisters for a UIL fundraiser. Their fee to appear was \$5,000. Their version of "San Antonio Rose" is outstanding. A student ticket cost \$8.00 and an adult ticket cost \$15.00. A total of 2100 tickets were sold and \$20.375 was raised after paying the fee. How many adult tickets were sold?

**25.** Consider four consecutive even integers, all positive, such that five times the sum of the first two exceeds three times the sum of the first and fourth by 80. The third integer is ______.

**26.** Simplify: $\frac{\frac{c}{w} + \frac{d}{w^2}}{\frac{m}{w^2} + \frac{k}{hw}}$

**27.** If $f(x) = x^2 + 4$ and $h(x) = 3x - 1$, then $f(h(5)) =$ ______.

**28.** Find the number that is $\frac{5}{6}$ of the way from $-4\frac{1}{2}$ to $9\frac{3}{8}$.

**29.** Cindy rode her bike for 60 miles at 24 mph and then rode 36 miles at 30 mph. How fast does she need to ride the final 44 miles to have an overall speed of 28 mph? (nearest tenth)

**30.** Consider the points $A(-6, 10)$ and $B(4, -6)$. Find the equation of a line that exists such that every point on the line is the same distance from $A$ as it is from $B$.

**31.**

| x | -3 | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|---|
| f(x) | 10 | -9 | -10 | -5 | -6 | -25 |

Find the value of $f(-4)$.

**32.** If $s(x)$ is the slant asymptote of $h(x) = \frac{x^3+6}{2x^2+x-1}$, then $h(20) - s(20) =$ ______. (nearest thousandth)

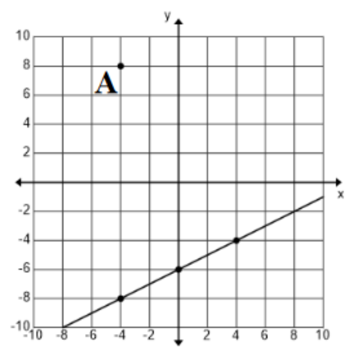
**33.** If $(x^3 - 9x^2 + kx - 12) \div (x - 1)$ has a remainder of zero, then $k =$ ______.

**34.** Consider the sequence $3, 5, 8, 11, 15, 20, 27, 37, m, n, 111, \ldots$ $m + n =$ ______

**35.** Find the distance between the points $(3, 5, 7)$ and $(-4, 1, -3)$. (nearest tenth)

**36.** Jeremy has 49 coins with a total value of \$7.05. He only has nickels, dimes, and quarters. He has three more quarters than nickels. How many dimes does he have?

**37.** Find the distance between point $A$ and the line shown on the right. (nearest tenth)




**38.** At Babe's in Sanger, we ordered four smoked chicken dinners for \$17.95 each, four iced teas for \$2.29 each and two slices of apple pie for \$4.25 each. The tax rate was 8.125% and I paid with one \$100 bill and one \$20 bill. I told the waitress to keep the change as a tip. How much was her tip?

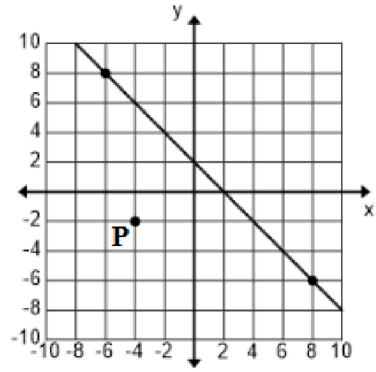
**39.** Consider the line with points $(-3, -5)$ and $(5, 7)$. The line contains the point $(0, b)$. $b =$ ______.

**40.** Joe sets the motor of his small boat to travel at its maximum speed. At this setting, he travels 36 miles upstream, against the current, in 9 hours and then turns around and travels 36 miles downstream, with the current, in 6 hours. What is the maximum speed of Joe's boat in still water?

**41.** Last summer, we drove from Lubbock, TX to McMinnville, OR to see relatives. On day 1, we drove 600 miles at an average speed of 62 mph. On day 2, we drove 620 miles at an average speed of 68 mph. On day 3, we drove 534 miles at an average speed of 60 mph. What was our overall average speed for the trip? (nearest tenth)

**42.** Jim can clean my pool in 75 min. Tom can clean my pool in 90 min. Julie can clean my pool in 60 min. If all three of them work together, how long would it take them to clean my pool? (nearest tenth)

**43.** Consider the line $y = f(x)$ which contains point $P$ and is parallel to the line shown below. Find the value of $f(9)$.




**44.** The UIL students at Latexo High School sold 246 tickets to the end of the year banquet. If adult tickets cost \$18, student tickets cost \$12, and \$3816 was raised, how many student tickets were sold?

**45.** Mary has 57 coins that are either nickels, dimes or quarters. The value of the coins is \$8.60. She has ten more quarters than nickels. How many dimes does she have?

**46.** Find the number that is $\frac{3}{4}$ of the way from $-1\frac{1}{2}$ to $6\frac{5}{8}$.

**47.** If $f(x) = \frac{2x+5}{3-7x}$, then $f^{-1}(2) =$ ______.

**48.** Sixty workers could do 9 jobs in 6 days. How many days would it take 10 workers to do 12 jobs? (nearest tenth)

**49.** Consider the line $y = f(x)$ such that all points on the line are equidistant from the points $(-6, 8)$ and $(4, -6)$. The $y$-intercept of the line $y = f(x)$ is $(0, b)$. $b =$ ______.

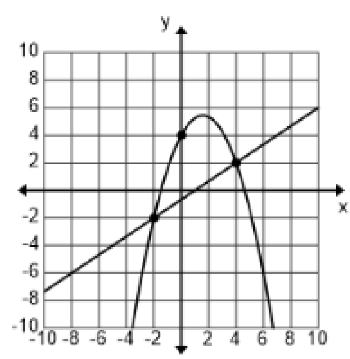
**50.** Find the domain of the function $f(x) = \frac{\sqrt{3+x}}{x^2-9x+20}$.

**51.** Solve the system

$$\frac{2}{5}a + \frac{3}{10}c = 2\frac{1}{5}$$
$$-.5a + 1.5b = 2.5.75a - 2.5c = -2$$

$b =$ ______.

**52.** The points of intersection of the curves shown on the right are $P$ and $Q$. $PQ =$ ______. (nearest tenth)




**53.** Joe and Arlene ate lunch at The Cotton Patch. Both ordered the Salmon Dinner which costs \$15.95 each and both ordered peach iced tea which costs \$2.25 each. They shared a slice of chocolate cake which costs \$4.95. THe tax rate was 8.25%. Joe was feeling generous so he paid with three \$20 bills and told the waitress to keep the change as a tip. How much was the tip?

**54.** An adult ticket to an Idaho Falls game cost \$10.00 and a youth ticket cost \$6.00. On Tuesday night's game, they sold 396 tickets and grossed \$3224. How many adult tickets did they sell?

**55.** Given: $f(x) = 2x^2 - 6$ and $h(x) = e^x - 8$. $f(h(3)) =$ ______. (nearest hundredth)

**56.** Find the range of the function $f(x) = \frac{5}{\sqrt{x^2-1}}$.

**57.** Justin can wash and wax 10 cars in a 4 hours. Aryan can wash and wax 20 cars in 6 hours. Justin started work at 8:00 AM. Aryan arrived at 10:00 AM and they both worked from 10:00 AM until a total of 30 cars had been washed and waxed. What time was it when they finished if they took no breaks? (nearest minute)

**58.** The roots of the quadratic equation $4x^2 + bx + c = 0$ are $-2.5$ and $1.5$. $b + c =$ ______.

**59.** The 5th term of an arithmetic sequence is 23 and the 13th term is 55. Find the sum of the first 15 terms of the sequence.

**60.** Let $A = \begin{bmatrix} 1 & -2 \\ 1 & -3 \end{bmatrix}$ and $B = \begin{bmatrix} -3 & 2 \\ -1 & 1 \end{bmatrix}$ and $AB = \begin{bmatrix} W & X \\ Y & Z \end{bmatrix}$. What is the determinant of $AB$?

**61.** Which of the following is true about the relation $h(x) = 5 - x^2$?

**62.** Consider the sequence $17, 21, 25, 29, 33, 37, \ldots, 129, 133$. Find the sum of the terms of the sequence.

**63.** Eric is solving the equation $3x^2 + 3x - 90 = 0$ by completing the square. On the third step, Eric adds ______to both sides of the equation.

**64.** Consider the function $f(x) = 4x^4 - 27x^3 + cx^2 + 7x + 30$. If $f(1) = 14$, then $c =$ ______.

**65.** The graph of $f(x) = \frac{x^2-36}{x^3-x^2-30x}$ has ______ asymptotes.

**66.** The sound level of a sound is given by $\beta = 10\log\left(\frac{I}{I_0}\right)$, where $\beta$ is the sound level in dB, $I$ is the intensity in W/m$^2$, and $I_0$ is the threshold of hearing which equals $10^{-12}$ W/m$^2$. Find the difference in sound levels for a sound with an intensity of $7.75 \times 10^{-3}$ W/m$^2$ and a sound with an intensity of $3.10 \times 10^{-5}$ W/m$^2$. (nearest whole number)

**67.** The first three terms of an infinite geometric series are 84, 72, and $61\frac{5}{7}$. Find the sum of the series.

**68.** Jack and Larry had supper at Bigham's Barbeque Friday night. Jack ordered the one-meat plate for $16.75, a slice of chocolate cake for $4.15, and an iced tea for $2.59. Larry ordered a two-meat plate for $18.95 and an iced tea for $2.59. The tax rate was 8.25%. Jack was feeling generous so he paid with three $20 bills and told the waitress to keep the change as a tip. How much was the tip?

**69.** The Wylie math team held a fundraiser for their UIL team. They flew in the 60s rock group, the Ohio Express, and the concert was a sell-out. Adult tickets were priced at $22.75 and student tickets were priced at $14.50. They sold 2500 tickets and netted $48,501.25. How many adult tickets did they sell?

**70.** If $f(x) = \sqrt{x^3 + 22}$ and $h(x) = \ln(x) + 6$, then $f(h(55)) =$ ______. (nearest tenth)

**71.** All of the houses on 6th street are the same size. Brennen can paint a house on 6th street by himself in 15 hours. If Luke works with him, they can paint a house on 6th street in 8 hr 45 min. How long does it take Luke to paint a house on 6th street by himself? (nearest whole number)

**72.** The $y$-intercept of the line that contains the points $(-6, 4)$ and $(12, -2)$ is the point $(0, b)$. $b =$ ______. (nearest tenth)

**73.** Find the domain of the function $f(x) = \frac{x-5}{\sqrt{9-x}}$.

**74.** The sound level of a sound is given by $\beta = 10\log\left(\frac{I}{I_0}\right)$, where $\beta$ is the sound level in dB, $I$ is the intensity in W/m$^2$, and $I_0$ is the threshold of hearing which equals $10^{-12}$ W/m$^2$. If the sound level is 98 dB, then the intensity is ______W/m$^2$. (nearest ten-thousandth)

For problems 75 and 76, consider a line containing points $A(-5, -1)$, $B(5, 9)$, and $C(d, 12)$.

**75.** The value of $d$ is ______. (nearest tenth)

**76.** If the point $F(e, 3)$ lies on the perpendicular bisector of $\overline{AB}$, then $e =$ ______.

**77.** Consider the function $f(x) = 3x^3 + bx^2 - 21x - 30$. If $f(-2) = 36$, then $b =$ ______.

**78.** The graph of $f(x) = \frac{x^2-16}{x^3+x^2-12x}$ has ______asymptotes.

**79.** Consider the sequence $4, 11, 18, 25, 32, 39, \ldots$. Find the sum of the first 14 terms.

**80.** Consider the sequence $40, 32, \frac{128}{5}, \frac{512}{25}, \ldots$. Find the sum of the first 10 terms. (nearest tenth)

**81.** Evaluate $5! - 5 \times 5 + 5^5 \div 5$

**82.** Graphing calculators are on a "buy 3 get 1 free" special sale. The cost of a single calculator is $85.50. Each calculator requires 4 batteries and a package of 6 batteries costs $2.50 and are not sold by the individual battery. The tax rate is $8\frac{1}{2}$%. What will the total cost be for 4 calculators, enough batteries to run them, and tax? (nearest cent)

**83.** The discriminant of $2x^2 - 3x + 4 = 0$ is ______.

**84.** If $\frac{2y}{3} - \frac{3}{4x} = \frac{5y}{6}$, then $x$ equals ______.

**85.** If $r$, $s$, and $t$ are real numbers such that $r + s + t = 14$, $t^2 = r^2 + s^2$, and $rs = 14$, find the value of $t$.

**86.** If $3^{x+y} = 9$ and $4^{x-y} = 64$ then $xy$ equals ______.

**87.** Find $C$ if the remainder when $x^3 - 2x^2 + x - 5$ is divided by $x + C$ is 31.

**88.** In the expansion of $(3x - 2y)^5$, the 4th term has a coefficient of ______.

**89.** Simplify: $(\sqrt{x^{-20}y^{40}z^{-4}})^{\frac{1}{5}}$

**90.** An operation "$\triangle$" is defined by: $a \triangle b = a^b - b^a$. What is the value of $(0\triangle 1)\triangle(1\triangle 2)$?

**91.**


The distances between the hash marks (|) are equal. Find $S$.

**92.** 30 miles per hour equals ______feet per minute.

**93.** The function $f(x) = |\ 1 - 2x\ | - 3$ crosses the $x$-axis at two points. Find the distance between the two points.

**94.** Dusty Rhodes flies from Durt E. Airport to Kleen X. Airport at a rate of 340 miles per hour. She rents a jeep and drives from Kleen X. Airport to Durt E. Airport at a rate of 60 miles per hour. How far is it from Kleen X. to Durt E. if the total traveling time was 2 hours and 30 minutes?

**95.** $x - 1, 2x + 3$ and $4x - 5$ are factors of which of the following?

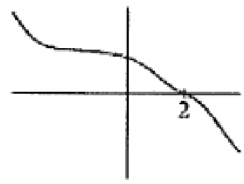
**(A)** $8x^3 - 10x^2 - 13x + 15$ **(B)** $8x^3 - 6x^2 - 17x + 15$ **(C)** $8x^3 + 6x^2 - 17x - 15$ **(D)** $8x^3 - 10x^2 - 17x + 15$ **(E)** $8x^3 - 6x^2 - 17x - 15$

**96.** The point $P(-1, 4)$ is rotated $90^\circ$ clockwise around the origin to point $Q$. Then point $Q$ is reflected across the line $y = x$ to point $R$. What are the coordinates of point $R$?

**97.** Mike Campbell is stacking soup cans at the Piggy Wiggy store for the weekend sale. The bottom row has 20 cans. Each successive row has 1 less can in it. If the top row has 3 cans, how many cans did Mike have on display?

**98.** If $a_1 = 1$, $a_2 = 3$, $a_3 = 4$ and $a_n = a_{n-1} + a_{n-2}$, where $n \geq 4$, then $a_9$ equals:

**99.** Which of the following is a false statement about the function $f$ whose graph is shown here?




**(A)**decreases monotonically **(B)**is positive at 0 **(C)**has a zero at $x = 2$
**(D)**decreases monotonically in quadrant I **(E)**increases monotonically

**100.** Let $f(x) = 3x - 2$ and $g(x) = 2x + 1$. Find the composite function $(g \circ f)(x)$.

**101.** General admission tickets at the ballpark cost \$3.00 for children under 12 and senior citizens over 55 and \$5.00 for everyone else. On Tuesday, 2006 general admission tickets totaling \$8008.00 were sold. How many children and/or seniors bought general admission tickets?

**102.** Simplify: $\frac{(n+2)(n+1)!}{(n-1)(n-2)!}$

**103.** $P$, $Q$, and $R$ are the three real roots of $5x^3 + 4x^2 - 3x = 2$. Find $PQ + QR + PR$.

**104.** The range of the function $y =| 1x - 2 | +3$ is:

**105.** Lotta Cash has a pocket full of change, but she can not make change for a dollar. Lotta has no half dollars and no silver dollars. What is the greatest value of coins she could have?

**106.** Evaluate: $(3)^3 \div (3 + 6) - 3! \times \sqrt{9}$

**107.** 70 miles per hour is equivalent to ______inches per second.

**108.** Which of the following equations has a graph of a parabola that intersects the $y$-axis at only one point and the $x$-axis at only one point? $y =$ ______.

**(A)** $.5x^2 - 2x + 1$ **(B)** $x^2 - 4x - 5$ **(C)** $|2x - 4| + 1$ **(D)** $2 \pm \sqrt{x}$ **(E)** $12(x)^{-1}$

**109.** Tryce Ikle can get to school in 12 minutes riding his bike at an average of 15 miles per hour (mph). How many minutes would it take him to walk to school if he walks at 4 mph?

**110.** If $x + y = 5$ and $xy = 1$ then $x^3 + y^3 =$?

**111.** Noah Sense is making a trapezoid using pennies. The bottom base is a row of 15 pennies. The next row above the base row contains 1 less penny and each successive row contains 1 less penny. He continues until the top base of the trapezoid has only 3 pennies. How much money does he need to form the trapezoid of pennies?

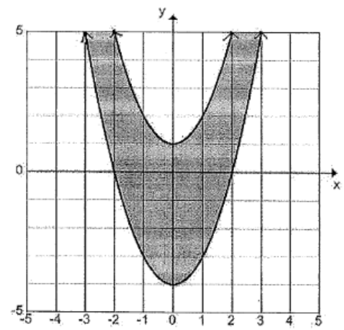
**112.** The roots of the equation $x^3 - bx^2 + 23x + d = 0$ are $-1, 9$, and $R$. Find $R$.

**113.** Let $A = \begin{bmatrix} 2 & 3 \\ 4 & x \end{bmatrix}$ and $B = \begin{bmatrix} y & 1 \\ -1 & -1 \end{bmatrix}$ then $AB = \begin{bmatrix} -1 & -1 \\ 1 & 1 \end{bmatrix}$. Find $x + y$.

**114.** Two non negative numbers $x$ and $y$ exist such that the sum of the numbers is 12 and that the product of one number and the square of the other number is a maximum. What is the maximum product?

**115.** Melody Toone's music store sells a new CD for 125% above the wholesale cost. The store will buy the CD back in used condition for 40% of the selling price. How much profit will the store make if the selling price was \$19.99?

**116.** Which of the following system of inequalities would be best represented by the shaded region shown?




**117.** Mr. White and his dog walked 1 mile at an average speed of $3\frac{1}{3}$ mph and returned home the same route at an average speed of $2\frac{1}{2}$ mph. What was their average speed for the entire walk?

**118.** The slope of the line tangent to the curve $y = x^3 - 5x + 6$ at $x = 1$ is $-2$. The point of intersection of the tangent line and the curve is:

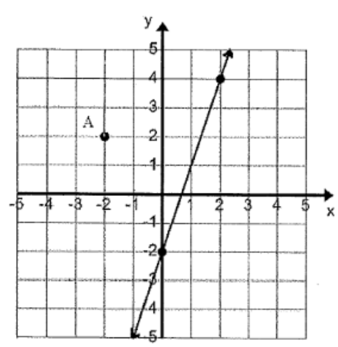
**119.** Find the product of all the solutions of $16^{x^2+x+4} = 32^{x^2+x}$.

**120.** The average of five tests is 85. If two test scores have 5 points removed from each, 1 test score has 20 points added, and the remaining two remain the same, the new average is:

**121.** Kandy Heart had a box of valentines. She gave $\frac{2}{3}$ of them to her classmates. She gave 5 of the remaining valentines to her brothers and sisters. SHe had 3 left over for her father, her mother, and herself. How many valentines were in the original box?

**122.** Line $6x - 5y = 4$ is perpendicular to line $3x - ay = 1$. What is the value of $a$?

**123.** Line $AB$ is paralell to the line shown. Which of the following points could be point $B$?




**(A)** $(-7, -5)$ **(B)** $(-6, -10)$ **(C)** $(4, 21)$ **(E)** $(2, 13)$ **(E)** $(5, -1)$

**124.** The point $(3, 4)$ is rotated 60 degrees clockwise about the origin. The coordinates of the point after the rotation is ______. (closest approximation)

**125.** One of the roots of $ax^2 + bx + c = 0$ is $2 - 3i$. Find $b^2 - 4ac$, when $a = 1$.

**126.** Evaluate: $(\log_2 8)(\log_3 9)(\log_4 4)$

**127.** How many asymptotes does this function have? $f(x) = \frac{x^2+6x+8}{x^2-6x+8}$.

**128.** Find the remainder when $f(x) = x^3 + 2x^2 - 3x - 4$ is divided by $x - 5$.

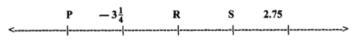
**129.** If $a_1 = -3$, $a_2 = 1$ and $a_n = (a_{n-1})(a_{n-2})$, where $n \geq 3$, then $a_5$ equals:

**130.** Point $A(2, -4)$ lies in the $x - y$ plane. Point $A$ is reflected across the line $y = -x$ to point $B$. Point $B$ is reflected across the $x$-axis to point $C$. Point $C$ is reflected across the line $y = x$ to point $D$. Find the coordinates of point $D$.

**131.** The value of $(0.08333\ldots)^{-1} \div (0.0625)^{-1} \times (.0555\ldots)$ is:

**132.** Evaluate: $[1.2 \div (\frac{3}{5})^2 - (3)^{-1}] \times 4!$

**133.** The distances between the hask marks (—) are equal. Find $P + R + S$.




**134.** Phil Upp's truck gets 17 miles per gallon of gas. He has \$20.00 to spend on gas. If the cost of a gallon of gas is \$3.50, how far can phil drive? (nearest whole mile)

**135.** Line $l$ going through points $(-1, 3)$ and $(k, -5)$ is perpendicular to $x + 4y = 5$. Find $k$.

**136.** Simplify: $\left(\frac{6w^2+7w-3}{2w^3+5w^2+3w}\right)\left(\frac{w^2-w-2}{3w^2-7w+2}\right)$

**137.** Ima Whett paddles her kayak at a constant speed of 5 mph relative to the water. She paddles upstream for 1 hour 20 minutes. The return trip back only takes 1 hour 5 minutes. Which of the following is the closest approximation of the speed of the current?

**138.** The graph best depicts Mei Strol's daily 6 minute walk. (speed is not truly linear in this case). During the time interval of 3 minutes to 4 minutes Mei is ______.

**139.** Let $x^5 - x^4 - px^3 - qx^2 - x - 1 = 0$, where $p, q > 0$. According to Descartes' Rule of Signs, how many possible roots are there?

**140.** If 5 adults and 2 teenagers work together, they can do a job in 1 day. If only 2 adults work, then 6 teenagers must in order to do the job in 1 day. If no adults work and only 1 teenager works, how long will it take the teenager to do the job?

**141.** Missy Klas was absent the day of the algebra exam. She took the test the next day and made a 96. Her score raised the class average from 71 to 72. How many students, including Missy, took the test?

**142.** If the roots of $x^3 + bx^2 + cx + d = 0$ are $-5, 1$, and $3$, then $b + c + d$ equals:

**143.** Mr. White's college math class has 40 students. 75% of the students are math majors. 32 of the students passed the final exam. 75% of those who passed the final exam are math majors. What percentage of the class who were not math majors passed the final exam?

**144.** If $y^2 = -4 + 0i$ and $y^3 = 0 - 8i$ where $y = a + bi$ then $a + b$ equals:

**145.** How many of the following numbers are NOT solutions to $7 - 5|3x + 1| \geq -1$?

-0.987    -0.777...    .222$\cdots$    0.3    .12

**146.** Let $f(x) = 4 - x$ and $g(x) = 3x - 5$ and $h(x) = 2x$. Find $h(f(g(0)))$.

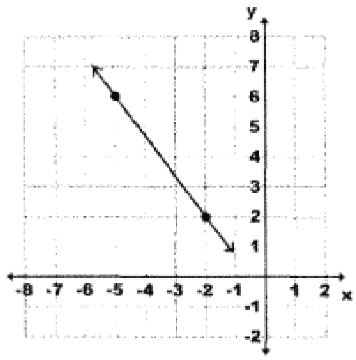
**147.** How many asymptotes does $f(x) = \frac{2-3x^2}{x-1}$ have?

**148.** Evaluate: $2(3 \times 4! \div (5 - 6) + 7^2 - 8)$

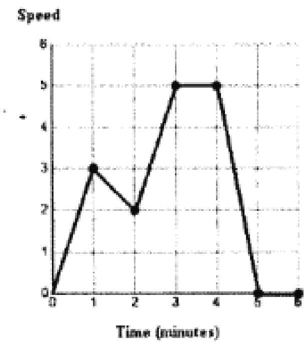
**149.** What is 25% of $\frac{3}{4}$ of 50 plus 75% of $\frac{5}{8}$ of 40?

**150.** The Cheep Choppe is having a February Sale. The regular price of their special coats is \$89.95. They are on sale for 30% off the regular price. A newspaper coupon offers 10% off of the sale price. What would the selling price be if the customer brings in the coupon?

**151.** Find an equation of the line shown.




**152.** Betty Wheel rides her bicycle up and down the hilly streets from her house to school. The graph best depicts her 6 minute ride. (speed is not truly linear in this case). During the time interval of 2 minutes to 3 minutes Betty is ______.




**153.** If 5 men working 5 hours a day for 5 days can dig a tunnel 5 km in length, then how long of a tunnel can 10 men working 10 hours a day for 10 days dig?

**154.** Lesleys Kwik runs the 400 meter dash at the local track meet. She runs the first 100 meters in 15 seconds, the second 100 meters in 16 seconds, the third 100 meters in 17.2 seconds and the last 100 meters in 18.5 seconds. What was her average speed? (nearest thousandth)

**155.** How many ordered pairs $(x, y)$ are solutions to the equation $5x + 3y < 40$, where $x, y$ are integers and $0 < y < x < 9$?

**156.** Find the smallest integer $k$ so that $4x^2 = 3x + k = 0$ has two imaginary roots.

**157.** Let $f(x) = 2x + 1$ and $g(x) = 4 - 3x$, then $f^{-1}[g^{-1}(-1)]$ equals:

**158.** If $p + q = 12$ and $p \times q = 22$ then $(p - q)^2 =$?

**159.** Noah Kanwen won 40 of 75 games. How many of the next 25 games can Noah lose in order to have won 60% overall?

**160.** Three students in Miss Woik's class were absent the day of the exam. The average of the other 12 students was 84. What would the three absent students have to average on their make-up exam in order to bring the entire class average to 86?

**161.** Find the determinant: $A = \begin{bmatrix} -1 & 2 & 3 \\ 1 & -2 & 3 \\ 1 & 2 & -3 \end{bmatrix}$

**162.** Simplify: $\frac{(n-1)!(n+2)!}{(n+1)!(n-2)!}$

**163.** Simplify: $((a^2b)^{-3} \times (ab^2) \div (a^2b^{-3}) \times (ab))^{-1}$, where $a, b > 0$.

**164.** In 3 years Sid Upp will be twice as old as his son, Stan Upp. Five years ago Stan's age was $\frac{1}{3}$ of his father's age at that time. What is the sum of their ages now?

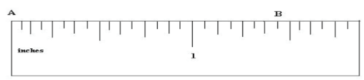
**165.** Point $P(2,-3)$ is reflected across the origin to point $Q$. Then point $Q$ is translated horizontally 3 units to the right to point $R$. Point $R$ is reflected across the origin to point $S$. The coordinates of point $S$ is $(x, y)$. Find $x+y$.

**166.** If $9^{(x+2y)} = 81$ and $9^{(2x-y)} = \frac{1}{9}$, then $3^{xy} =$?

**167.** Evaluate: $30 - 24 \div 18 \times 12 + 6$

**168.** Reid Moore went to the Ye Olde Book store to buy 3 copies of the same book for gifts. The regular price of the book is \$19.95. Because he is buying 3 copies, he gets 25% off of the regular price of the second copy and 40% off the regular price of the third copy. What would the total cost of the 3 books be before taxes? (to the nearest cent)

**169.** Using the partial ruler shown below, find the distance from $A$ to $B$.




**170.** Which of the following is not a solution to $|8x-6| - 4 \geq 2$?

**(A)** $-2\frac{1}{5}$ **(B)** $-\frac{2}{5}$ **(C)** $\frac{3}{5}$ **(D)** $1\frac{4}{5}$ **(E)** $2$

**171.** The function $f(x) = x^2 - x - 12$ crosses the $x$-axis at two points. Find the distance between the two points.

**172.** A male zebra fish has 8 stripes. A female zebra fish has 7 stripes. What is the ratio of male fish to female fish, if the total number of stripes on all of the zebra fish in an aquarium totals 87?

**173.** Noah Sense has 28 coins consisting of pennies, nickels, and quarters. He has four times as many nickels as pennies and half as many quarters as nickels. How much money does he have?

**174.** If $8^{(k-1)} = 16^{(3k)}$, then $4^{(k^{-1})} =$?

**175.** Find the determinant of the $2 \times 2$ matrix $A = \begin{bmatrix} -2 & 3 \\ 5 & -7 \end{bmatrix}$

**176.** Given the arithmetic sequence $15, a, b, c, 47, \ldots$, find $a+b+c$.

**177.** The number of integers that satisfy the inequality $\frac{4}{15} \leq \frac{n}{5} \leq 1\frac{1}{30}$ is:

**178.** Simplify: $\frac{(n+1)!-(n-1)!}{(n-2)!}$

**179.** Simplify: $a^5 \div b^{-4} \times a^{-4} \times b^5 \div a^3 \times b^{-3}$

**180.** Simplify: $\frac{x^2-9}{4x+12} \div \frac{x^2-x-6}{x^2+2x}$

**181.** The distance from Abilene to Dallas by way of I30 is 185 miles. Ima Slow is leaving Abilene on I30 at 9:00 a.m. driving towards Dallas at 55 mph. Ura Quick is leaving Dallas on I30 at 9:00 a.m. driving toward Abilene at 70 mph. What time will they meet? (nearest minute)

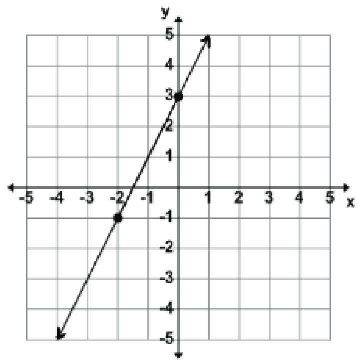
**182.** If $a_1 = 2, a_2 = 4.5$, and $a_3 = 7$ are the first 3 terms of an arithmetic sequence, then $a_9 =$?

**183.** The operation "$\triangle$" is defined by: $a \triangle b = a^b - b^a$. What is the value of $(0 \triangle 1) \triangle (2 \triangle 3)$?

**184.** Slim Sails rents kayaks and life vests for white water rafting. The kayak rental fee lats year was \$40 and the life vest rental fee last year was \$12. This year, the kayak rental fee increased 15% and the life vest fee decreased 25%. What is the overall percent increase in rental fees for the kayak and vest from last year to this year? (nearest tenth)

**185.** If $-3(2-x) = 2(x+3)$ then $(2x-3)$ equals:

**186.** Find the slope of a line perpendicular to the line drawn in the graph below.

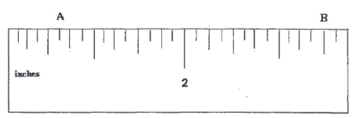



**187.** Let $f(x) = 2 - 5x$ and $g(x) = 3x + 5$. If $h(x)$ is the inverse function of $\frac{f(x)}{g(x)}$, then $h(-4) =$?

**188.** The polynomial $2x^4 - 8x^2 + x + 5$ has at most ______negative zeros.

**189.** Evaluate: $\frac{7}{8} + \frac{3}{4} \div (\frac{5}{8} - \frac{1}{2}) \times \frac{3}{8} + \frac{1}{4} - \frac{1}{8}$

**190.** Using the partial ruler shown below, find the distance from $A$ to $B$.




**191.** May B. Fishy has a salt water aquarium. She mixes 5 gallons of water with some salt to make a 20% saline solution. The fish require a 16% solution. How much water will she have to add to make the required 16% saline solution?

**192.** Find $f(5) + f(-1) + f(2)$ if $f(x) = \begin{cases} x - 3 & \text{if } x < 0 \\ 3x & \text{if } 0 < x < 3 \\ 3 - x & \text{if } x > 3 \end{cases}$

**193.** If $y = 1 - x$ and $y = \frac{2}{x}$ then $(x + y)(x^2 - xy + y^2) =$?

**194.** Find the quotient: $(x^4 + 2x^3 - 10x^2 + 22x - 15) \div (x^2 - 2x + 3)$

**195.** Les Moolah has 28 coins. The coins are nickels and quarters and have a total value of \$4.00. How many more nickels than quarters does Les have?

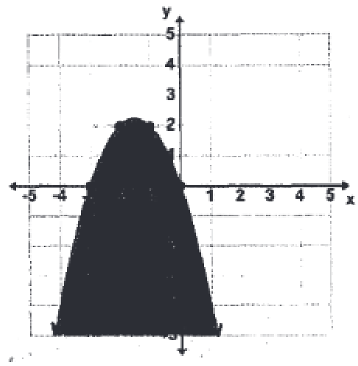
**196.** Find $k$ if $x + 4$ is a factor of $x^3 - x^2 + kx + 12$.

**197.** On the map legend, 1 inch represents 120 miles. Beautiful downtown Millersview is 45 miles from San Angelo. How far is it on the map?

**198.** Which of the following is not a solution of $3 + 2|5x - 1| \leq 4$?

**(A)** $\frac{1}{4}$ **(B)** $\frac{2}{5}$ **(C)** $\frac{1}{6}$ **(D)** $\frac{2}{7}$ **(E)** $\frac{1}{8}$

**199.** Which of the equations will produce the shaded portion of the graph shown?




**200.** The Azusa Aztec band is selling band calendars to make money for their trip. They get 30% of the sales for the first 100 sold, 40% of the sales above 100 but less than or equal to 200, and 50% of the sales over 200. How much will the band make if they sell 275 calendars if each calendar sells for $10.

**201.** Simplify: $a^{-2} \times b^2 \div a^3 \div b^{-3} \times a \div b$

**202.** The points $(2, 3)$ and $(-4, k)$ lie on the line $5x - 6y = C$. Find $k$.

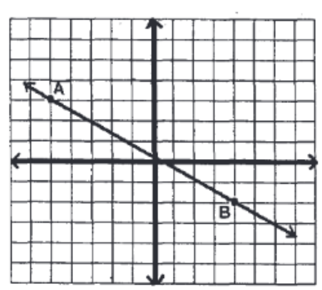
**203.** Les Quik, Moe Fass, and Willie Makit run in a 100 meter race. Les beat Moe by 10 meters and Moe beat Willie by 20 meters. If the runners ran at a constant speed, by how much did Les beat Willie?

**204.** Point $P(-3, 2)$ and point $Q(4, -5)$ line on the $x - y$ plane. $P$ is translated horizontally 2 units to the left. $Q$ is reflected across the $y$-axis. What is the distance between the points after the translations? (nearest tenth of a unit)

**205.** If $a_1 = 2$, $a_2 = 3$, $a_3 = 5$ and $a_n = a_{n-1} + a_{n-2} - a_{n-3}$, where $n \geq 4$, then $a_8$ equals:

**206.** Find $f(g(1 - x))$ when $f(x) = 3x - 1$ and $g(x) = x - 3$.

**207.** Find an equation of a line parallel to line $AB$ and passing through point $(-2, -3)$.




**208.** Find the determinant of the $3 \times 3$ matrix. $\begin{bmatrix} 1 & 1 & 2 \\ 2 & 1 & 3 \\ -1 & 0 & 1 \end{bmatrix}$

**209.** $R_1, R_2$ and $R_3$ are the roots of the equations $24x^3 + 26x^2 - 19x - 6 = 0$. $R_1$ and $R_2$ are the roots of the equation $12x^2 - 5x - 2 = 0$ as well. Find $R_3$.

**210.** Let $x = \frac{1}{2+\frac{1}{3+\frac{1}{2+\frac{1}{3+\dots}}}}$ be the continued fraction. Find $x$.

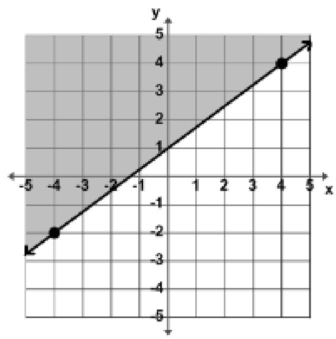
**211.** Simplify: $\frac{(n+1)!}{(n-1)!} \div \frac{(n+2)!}{n!}$

**212.** Evaluate: $4! \times (4)^{-2} + (4^2)^{\frac{1}{4}} - 4 \div 2$

**213.** Lotta Cash received a $50.00 gift card for graduation. She went shopping at the Cheap Shoppe. She bought 2 pairs of shorts at $7.99 each, 3 pair of flip-flop sandals at $4.50 each, a bottle of suntan lotion at $8.25, a sun hat at \$9.89, and 2 bottles of water at 75¢each. She got 15% off for using a gift card instead of a credit card. How much does she have left on her gift card if the tax rate was 7.5%.

**214.** If $45\%$ of $A$ is $4\frac{1}{5}$ of $B$, then $B$ is what percent of $A$?

**215.** Which of the inequalities is best represented by the graph below?




**216.** Simplify: $\left(\frac{2x^2-7x+5}{4x^2+8x-12}\right) \div \left(\frac{4x^2-8x-5}{2x^2+73}\right)$

**217.** If $4x^2 - x + c = (ax+b)(x+1)$ then $a+b+c =$______.

**218.** The line $y = mx + b$ contains the point $(-5, -2)$ and has a slope of $-\frac{3}{4}$. The $y$-intercept is:

**219.** A rectangular swimming pool is twice as long as it is wide and has a 10 foot-wide concrete border around it. If the border has an area of 2800 sq. ft., find the perimeter of the pool.

**220.** If $27^{(k)} = 9^{(k+1)}$, then $3^{(k+2)} =$?

**221.** Let $f(x) = x - 2$, $g(x) = 2x - 1$, $h(x) = 3x$, and $g(f(x)) + f(h(x)) = -4$. Find $x$.

**222.** Which of the following does not have an inverse function?

**(A)** $y = 2x - 4$ **(B)** $y = \frac{1}{4}x + 2$ **(C)** $y = -x^2 + 4$ **(D)** $y = \ln(x+4)$ **(E)** $y = \sqrt{2x-4}$

**223.** Phil Dewallit got a \$20.00 allowance for mowing his parent's lawn this week. They agreed to increase his previous week's allowance 80¢each week for the next 24 weeks. Phil decides to put half of his allowance in his piggy bank each week. How much will he have in the bank at the end of the 25 week period?

**224.** In the expansion of $(3x-2)^5$, the sum of the coefficients of the 3rd and the 4th term is:

**225.** $\sum_{k+1}^{3}(-1)^k(kx - (k+1)y - k) =$?

**226.** Sameer, Anisha, and Ian worked a total of 125 problems on the number sense test at the math camp. Sameer worked 28% of the total problems, Anisha worked 40 less problems than Ian did. What percent of problems did Ian work?

**227.** Find $a + b + c + d$ given the arithmetic sequence: $-11, a, b, c, 3, d, \ldots$

**228.** Let $f(x) = ax^3 - bx + 3$ where $a$ and $b$ are integers. If $f(2) = -4$, then $f(-2) =$?

**229.** Coach Ball has 22 students in his PE class. 9 of the students play football, 10 play basketball, 5 play tennis and basketball but not football, 5 play basketball and football but not tennis, and 2 play tennis only. How many students do not play any of these 3 sports?

**230.** I. Cee and U. Saul used a 2 in. $\times$ 12 in. $\times$ 16 ft. board to make a teeter-totter with the center being on a fulcrum. Cee weighs 85 pounds and is sitting 8 feet from the center of the teeter-totter. Saul weighs 100 pounds and is sitting on the opposite end. How far from the center should Saul sit if the teeter-totter has a slope of zero? (nearest inch)

**231.** If $\log_6(16) - \log_6(4x) = \log_6(x+2)$, then $x$ equals ______.

**232.** Let $g(x) = 3x^2 - 2x + 1$. Find $k$ is $g(k-1) - g(k) = 11$.

**233.** How many ordered pairs of positive integers $(a, b)$ with $a+b \leq 50$, satisfy the equation: $(a+b^{-1}) \div (a^{-1}+b) = 13$.

**234.** If $x < y$ and $x < 0$, which of the following is never greater than any of the others?

**(A)** $x+y$ **(B)** $x-y$ **(C)** $x+|y|$ **(D)** $x-|y|$ **(E)** $-|x+y|$

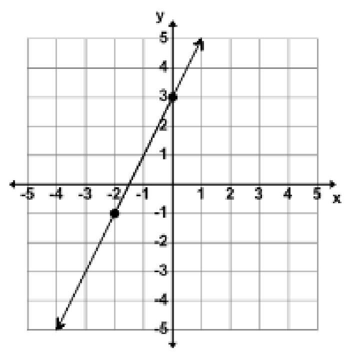
**235.** Given the sequence, $\frac{7}{(1\times1+1)} - \frac{7}{(2\times2-1)} + \frac{7}{(3\times3+1)} - \frac{7}{(5\times5-1)} + \frac{7}{(8\times8+1)} - \ldots$, find the digit in the ten-thousandths place.

**236.** Evaluate: $\sqrt[3]{1728} \div (16)^{\frac{1}{2}} + 8 \times (2)^{-1} - 4$

**237.** Two and one-fourth million is added to three hundred twenty thousand five hundred. One million one thousand one hundred is subtracted from the sum. The difference is divided by eleven. The quotient is truncated to the units place. Which digit appears the most in the final results?

**238.** If $(3x+1)(x-3)(2x) = ax^3 + bx^2 + cx + d$ then $a+b+c+d =$ ______.

**239.** A line parallel to the line shown through the point $(1, -1)$ has $x$-intercept at point $(a, b)$ and $y$-intercept at point $(c, d)$. Find $a+b+c+d$.




**240.** Max Whale likes to mix his regular blend coffee with a boost blend coffee at a ratio of 3 to 1. The regular blend sells for \$11.00 per pound and the boost blend sells for \$8.00 per pound. Find the cost per pound of Max's special mixture of regular blend and boost blend. (nearest cent)

**241.** What is the only real number which, when divided by itself, is 2020 times itself?

**242.** What is the smallest perfect square that can be written as the sum of three different prime numbers?

**243.** Gerry arrived at the bus stop $x$ hours past noon. Dale arrived 4 hours later. Pat arrived at 5 P.M., $x$ hours after Dale. At which time did Gerry arrive at the bus stop?

**244.** For what value of $x > 0$ does $\frac{x^2+2021x+2020}{x^2-2020x-2021} = 2$?

**245.** What is the greatest integer that always divides the difference of the squares of any two different positive odd integers?

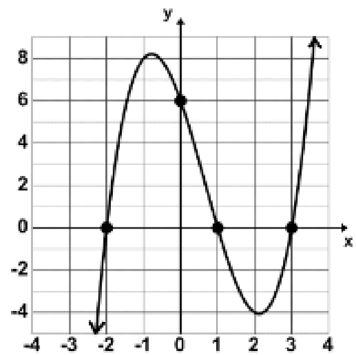
**246.** Of the positive integers between 1000 and 10000 that are divisible by 8, how many have a hundreds digit of 5?

**247.** Les Square increased the length of two opposite sides of a square by 20%, and decreased the other two opposite sides by 50%. What percent of the area of the original square is the area of the new rectangle?

**248.** If $\frac{x+5}{2x-1} + \frac{Ax+B}{3x+2} = \frac{-7x^2+30x+6}{6x^2+x-2}$, where $A$ and $B$ are constants, then $A+B$ equals:

**249.** Let $f(x) = 2x-1$ and $g(x) = 2-3x$ and $h(x) = x+3$. Find $g(h(f(1-x)))$.

**250.** The graph of $f(x) = Ax^3 + Bx^2 + Cx + D$ is shown here. Find $A+B+C+D$.




**251.** Les Qwik and Lotta Speed worked together to finish their research project in 12.5 hours. Lotta works 2.5 times faster than Les. How long would it have taken Lotta to do the project alone?

**252.** How many negative real roots will $x^5 + x^4 - 2x^3 + x^2 - 1 = 0$ have?

**253.** Which of the following is true about the function $f(x) = \frac{x^2+4}{x^3-3}$?

I. $f(x)$ is odd II. $f(x)$ is even III. $f(x)$ has 3 asymptotes.

**254.** Find $k$ if $GCF(48, k) = 8$ and $LCM(48, k) = 336$.

**255.** $(x, y)|x, y \in$ Integers, $-10 \leq x \leq 10$, and $-10 \leq y \leq 10$ is the solution set of $2x + 5y = 10$. How many such ordered pairs exist?

**256.** Find $C$ if the remainder when $(3x^3 + 2x^2 - x + C) \div (x + 1)$ is $4$.

**257.** Ester Bunnee had a box of chocolate eggs. She hid half of them in the yard for the big hunt. Then she put two of the remaining eggs in her room for a late night snack. The remaining six eggs were put in the refrigerator for a later day. How many chocolate eggs were in the original box?

**258.** If $12x^2 + ax - 5 = (bx - 5)(2x + c)$ then $abc =$ ______.

**259.** Let $e^{(2x-3)} = 4e^{5x+6}$. Find $e^{(x)}$. (nearest hundredth)

**260.** Let $f(x) = ax + 4$ and $g(x) = bx - 1$, where $a$ and $b$ are positive integers. Find $a + b$ if $f(g(x)) = g(f(x))$.

**261.** In honor of Valentines day, let $x = 2 + \frac{14}{2+\frac{14}{2+\frac{14}{2+\frac{14}{2+\ldots}}}}$. Find $x$. (nearest tenth)

**262.** The fraction $\frac{30}{\sqrt{3}+\sqrt{5}+\sqrt{8}}$ can be written as $a\sqrt{30} + b\sqrt{3} + c\sqrt{5} + d\sqrt{8}$. Find $a + b + c + d$.

**263.** Let $f(x) = \sqrt{6 - \sqrt{2x + 7}}$. The domain of $f(x)$ is $x|p \leq x \leq q$. Find $\frac{P+Q}{2}$.

**264.** Given: $9x - 6y = 21$ and $6x - 4y = k$. Find the value of $k$ such that the system of equations has an infinite number of solutions.

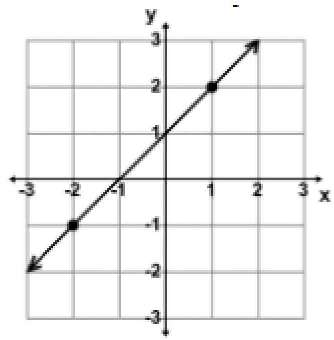
**265.** Evaluate $[4! - (3)^3] + 2^{-2} \times \sqrt{2^4 \div 3^4}$

**266.** Will Itkosmoor wants to buy 4 new calculators for his math team. He can buy 2 at the regular price, 2 at the half price, and pay 8% of the total price for shipping and handling. He can get 16% off and pay no shipping if he buys 4 at the regular price. If the regular price is $89.95, how much will he save if he takes the best deal? (tax exempt)

**267.** Evaluate: $1 + 11^2 \div (2 + 9) + 1 \times 9$

**268.** Mae B. Tulong had twelve yards of rope. She cut off a length of rope that was 2 yards 1 foot 8 inches long. Then she divided the remaining length of rope into four equal parts. How long was each of the four equal parts of rope?

**269.** Which of the following points lies on a line parallel to the line shown and containing point $(0, 3)$?




**(A)** $(9,6)$ **(B)** $(7,11)$ **(C)** $(11,15)$ **(D)** $(-7,-4)$ **(E)** $(-12,-12)$

**270.** Let $4x^2+17x-15=(ax+b)(cx+d)$. Find $a+b+c+d$.

**271.** Let $(2x-1)^2(2x+1)=ax^3+bx^2+cx+d$. Find $a+b+c+d$.

**272.** Simplify: $\left(\frac{x^2-3x-10}{x^2+2x-35}\right) \div \left(\frac{x^2+9x+14}{x^2+4x-21}\right)$

**273.** If $\frac{3x+2}{x-1}-\frac{x-3}{2x+1}=\frac{ax^2+bx+c}{dx^2+ex+f}$, then $a+b+c+d+e+f$ equals:

**274.** If $a_1=1, a_2=3, a_3=-5$ and $a_n=a_{n-1}+a_{n-3}-a_{n-2}$, where $n \geq 4$, then $a_6$ equals:

**275.** Let $x-3y=5$ and $2y+z=3$ and $2-z=x$. Find $x+yz$.

**276.** If $f(x)=x^2-3x+2$ and $g(x)=2x^2-x+3$, then $g(f(4))=$?

**277.** $(8x^3-4x^2-2x+1)\div(2x+1)$ has a remainder of ______.

**278.** Find the absolute value difference between coefficients of the $x^2y^3$ term and the $x^3y^2$ term in the expansion of $(3x+2y)^5$.

**279.** Find the 20th term of the sequence: $3, 8, 15, 24, 35, 48, \ldots$

**280.** The Shawk Electric Company charges a monthly base fee of $10.50 and a usage fee of 8¢per kilowatt hour used. The company offers a $25.00 credit if the kilowatt usage is over 1200 kWh. How much would the bill be before taxes if the monthly usage was 1450 kWh.

**281.** Two billion three hundred four million five thousand sixty-seven is added to twenty-three million four hundred fifty-two thousand six hundred seven. Which of the following digits appears the most in the sum?

**282.** Soh Yung is 3 times as old as her sister Tu Yung. In 4 years Soh will only be twice as old as Tu. What will the sum of their ages be in 10 years?

**283.** PurtyDurty detergent contains 80% soap and 20% bleach. WishyWashy detergent contains 55% soap and 45% bleach. If PurtyDurty is mixed with WishyWashy, what percent of the mixture should be PurtyDurty if the final mixture is 35% bleach?

**284.**

## Solutions

1. $2\frac{2}{5}$
2. 22% less
3. $4.15
4. 5
5. 180 km

6. $4\log_b(6y)$
7. $(-1,-3)$
8. $y > x^2 - 3x + 4$
9. $28\frac{1}{8}$
10. 3
11. 256
12. .0625
13. 784 miles
14. 9
15. $3x - y = 2$
16. $-\frac{1}{64}$
17. A
18. -2
19. -39
20. -1620
21. 4
22. $4.93
23. 2.0
24. 1225
25. 26
26. $\frac{chw+dh}{hm+kw}$
27. 200
28. $7\frac{1}{16}$
29. 33.8 mph
30. $5x - 8y = -21$
31. 55
32. 0.025
33. 20
34. 127
35. 12.8
36. 12
37. 14.3
38. $23.27
39. -0.50
40. 5.0 mph
41. 63.3 mph

**42.** 24.3 min

**43.** -15

**44.** 102

**45.** 19

**46.** $4\frac{19}{32}$

**47.** $\frac{1}{16}$

**48.** 48.0 days

**49.** $\frac{12}{7}$

**50.** $x \geq -3, x \neq 4, 5$

**51.** 3

**52.** 7.2

**53.** $15.24

**54.** 212

**55.** 286.12

**56.** $(0, \infty)$

**57.** 2:17 PM

**58.** -11

**59.** 525

**60.** 1

**61.** even function

**62.** 2250

**63.** $\frac{1}{4}$

**64.** 0

**65.** 3

**66.** 24 dB

**67.** 588

**68.** $11.26

**69.** 1485

**70.** 32.0

**71.** 21 hr

**72.** 2.0

**73.** $x \in R, x < 9$

**74.** 0.0063

**75.** 8

**76.** 1

**77.** 12

**78.** 3

**79.** 693

**80.** 178.5

**81.** 720

**82.** $286.44

**83.** -23

**84.** $-\frac{9}{2y}$

**85.** 6

**86.** -1.25

**87.** -4

**88.** -720

**89.** $x^{-2}y^4z^{-.4}$

**90.** 0

**91.** $1\frac{1}{16}x$

**92.** 2640

**93.** 3

**94.** 127.5 miles

**95.** B

**96.** $(1,4)$

**97.** 207

**98.** 76

**99.** E

**100.** $6x-3$

**101.** 1011

**102.** $n^3+3n^2+2n$

**103.** $-\frac{3}{5}$

**104.** $y : y \geq 3$

**105.** $1.19

**106.** -15

**107.** 1232

**108.** D

**109.** 45

**110.** 110

**111.** $1.17

**112.** 4

**113.** 4

**114.** 256

**115.** $3.11

**116.** $y \geq x^2 - 4$
$y \leq x^2 + 1$

**117.** $2\frac{6}{7}$ mph

**118.** $(-2, 8)$

**119.** -16

**120.** 87

**121.** 24

**122.** -3.6

**123.** B

**124.** $(5, -.6)$

**125.** -36

**126.** $1\frac{5}{6}$

**127.** 3

**128.** 156

**129.** 9

**130.** $(2, 4)$

**131.** $\frac{1}{24}$

**132.** 72

**133.** -5.75

**134.** 76 miles

**135.** -3

**136.** $\frac{1}{w}$

**137.** $\frac{1}{2}$ mph

**138.** walking at a constant speed

**139.** 3 or 1

**140.** $8\frac{2}{3}$ days

**141.** 25

**142.** -1

**143.** 80%

**144.** 2

**145.** 3

**146.** 18

**147.** 2

**148.** -62

**149.** 28.125

**150.** \$56.67

**151.** $4x + 3y = -2$

**152.** increasing speed

**153.** 40 km

**154.** 5.997 m/sec

**155.** 14

**156.** 1

**157.** $\frac{1}{3}$

**158.** 56

**159.** 5

**160.** 94

**161.** 24

**162.** $n^2 + n - 2$

**163.** $a^6 b^{-3}$

**164.** 42

**165.** -4

**166.** 1

**167.** 20

**168.** \$46.88

**169.** $1\frac{7}{16}$"

**170.** C

**171.** 7

**172.** $\frac{1}{3}$

**173.** \$2.84

**174.** $\frac{1}{64}$

**175.** -1

**176.** 93

**177.** 4

**178.** $n^3 - 2n + 1$

**179.** $a^{-2} b^6$

**180.** $\frac{x}{4}$

**181.** 10:29 a.m.

**182.** 22

**183.** 0

**184.** $5.8\%$

**185.** 21

**186.** -.5

**187.** $-\frac{22}{7}$

**188.** 2

**189.** $2\frac{9}{16}$

**190.** $1\frac{9}{[}16]$"

**191.** 120 oz

**192.** 3

**193.** 8

**194.** $x^2 + 5x - 6$

**195.** 2

**196.** 8

**197.** $1\frac{1}{8}$"

**198.** C

**199.** $y \leq -(x^2 + 3x)$

**200.** $1375.00

**201.** $a^0b^{-2}$

**202.** -2

**203.** 10 meters

**204.** 9.5

**205.** 9

**206.** $-7 - 3x$

**207.** $y = \frac{5x-17}{9}$

**208.** 1

**209.** -4

**210.** $\frac{\sqrt{15}+1}{2}$

**211.** $\frac{n+1}{n}$

**212.** 1.5

**213.** $5.12

**214.** $10\frac{5}{7}$%

**215.** $3x - 4y \leq -4$

**216.** $\frac{1}{4}$

**217.** -6

**218.** $(0, -5\frac{3}{4})$

**219.** 240 ft

**220.** 81

**221.** $\frac{3}{5}$

**222.** C

**223.** $370.00

**224.** 360

**225.** $-(2x - 3y - 2)$

**226.** 52%

**227.** -5.5

**228.** 10

**229.** 6

**230.** 6' 10"

**231.** $\sqrt{5} - 1$

**232.** -1

**233.** 3

**234.** D

**235.** 4

**236.** 3

**237.** 2

**238.** -16

**239.** -1.5

**240.** $10.25

**241.** $\frac{1}{2020}$

**242.** 16

**243.** 12:30 P.M.

**244.** 6062

**245.** 8

**246.** 108

**247.** 60%

**248.** -1

**249.** $6x - 10$

**250.** 0

**251.** 17.5 hrs

**252.** 2 or 0

**253.** none of these

**254.** 56

**255.** 5

**256.** 4

**257.** 16

**258.** -24

**259.** .03

**260.** 2

**261.** 4.9

**262.** 6

**263.** 5.5

**264.** 14

**265.** $-2\frac{8}{9}$

**266.** $10.79

**267.** 21

**268.** 2 yrds 1' 1"

**269.** D

**270.** 7

**271.** 3

**272.** $\frac{x-3}{x+7}$

**273.** 15

**274.** 3

**275.** -103

**276.** 69

**277.** 0

**278.** 360

**279.** 440

**280.** $101.50

**281.** 7

**282.** 36

**283.** 40%

**284.**

# 2 Geometry

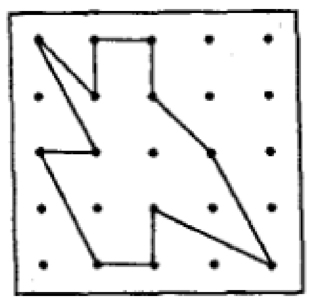
## Problems

1. The sides of a triangle are 9 in, 12 in, and 15 in. The triangle is a(n) ______triangle:

2. An isosceles trapezoid has a top base of 8 cm, a bottom base of 14 cm, and a slanted side length of 5 cm. Find the area of the isosceles trapezoid.

3. Rene drew $\triangle ABC$ using the coordinates $(1,2),(2,-2)$ and $(5,1)$. Find the area of Rene's triangle.

4. Georg Alexander picks the special figure and places it on a five-peg-by-five-peg geoboard. Find the area enclosed by the figure.

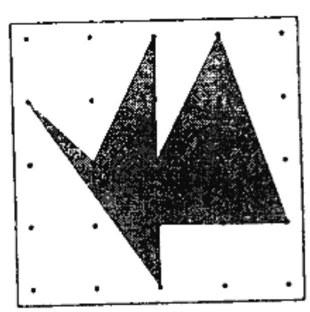


5. $\triangle DEF$ is an obtuse isosceles triangle such that m$\angle DEF$ is 104° and EF is 14 cm. Find the area of $\triangle DEF$ to the nearest integer.

6. Point $P(3,3)$ is rotated 270° counterclockwise about the origin to point $Q$. Point $Q$ is reflected across the $y$-axis to point $R$. Find the coordinates of point $R$.

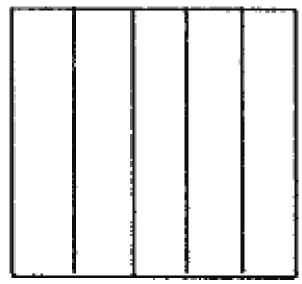
7. Two chords, $AC$ and $BD$ intersect in the interior of a circle at point $X$ such that $m\ \overset{\frown}{BC}= 20°$ and $m\ \overset{\frown}{AD}= 120°$. If points $B$ and $C$ are not on $\overset{\frown}{AD}$ then $m\angle AXD$ is:

8. The adjacent dots on the grid are 1 cm apart when measured vertically and horizontally. Find the area of the shaded figure shown.



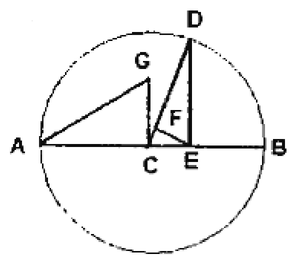
9. One of the base angles of an acute isosceles triangle has a measure of 50° and the length of its base is 6 cm. Find the perimeter of the acute isosceles triangle. (nearest tenth)

**10.** The square below is divided into 5 congruent rectangles. The perimeter of each of the congruent rectangles is 30 units. What is the perimeter of the square?



**11.** Simplify: $\frac{n!+(n-1)!}{(n-2)!}$

**12.** Let $AB$ be the diameter of the circle with center $C$ with $CG \perp AB, DE \perp AB$, and $EF \perp DC$. If $AE = 9$ and $BE = 4$ then $DE =$?

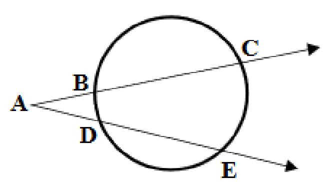



**13.** Given: $\triangle ABC \sim \triangle DEF, AB = 15, AC = 12, m\angle A = 62^{\circ}, DE = 10$. $EF =$ ______. (nearest tenth)

**14.** Points $A$ and $B$ line on a circle with center $O$. The area of the circle is 531 and $AB = 24$. Find the distance from $O$ to chord $\overline{AB}$. (nearest tenth)

**15.** Consider a circle circumscribed about a regular pentagon. If the area of the circle is 452.4, then the area of the pentagon is ______. (nearest whole number)

Use the sketch below for problems 16 and 17. The information given in problem 16 does not carry over to problem 17.



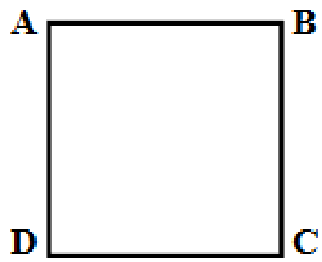

**16.** If $AB = 6, BC = 15$, and $AD = 8$, then $DE =$ ______. (nearest hundredth)

**17.** If $mBD = 28^{\circ}$ and $mCE = 86^{\circ}$, then $m\angle CAE =$ ______.°

**18.** The base of a pyramid is a square with each side equal to three-fifths of the height of the pyramid. If the volume of the pyramid is 700, what is the total area of the pyramid? (nearest whole number)

**19.** Angles $A$ and $B$ are complementary angles while angles $A$ and $C$ are supplementary angles. If $m\angle A = 6x+1$ and $m\angle B = 9x - 1$, then $m\angle C =$ ______°.

**20.** Quadrilateral $ABCD$ shown below is a square. The midpoint of $\overline{AD}$ is point $E$ and the midpoint of $\overline{AB}$ is point $F$. If $EF = 18$, then the area of the square is ______.

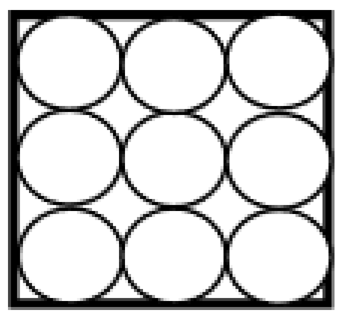



**21.** Consider a quadrilateral with vertices $A(-6, 4), B(0, -8), C(6, 4)$, and $D(0, 12)$. This quadrilateral can be classified as a ______.

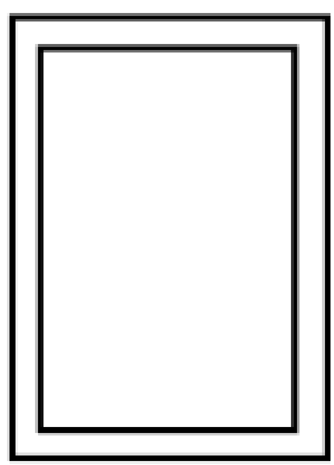
**22.** Consider $\triangle ABC$ with point $D$ on $\overline{AB}$ such that $\overline{CD} \perp \overline{AB}$. If $m\angle ACB = 78.28^{\circ}$, $AD = 9$ and $CD = 12$, then $DB =$ ______. (nearest tenth)

**23.** Find the area of a triangle with vertices $(0, 12), (0, 0)$ and $(12, 0)$.

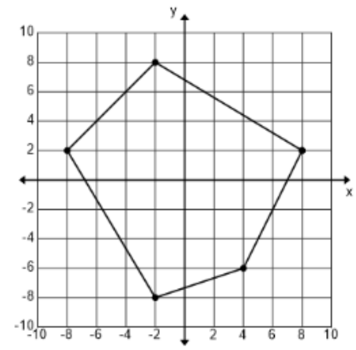
**24.** If you cut nine circles out of a square piece of cardboard that measures 12 in by 12 in, how much cardboard is discarded? (nearest tenth)



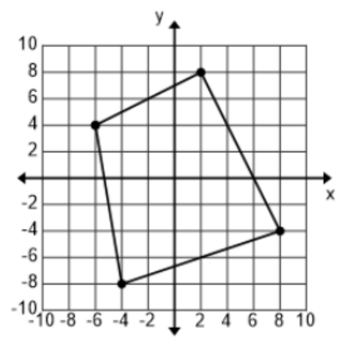
**25.** Russell's backyard pool is shaped like a rectangle that measures 30 ft by 50 ft. He decides to add a sidewalk that is 3 feet wide around the perimeter. Vedant, Caleb and Curtis will provide free labor, so he only has to pay for the concrete, which cost $6.00 per square foot. What will the sidewalk cost?



**26.** Find the area of the polygon below. (nearest whole number)




The following polygon is used for problem 27 and 28.

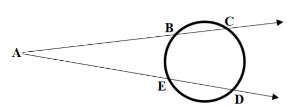



**27.** Find the perimeter of the polygon shown. (nearest tenth)

**28.** Find the area of the polygon shown.

**29.** Consider $\triangle ABC$ with $AB = 18$ and $BC = 14$. Point $D$ lies on $\overline{AC}$ such that $\overline{BD}$ bisects $\angle ABC$. If $AD = 10$, then $DC =$ ______. (nearest tenth)

Use the following sketch for problems 30 and 31.




**30.** If $m\angle CAD = 19^{\circ}$, $mCD = 120^{\circ}$, $mDE = 102^{\circ}$, then $mBC =$ ______.

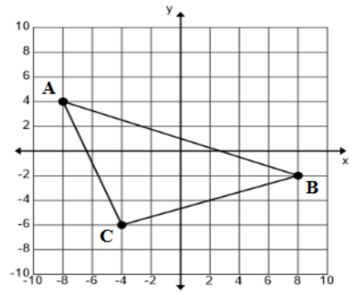
**31.** If $\overline{BD}$ intersects $\overline{CE}$ at point $P$ (not shown) with $BP = x+1$, $CP = 2x$, $DP = 2x+2$, and $EP = x+4$, then $CE =$ ______. (nearest tenth)

**32.** Consider a right circular cone with a base perimeter of 75 cm and a lateral area of 490 cm. Find the volume of the cone. (nearest whole number)

**33.** Consider a circle inscribed in a square with side lengths 44.6 mm. Find the area inside the square but outside the circle. (nearest whole number)

**34.** Find the perimeter of a regular decagon that can be inscribed in a circle with an area of 254 cm$^2$. (nearest tenth)

The following diagram is used for problems 35-40.




**35.** The $y$-intercept of $\overline{AB}$ is the point $P(a, b)$. $b =$ ______.

**36.** Point $D(3, d)$ lies on the perpendicular bisector of $\overline{CB}$. $d =$ ______.

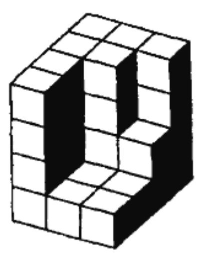
**37.** The perimeter of $\triangle ABC$ is ______. (nearest tenth)

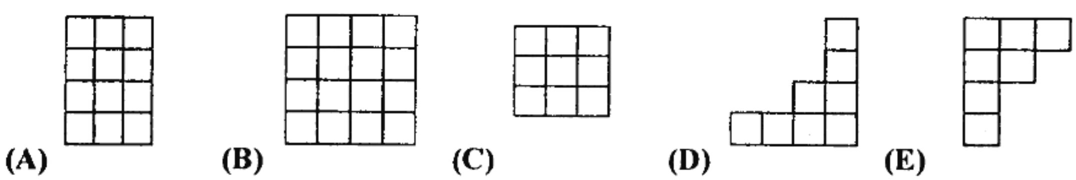
**38.** The area of $\triangle ABC$ is ______. (nearest tenth)

**39.** The length of the median from point $C$ to $\overline{AB}$ is ______. (nearest hundredth)

**40.** $\triangle ABC$ is a/an ______triangle.

**41.** Which of the following would best represent a two dimensional perspective of the top view of this figure shown?



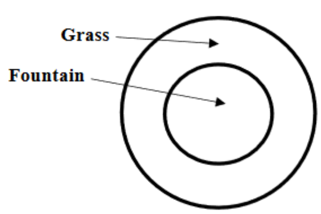



For Problems 42 and 43, consider the regular polygon $ABCDEF$ with $EF = 8$.

**42.** The area of the polygon is ______. (nearest whole number)

**43.** The area of $\triangle ACE$ is ______. (nearest whole number)

Consider the following diagram for problems 44 and 45.



Russell entertains a guest in an area of his backyard which has a magnificent fountain surrounded by an area of grass. The fountain area is circular with a radius of 6 feet. The grass area is the outer part of a circle with the same center as the fountain and with a radius of 10 feet.

**44.** The area of the grass region is ______square feet. (nearest whole number)

**45.** Russell decided to put up a fence along the outer perimeter of the grass region. If the fence is 6 feet tall and the cost of fencing is $25/square foot, find the total cost of the fencing.

For problems 46 and 47, consider a circle with center $O$ and diameter $\overline{BD}$. Chord $\overline{AC}$ is perpendicular to $\overline{BD}$. $BD = 50$ and $AC = 40$.

**46.** Find the area of sector $AOD$. (nearest whole number)

**47.** Find the area of the region between chord $\overline{AC}$ and minor arc $AC$. (nearest whole number)

For problems 48 and 49 consider isosceles trapezoid $PQRS$ with $PQ = RS = 10$. $\overline{QR}$ is parallel to $\overline{PS}$. $QR = 15$ and $PS = 25$.

**48.** Find the area of $PQRS$. (nearest whole number)

**49.** $QS =$ ______. (nearest tenth)

**50.** The lateral area of a cone with a volume of 667 and a diameter of 14 is ______. (nearest hundredth)

For problems 51-54, consider triangle $ABC$ with vertices $A(2, 8), B(6, -2)$, and $C(-4, -4)$.

**51.** Find the perimeter of triangle $ABC$. (nearest tenth)

**52.** The measure of $\angle ABC$ is ______°. (nearest tenth)

**53.** The area of triangle $ABC$ is ______. (nearest whole number)

**54.** Given: Triangle $ABC$ is similar to triangle $DEF$. If $EF = 6.9$, then $DF =$ ______. (nearest tenth)

For problems 55-57, you are given: Circle with center $O$, diameter $\overline{CD}$, chord $\overline{EF}$ parallel to $\overline{CD}$. $CD = 20$ and $EF = 16$. $m\angle COE < 90°$.

**55.** If $H$ is the midpoint of $\overline{EF}$, then $OH =$ ______. (nearest tenth)

**56.** The area of sector $COE$ is ______. (nearest tenth)

**57.** The arclength of minor arc $EF$ is ______. (nearest tenth)

**58.** A right circular cylinder has a diameter of 22 and a volume of 10,264. The total surface area of the cylinder is ______. (nearest whole number)

For problems 59 and 60, consider isosceles trapezoid $PQRS$ with $PQ = RS = 13$. $\overline{QR}$ is parallel to $\overline{PS}$. $QR = 16$ and $PS = 26$.

**59.** The area of trapzeoid $PQRS$ is ______. (nearest whole number)

**60.** $PR =$ ______. (nearest tenth)

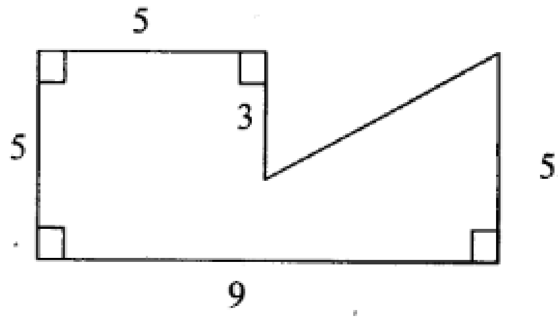
**61.** The diagonal of a television screen measures 54.12 inches. The width of the rectangularly shaped television screen is 23 inches greater than the height. The area of the television screen is ______in$^2$. (nearest whole number)

**62.** $\triangle ABC$ is similar to $\triangle FDE$. $AB = 20, BC = 35, DF = 12$, and $DE = 21$. Which of the following is a false statement?

**(A)** $\angle B \cong \angle D$ **(B)** $\angle C \cong \angle E$ **(C)** $\angle A \cong \angle D$ **(D)** $\frac{AC}{EF} = \frac{5}{3}$ **(E)** $\frac{DE}{BC} = \frac{3}{5}$

**63.** If the height of a right cylindrical container is doubled and the diameter is cut in half, then the ratio of the volume of the original container to the volume of the new container is?

**64.** What is the perimeter of this hexagon? All lengths are in cm.



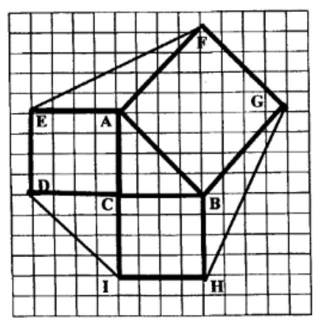

**65.** The coordinates of the vertices of $\triangle ABC$ are $C(0,7), B(2,5)$, and $A(x,2)$. $\angle ABC$ is a right angle if $x$ equals:

**66.** The center of a circle inscribed in a triangle is caleld the ______.

**67.** $\overline{NQ}$ is an altitude of $\triangle MNO$. $NM = 13$ cm, $NO = 15$ cm, and $NQ = 12$ cm. The perimeter of $\triangle MNO$ is

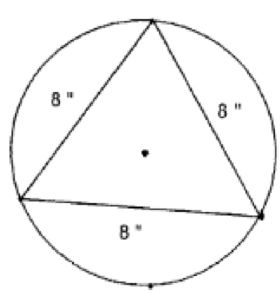
**68.** If $(6,9)$ and $(10,3)$ are the coordinates of two opposite vertices of a square, which of the following is one of the other vertices of the square?

**69.** The drawing contains $\triangle ABC$, a right triangle, and three squares attached to $\triangle ABC$. Find the sum of the areas of the four triangles.



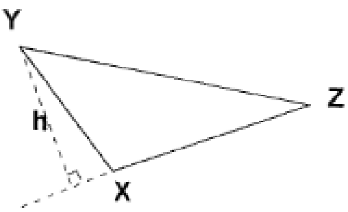

**70.** The area of a rectangle is 300 cm$^2$. The ratio of its length to its width is 4:3. The perimeter of the rectangle is:

**71.** Find the radius of the circle. (nearest tenth)

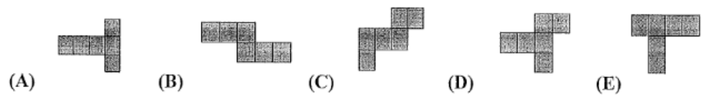



**72.** $\angle P$ is supplementary to $\angle Q$ and $\angle R$ is complementary to $\angle S$. If $m\angle P = 75°$ and $m\angle Q = 3 \times m\angle R$, then $m\angle S = ?$

**73.** A triangle is drawn as shown. Find the height, $h$, if $YZ = 18''$, $m\angle YZX = 30°$, and $XZ = 12''$.



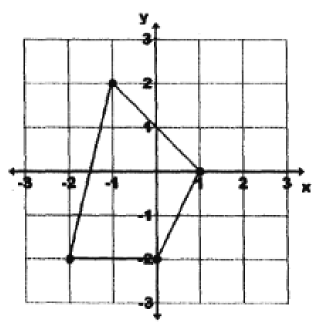

**74.** Which of the following nets when folded will not form a cube?




**75.** A tangent and a secant intersect at point $A$ in the exterior of a circle. The measures of the two intercepted arcs are 75° and 50°. What is the measure of angle $A$ formed by the tangent and the secant?

**76.** Two legs of a triangle have lengths of 10 cm and 15 cm with an included angle of $30^\circ$. Find the area of the triangle.

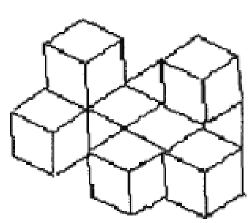
**77.** Rene drew this quadrilateral on the coordinate plane below. The coordinates of the vertices are integers. What is the area of his quadrilateral?



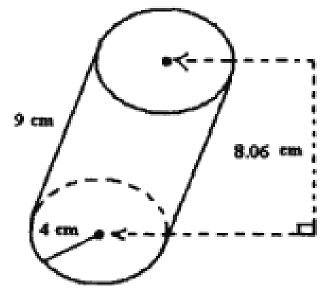

**78.** If a line in the plane of a circle is perpendicular to a radius at its endpoint on the circle then the line is ______to the circle.

**79.** $\angle A$ and $\angle B$ are complementary. The ratio of $m\angle A$ to $m\angle B$ is 4:5. Find the ratio of $m\angle B$ to its supplement.

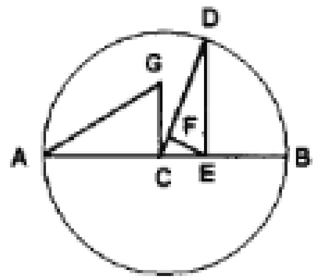
**80.** The length of the sides of each of the small cubes is 1 cm. How many of the small cubes would need to be added to this figure to make a rectangular prism that is 4 cm long, 3 cm wide, and 2 cm tall?



**81.** Find the lateral area, nearest square cm, of the oblique cylinder.




**82.** Let $AB$ be the diameter of the circle with center $C$ with $CG \perp AB$, $DE \perp AB$, and $EF \perp DF$. If $AE = 9$ and $BE = 4$ then $DF =$?




**83.** Points $A$, $B$, $C$, and $D$ are the vertices of a square. Point $E$ is on the interior of the square such that points $A$, $B$, and $E$ form an equilateral triangle. A line segment connects point $D$ and $E$. Another line segment connects points $C$ and $E$. Find $m\angle CED$.

**84.** The coordinates of the vertices of $\triangle ABC$ are $(-1, 2), (1, 0)$ and $(-2, -2)$. The medians of the $\triangle ABC$ intersect at $(x, y)$. Find $x + y$.

**85.** Deputy Dawg is building two adjacent rectangular pens to hold his puppies. Each pen has a length 3 times longer than its width and the pens share a common side (width). He has 65 feet of fencing. What will the area of each pen be?

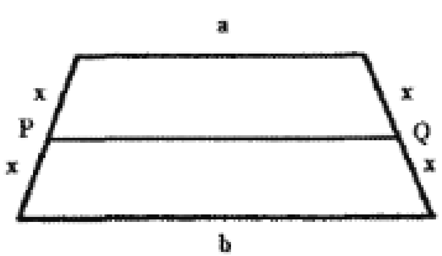
**86.** If a quadrilateral is inscribed in a circle, then its opposite angles are ______.

**87.** The coordinates of the vertices of $\triangle ABC$ are $(-2, 0), (1, 4)$, and $(4, 0)$. The coordinates of the incenter is:

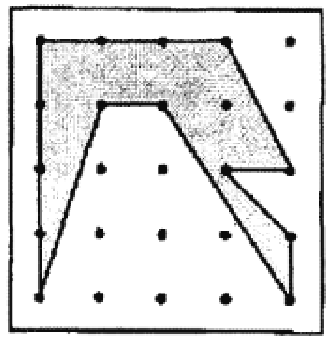
**88.** Shirley Knott is filling up her circular wading pool. The diameter of the pool is 6 feet and the height of the pool is 1 foot. What is the maximum number of whole gallons of water can she use and not cause the pool to overflow?

**89.** The vertex angle of an obtuse isosceles triangle has a measure of 100° and the length of one the sides adjacent to the vertex angle is 4 cm. Find the area of the triangle. (nearest tenth)

**90.** Given the trapezoid shown with bases $a$ and $b$, the length of segment $PQ$ is the ______mean of $a$ and $b$.

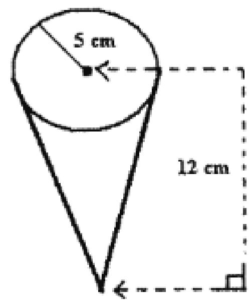


**91.** Adjacent dots on the grid are 1 cm apart when measured vertically and horizontally. Find the area of the shaded figure shown.

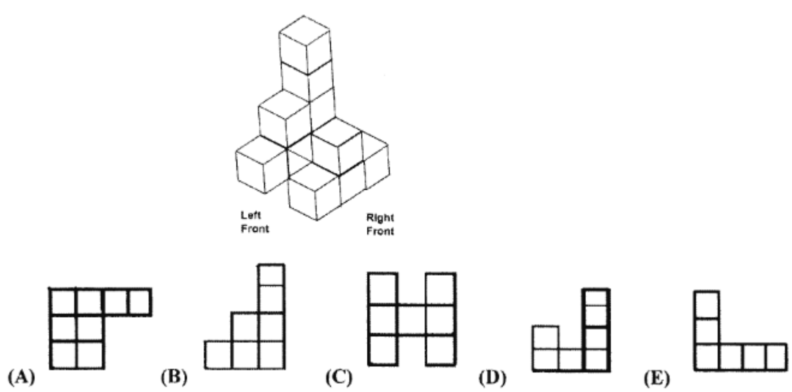


**92.** Two chords, $WY$ and $XZ$ intersect in the interior of a circle at point $P$ such that $m\angle WPX = 70^\circ$ and $m\,\overset{\frown}{WX} = 120^\circ$. If points $X$ and $Y$ are not on $\overset{\frown}{WZ}$ then $m\,\overset{\frown}{YZ}$ is:

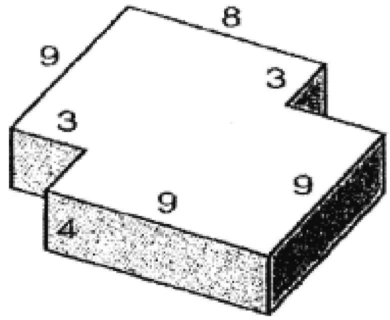
**93.** Find the lateral area, nearest square cm, of the cone.




**94.** Which of the following would best represent a two dimensional perspective of the front right side view of this figure shown?



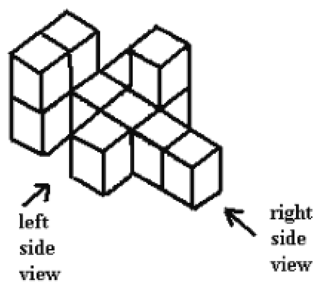

**95.** Find the lateral surface area of this prism. All angles are right angles.




**96.** A right cylinder water tank is 6 feet high and has an inside radius of 3 feet. The amount of water in the tank is 75% of its maximum capacity. How much water is in the tank? (nearest gallon)

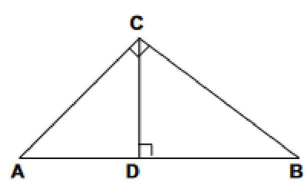
**97.** The region bounded by two radii of a circle and their intercepted arc is called a:

**98.** One-centimeter cubes are glued together to form the object in the figure shown. The two-dimensional persepctive of the top view of this figure has a perimeter of:



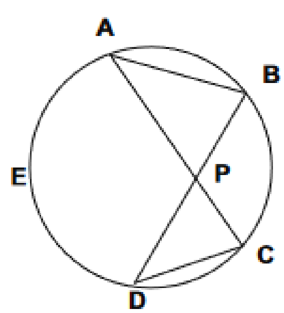

**99.** $\angle A$ and $\angle B$ are complementary angles. $\angle A$ and $\angle C$ are supplementary angles. Find $m\angle C$ if $m\angle A = 2x - 5$ and $m\angle B = x + 2$.

**100.** Find $AD$ if $AB = 90$ cm. and $AC = 50$ cm. (nearest cm)




**101.** The area of a right isosceles triangle is 12.5 cm$^2$. Its perimeter is: (nearest tenth).

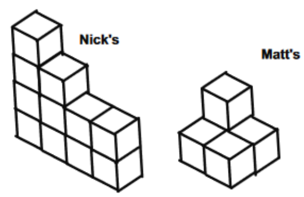
**102.** $\overline{AB}$, $\overline{AC}$, $\overline{BD}$, and $\overline{CD}$ are chords of circle $O$ and point $E$ lies on circle $O$. Which of the following is a true statement?



**(A)** $m\angle ABD = \frac{1}{2} \times m\ \overset{\frown}{AED}$ **(B)** $m\angle BPC = \frac{1}{2} \times m\ \overset{\frown}{CB}$ **(C)** $m\angle ACD = 2 \times m\ \overset{\frown}{AED}$
**(D)** $m\angle APD = m\angle ABP + m\angle DCP$ **(E)** $m\angle ABP + m\angle BDC$

**103.** A regular polygon has $S$ sides and $D$ diagonals. If the polygon had one more side, $S+1$, it would have $D+10$ diagonals. The polygon is a:

**104.** Matt and Nick constructed two buildings using identical cubes. Matt's building weighs 200 g, and Nick's building weighs 600 g. How many of the cubes in Nick's building are hidden and cannot be seen in the figure?

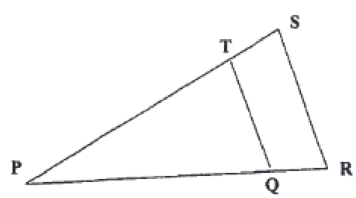



**105.** Which of the following are the side lengths of a scalene acute triangle?

**(A)** $9, 40, 41$ **(B)** $4, 7, 11$ **(C)** $9, 10, 11$ **(D)** $5, 5, 8$ **(E)** $8, 7, 14$

**106.** The point $(6, -6)$ is rotated 60 degrees clockwise about the origin. The coordinates of the point after the rotation is ______. (closest approximation)

**107.** In $\triangle PRS, QT//RS, RS = 4, QT = 3, ST = x$, and $PT = x + 5$. Find $PS$.

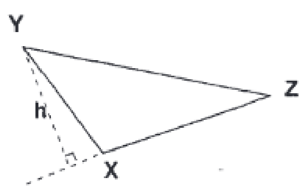



**108.** If two parallel lines are intersected by a transversal, then the alternate angles are ______.

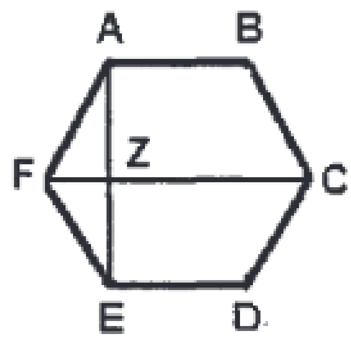
**109.** $\triangle ABC$ and $\triangle PQR$ exist such that $AB = BC = PQ = PR, m\angle ABC = 2x^\circ, m\angle QPR = x^\circ$, and they have equal areas. Find $x$.

**110.** A circle with a center at $C$ has a radius of 9 cm. A chord $AB$ of the circle is 6 cm long. Find the distance from the chord to the center $C$.

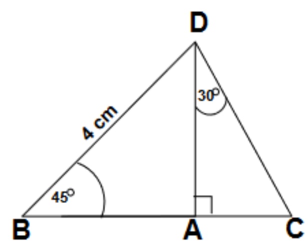
**111.** Find the perimeter of $\triangle XYZ$ if $XY = 8''$, $XZ = 11''$ and $m\angle XYZ = 120^\circ$. (nearest tenth)




**112.** Polygon $ABCDEF$ is a regular hexagon and segments $AE$ and $CF$ intersect at point $Z$. The ratio of the area of triangle $EFZ$ to the area of the quadrilateral $ABCZ$ is:




**113.** Find the perimeter of $\triangle BCD$. (nearest tenth)

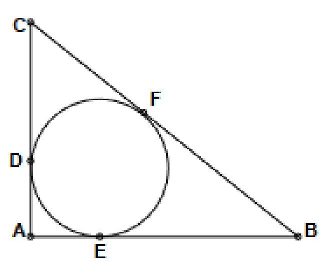



**114.** Max Space has a rectangular sheet of cardboard that is 4 feet by 6 feet. He is going to cut out a 5 inch square from each of the four corners, then fold up the sides, tape edges, and make a rectangular box without a top. What is the volume of the box? (nearest tenth)

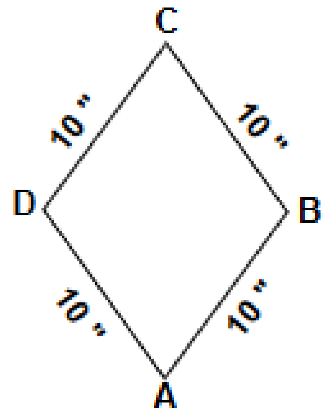
**115.** Given: $\triangle ABE$ is similar to $\triangle DON$; $\angle A \cong \angle N$; $\angle B \cong \angle D$; $AB = 30$ cm; $DN = 24$ cm; and $NO = 16$ cm. Find $AE$.

**116.** $\triangle ABC$ is a scalene triangle. Point $P$ lies on segment $AB$ such that segment $CP$ is the altitude of the triangle, $m\angle CBP = 65°$, $AP = 12"$, $BP = 15"$. Find $m\angle ACP$. (nearest degree)

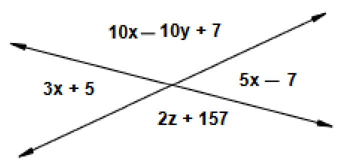
**117.** Find the radius of the circle inscribed in $\triangle ABC$ with $AC = 3"$, $AB = 4"$, and $BC = 5"$.



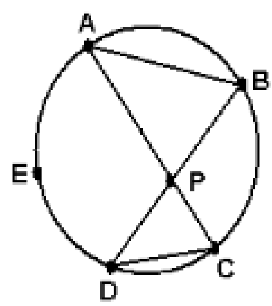

**118.** Find the area of the rhombus shown given that $AC - BD = 4"$




**119.** Find the sum of $x, y$, and $z$, given the degree measures of the angles shown.

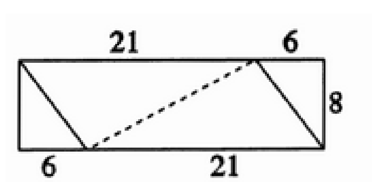



**120.** $\overline{AB}, \overline{AC}, \overline{BD}$, and $\overline{CD}$ are chords of circle $O$ and point $E$ lies on circle $O$. Find $m\ \overset{\frown}{AED}$ given $m\angle BPC = 95^\circ$ and $m\angle BAP = 25^\circ$.

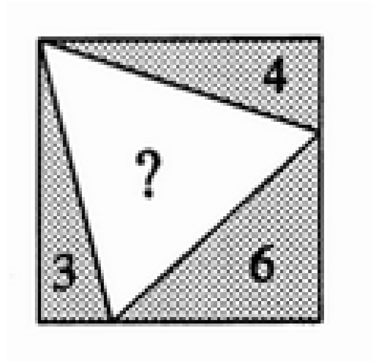



**121.** $\angle A$ and $\angle B$ are supplementary angles with $m\angle A = 5x - 4$ and $m\angle B = 3x + 2$. Find the absolute value difference in the measures of $\angle A$ and $\angle B$.

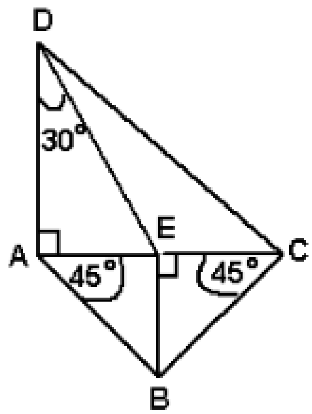
**122.** An $8 \times 27$ rectangle is split into four triangles, as shown below, by three line segments which divide the rectangle's longer sides into segments of lengths 6 and 21. How long is the dotted segment?




**123.** A square is split into four triangles, and then three of the four triangles are shaded, as shown. If the areas of the shaded triangles are 3, 4, and 6, as shown, what is the area of the unshaded triangle?




**124.** Find $DC$ if $AE = 3''$.



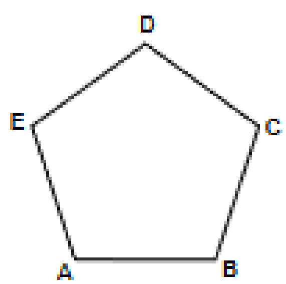

**125.** Which of the following points of concurrency are always on the exterior of an obtuse triangle

(1) circumcenter (2) centroid (3) incenter (4) orthocenter

**126.** An elongated square pyramid is a nonahedron. It has 9 faces and 9 vertices. How many edges does it have?

**127.** Points $P(-1, 1), Q(3, 5), R(17, 1)$, and $S(x, y)$ are the coordinates of the vertices of a parallelogram. How many possible coordinates of $S$ exist for the fourth vertex?

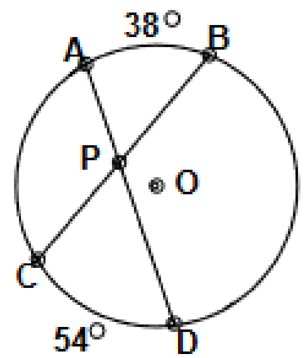
**128.** Given the regular pentagon shown, find $BC$ with $AC + AD + BE + BD + CE = 44.5''$. (nearest tenth)




**129.** Leo Oiler drew a polyhedron with 7 faces and 11 edges. How many vertices does it have?

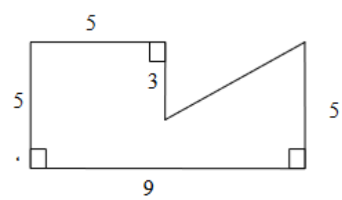
**130.** Two lines are ______? ______if and only if the product of their slopes is -1.

**131.** Find $m\angle APB$. (drawing is not to scale)

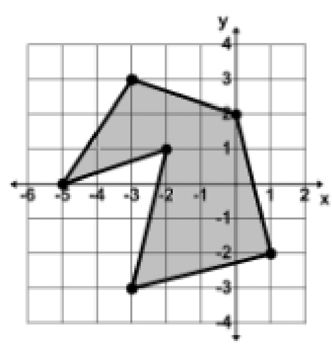



**132.** A right cylinder can of Papi Spinach has a diameter length of 4" and a height of 5". What is the total surface area of the spinach can? (nearest tenth)

**133.** Find the perimeter this hexagon? All lengths are in cm.




**134.** Find the area of the shaded figure.



**135.** The length of the base of $\triangle PQR$ is 40 cm. and the height is 60 cm. $\triangle ICU$ is formed by cutting off 25% of the base of $\triangle PQR$ and adding 20% of the height of $\triangle PQR$. The area of $\triangle ICU$ is what percent of $\triangle PQR$?

**136.**

## Solutions

1. Right
2. 44 cm$^2$
3. 7.5 units$^2$
4. 8 units$^2$
5. 95 cm$^2$
6. $(-3, -3)$

7. 70°
8. 6 cm$^2$
9. 15.3 cm
10. 50 units
11. $n^2 - 1$
12. 6
13. 9.4
14. 5.0
15. 342
16. 7.75
17. 29°
18. 523
19. 143
20. 648
21. kite
22. 10.6
23. 72
24. 30.9 in$^2$
25. $3096.00
26. 148
27. 47.2
28. 136
29. 7.8
30. 56°
31. 5.5
32. 793 cm$^3$
33. 427 mm$^2$
34. 55.6 cm
35. 1
36. -7
37. 40.5
38. 68.0
39. 8.06
40. obtuse
41. A
42. 166

**43.** 83

**44.** 201

**45.** $9,424.78

**46.** 692

**47.** 280

**48.** 173

**49.** 21.8

**50.** 324.67

**51.** 34.4

**52.** 79.5

**53.** 54

**54.** 9.1

**55.** 6.0

**56.** 32.2

**57.** 18.5

**58.** 2626

**59.** 252

**60.** 24.2

**61.** 1200

**62.** C

**63.** 2:1

**64.** 32 cm

**65.** -1

**66.** Incenter

**67.** 42 cm

**68.** $(5, 4)$

**69.** 32 sq. units

**70.** 70 cm

**71.** 4.6"

**72.** 55°

**73.** 9"

**74.** E

**75.** $12.5°$

**76.** 37.5 cm$^2$

**77.** 7 units$^2$

**78.** tangent

**79.** 2:7

**80.** 14

**81.** 226 cm$^2$

**82.** $5\frac{7}{13}$

**83.** $\frac{5\pi}{6}$

**84.** $-\frac{2}{3}$

**85.** $56\frac{1}{3}$ sq. ft.

**86.** supplementary

**87.** $(1, 1\frac{1}{2})$

**88.** 211

**89.** 7.9 cm$^2$

**90.** arithmetic

**91.** 7 cm$^2$

**92.** $20^\circ$

**93.** 204 cm$^2$

**94.** B

**95.** 192 units$^2$

**96.** 952 gal

**97.** sector

**98.** 18 cm

**99.** $123^\circ$

**100.** 28 cm

**101.** 17.1 cm

**102.** A

**103.** undecagon

**104.** 4

**105.** B

**106.** $(5.1, -8.2)$

**107.** 10

**108.** supplementary

**109.** 30

**110.** $6\sqrt{2}$ cm

**111.** 22.7"

**112.** 1:3

**113.** 11.7 cm

**114.** 6.8 cu. ft.

**115.** 20 cm

**116.** $20°$

**117.** 1"

**118.** 96 in$^2$

**119.** -3

**120.** $140°$

**121.** $39.5°$

**122.** 17

**123.** 11

**124.** $3\sqrt{7}$ in

**125.** 1 & 4

**126.** 16

**127.** 3

**128.** 5.5"

**129.** 6

**130.** perpendicular

**131.** $46°$

**132.** 88.0 in$^2$

**133.** 32 cm

**134.** 18 units$^2$

**135.** 90%

**136.**

# 3 Pre-Calculus

## Problems

**1.** The graph of $x^2 + y^2 - 4x + 12y + 30 = 0$ is a circle with a diameter of:

**2.** Let $\tan A = \frac{7}{24}$, where $A$ is in QIII. Find $\cos A$.

**3.** An equivalent expression for $(\sin x + \cos x)^2 + (\sin x - \cos x)^2$ is:

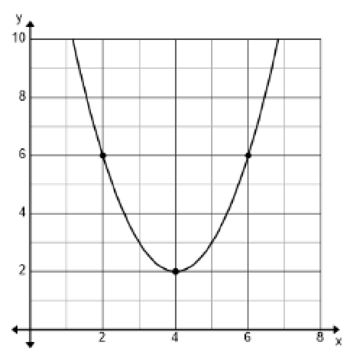
**4.** The graph of $x^2 + y^2 + 10x - 12y - 20 = 0$ is a circle with a radius of:

**5.** A cliff near a lake is 125 feet high. The angle of depression of a canoe from the top of the cliff is 30°. How far is the canoe from the base of the cliff? (nearest foot).

**6.** Simplify: $\sin\theta\tan\theta + \cos\theta$

**7.** Use the angle of rotation, $\theta$ (nearest degree), where 0° $< \theta < 90°$, to transform the conic $xy = 1$ into an equation that is in standard position and does not contain an $xy$ term. The transformed equation is:

**8.** The focus of the parabola below has coordinates $(a, b)$. $a + b =$ ______.




**9.** Find the eccentricity of the ellipse. $9x^2 + 16y^2 - 36x + 96y + 36 = 0$. (nearest hundredth)

**10.** Simplify: $4\csc(2x)\cos(x)$

**11.** Polonium 221 has a half-life of 130 seconds. How long will it take a sample with a mass of 1.80 g to decay to a mass of 1.20 g? (nearest tenth)

**12.** Assume the number of hours of daylight varies sinusoidally at the Clydehurst Christian Ranch in Montana. The longest day of the year has 15 hr 30 min of daylight and the shortest day has 8 hr 30 min of daylight. How many days during the year have at least 13 hours of daylight?

**13.** The Holiday Inn is across the street from the Hilton. The hotels are 120 feet apart. Joe looks out the window of his room at the Holiday Inn and notices that the angle of depression to the base of the Hilton is $36°$ and the angle of elevation to the top of the Hilton is $44°$. How tall is the Hilton? (nearest foot)

**14.** The graph of $r = 3 - 3\sin\theta$ is a ______.

**15.** The graph of the parametric equations $x = 2 + 3\cos\theta$ and $y = 1 + 2\sin\theta$ is an ellipse with vertices $(a, b)$ and $(c, b)$. $a + c =$ ______.

**16.** If $\frac{12i+8i^4+12i^3}{\sqrt{-100+10i+6i^4}}$ simplifies to $\frac{a}{b} + \frac{c}{b}i$, then $a + b + c =$ ______.

**17.** If $f(x) = \sec(2x)$ and $h(x) = \csc(3x)$. $f\left(\frac{5\pi}{8}\right) + h\left(\frac{11\pi}{18}\right) =$ ______. (nearest tenth)

**18.** Each of the wheels on Russell's jumbo wheel swamp buggy has a 4 ft diameter. When he is traveling 42 mph, what is the angular velocity of the wheels in revolutions per minute? (nearest whole number)

**19.** The vertex of the parabola $y = -4x^2 + 6x - 8$ is the point $(a, b)$. $a + b =$ ______. (nearest hundredth)

**20.** Multiply $(6\,\mathrm{cis}(60°))(-4\,\mathrm{cis}(-150°))$ and express the result in rectangular form.

**21.** Sarah released 36 bunnies into the woods near her house. Six months later the population had increased to 100 bunnies. Assume the bunny population is increasing exponentially and calculate the expected bunny population 21 months after the original release of 36 bunnies.

**22.** Devin drops a ball from a height of 24 feet. On each bounce, the ball rebounds three-fourths of the distance it fell. How far does the ball rebound on the tenth bounce? (nearest inch)

**23.** Consider $f(x) = x^3 + bx^2 + cx + d = 0$. Two of the zeroes are $5$ and $2i$. $\mid b + c + d \mid =$ ______.

**24.** The vertices of the hyperbola $16y^2 - 9x^2 - 96y - 72x - 144 = 0$ are $(a, b)$ and $(a, c)$. $b + c =$ ______.

**25.** Consider a parabola with vertex $\left(\frac{3}{2}, \frac{1}{4}\right)$. If the point $(-2, 4)$ lies on the graph of the parabola, which of the following points also lies on the graph of the parabola? The graph is concave up.

**(A)** $(2, -2)$ **(B)** $(3, 0)$ **(C)** $(4, 2)$ **(D)** $(5, 4)$ **(E)** $(6, 6)$

**26.** Find the angle between the line $3x - y = 6$ and the line $4x + 5y = 9$. (nearest tenth)

**27.** The graph of the polar equation $r = 3 - 3\cos(\theta)$ is a ______.

**28.** The graph of the parametric equations $x = 13\cos(\theta)$ and $y = 5\sin(\theta)$ is an ellipse with a foci $(a, b)$ and $(c, b)$. $\mid a - c \mid =$ ______.

**29.** Consider the sphere $x^2 + y^2 + z^2 + 4x - 6y + 2x - 11 = 0$. Find the volume of the sphere. (nearest tenth)

**30.** The unit vector orthogonal to both $u = 2i - 3j + 4k$ and $v = -2i + 5j - 7k$ is the vector $\frac{a}{\sqrt{53}}i + \frac{b}{\sqrt{53}}j + \frac{c}{\sqrt{53}}k$. $a + b + c =$ ______.

**31.** Which of the following is not one of the fourth roots of $16(\cos 120° + i \sin 120°)$?

**(A)** $-\sqrt{3} - i$ **(B)** $\sqrt{3} + i$ **(C)** $1 - \sqrt{3}i$ **(D)** $-\sqrt{3} + i$ **(E)** $-1 + \sqrt{3}i$

**32.** Suppose Calvin has 112 mg of bismuth-214 at 12:15 PM. His sample undergoes radioactive decay and is reduced to 74.562 $\mu$g at 3:45 PM the same day. Find the half-life os bismuth-214. (nearest tenth)

For problems 33 and 34, consider the parabola with equation $9y = 2x^2 - 8x - 46$.

**33.** The vertex of the graph of the parabola is the point $P(a, b)$. $a + b =$ ______.

**34.** The equation of the directrix of the graph of the parabola is $y =$ ______.

**35.** Consider the ellipse with equation $16x^2 + 9y^2 + 64x - 54y + 1 = 0$. The vertices of the graph of the ellipse are $(a, b)$ and $(a, c)$. $a + b + c =$ ______.

**36.** Consider the hyperbola with equation $9x^2 - 4y^2 - 108x - 16y + 272 = 0$. The eccentricity of the hyperbola is ______. (nearest tenth)

**37.** A stick in the ground is 4 ft 8 in tall and it casts a shadow that is 6 ft 2 in long. At the same time, the Newcastle State Bank casts a shadow that is 90 ft long. How tall is the bank? (nearest foot)

**38.** A guy wire runs from the groudn to the top of a 42-foot pole. The angle formed between the wire and the pole is 44°. How far from the base of the pole is the wire attached to the ground? (nearest tenth)

**39.** Given $\vec{v} = \langle 1, 2, 3 \rangle$ and $\vec{w} = \langle 4, 5, 6 \rangle$. The unit vector in the direction $2\vec{v} + 3\vec{w}$ is the vector $\left\langle \frac{a}{d}, \frac{b}{d}, \frac{c}{d} \right\rangle$ where $d =$ ______. (nearest hundredth)

**40.** Consider the circle $x^2 + y^2 + 14x - 6y + 9 = 0$. The area of the circle is ______. (nearest tenth)

**41.** If a 56-ft-tall tree produces a shadow that is 12 ft long, how long will the shadow be for a person that is 5 ft tall? (nearest hundredth)

**42.** The graph of the circle $x^2 + y^2 = 49$ and the graph of the line $y = 0.6x + 5$ intersect at points $A$ and $B$. $AB =$ ______. (nearest tenth)

**43.** The graph of $y = 3\tan(.25x)$ has a vertical asymptote at $x =$ ______.

**44.** The relation $(0, 0), (2, 2), (2, -2), (6, 8), (6, -8)$ is:

**45.** A hawk is perched at the edge of a roof of the Denver City State Bank. The hawk spots a mouse on the ground below. The angle of depression from the hawk to the mouse is $22°$. The mouse is located 154 feet from the base of the bank. How tall is the Denver City State Bank? (nearest foot)

**46.** On March 1st of 2015, Piyush's father placed $75,000 into an account for Piyush that earns interest at a rate of 6.75% compounded quarterly. Piyush plans to withdraw all of the money in the account on March 1st of 2025 and use it toward the purchase of a new BMW X7 From Grapevine BMW. If the total cost including tax, title and license is $146,875.19 how much money will Piyush have to come up with? (nearest dollar)

**47.** Consider the circle $x^2 + y^2 + ax + by + c = 0$. The center of the circle is at the point $(2, 5)$ and the diameter is 14. $a + b + c =$ ______.

**48.** A population of Fire Ants is increasing exponentially in Hale County. Phoenix introduced a population of 150 ants at $t = 0$. At $t = 60$ days, the population reached 1800 ants. The population should reach 212,000 ants at $t =$ ______ days. (nearest whole number)

**49.** Austin leaves the Lubbock airport at 2:00 PM and flies on a bearing of $60°$ at a speed of 180 mph. At 2:30 PM, Zhikai leaves the Lubbock airport and flies on a bearing of 195° at a speed of 160 mph. How far apart are they at 4:00 PM? (nearest mile)

**50.** Consider an ellipse centered at $(4, 3)$ with a vertex at $(-2, 3)$. The point $(4, 7)$ lies on the ellipse. The area of the ellipse is ______. (nearest tenth)

**51.** Consider the curve represented by the parametric equations $x = 6\cos(\theta)$ and $y = 4\sin(\theta)$. The distance between the foci is ______. (nearest tenth)

**52.** Given: $\vec{v} = \langle 1, 2, 3\rangle$ and $\vec{w} = \langle 4, 6, 8\rangle$. The unit vector in the direction of $2\vec{v} + 3\vec{w}$ is the vector $\left\langle \frac{a}{d}, \frac{b}{d}, \frac{c}{d} \right\rangle$ where $d =$ ______. (nearest hundredth)

**53.** Consider the hyperbola with equation $4y^2 - 9x^2 + 16y + 108x - 344 = 0$. The eccentricity of the hyperbola is ______. (nearest tenth)

**54.** Geometry class ends when the bell rings at 8:50. Bo Ring looks at the circular clock and sees that the time is 8:30. How much bigger is the angle formed by the hands at 8:30 then the angle formed when the bell rings?

**55.** The ______of a hyperbola is equal to the ratio of the distance between the center and a focus to the distance between the center and the corresponding vertex.

**56.** The highest average monthly temperature for Miller's View is 78.5° F and occurs in July. The lowest average monthly temperature occurs in January and is 43.5° F. The average monthly temperature of Miller's View varies sinusoidally with the month. What would be the predicted average temperature for May? (nearest tenth)

**57.** If the $\cos A = .96$ and $A$ is in QIV, then $\cot A$ is:

**58.** Which of the following is NOT a solution for $\cos\theta + 1 = \cos^2\theta$?

**(A)** $\frac{8\pi}{3}$ **(B)** $\frac{4\pi}{3}$ **(C)** $-\frac{2\pi}{3}$ **(D)** $-\pi$ **(E)** $-4\pi$

**59.** $(1 - i)^7$ equals:

**60.** A ramp rises $\frac{1}{4}$ inch for every foot of run. Find the angle the end of the ramp makes with the ground if the ramp is 12 feet long. (nearest tenth of a degree)

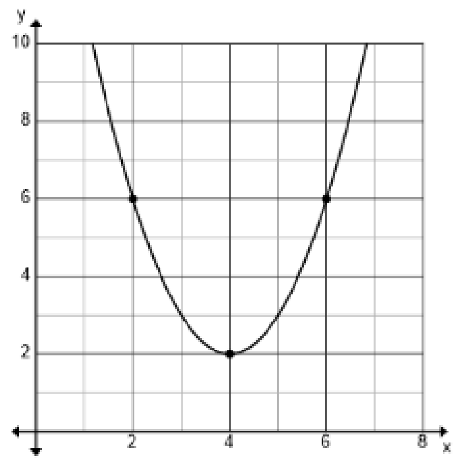
**61.** If $3\sin\theta + 4\cos\theta = 5$ then $\tan\theta$ is:

**62.** The directrix of the parabola $y = -(x^2 + 2x + 5)$ is $y =$ ______.

**63.** How many points of intersections do the graphs of $r = 3\cos\theta$ and $\theta = -\frac{\pi}{2}$ have?

**64.** Diamond Jim deposited some money in a savings account 30 months ago at a rate of 2.5% compounded monthly. His current balance is $553.50. How much was his original deposit?

**65.** The equation $y =$ ______ will produce this graph.




**66.** Determine the type of conic section this equation $x^2 + 2xy + y^2 - 6x - 6y + 9 = 0$ will produce.

**67.** Determine the period of the function $y = 3 - 2\cos\left(\frac{x}{4} + \pi\right)$

**68.** How many points of intersections are there for the curves $r = 2\sin\theta$ and $r = 2\sin\theta$?

**69.** The directrix for the parabola $-8y = x^2$ is $y =$ ______.

**70.** Let $\frac{6x^2}{5} - \frac{3xy}{2} + \frac{19y^2}{5} - 4 = 0$. What is the angle of rotation from it's parent function? (nearest degree)

**71.** Vector $v = (8, 6, -2)$ and vector $u = (-4, x, 1)$. Find $x$ if the dot product of vectors $u$ and $v$ is 2.

**72.** A porch is 3 feet high. A ramp is built to reach from the porch to the ground with an angle of elevation of $15^\circ$. How far from the base of the porch does the ramp touch the ground? (nearest inch)

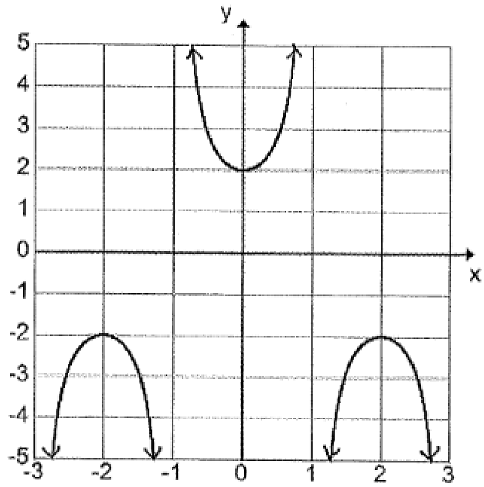
**73.** Two circles, $(x-2)^2 + (y-5)^2 = 25$ and $(x-6)^2 + (y-13)^2 = 65$, intersect at two points. Find the equation of the line passing through the two points of intersection.

**74.** Find the unit vector in the same direction as $(8, 15)$.

**75.** Find the value of $\sin(\arcsin\frac{1}{2} - \arccos\frac{1}{2})$.

**76.** A scout troop leaves their vehicles and travels on a hike of 2 km on a bearing of $45^\circ$ to Camp Fife for a swim. Then they travel 3 km on a bearing of $135^\circ$ to the scout lodge for lunch. What is the least distance they will have to hike to return to their vehicles? (nearest tenth)

**77.** The equation $y =$ ______ will produce this graph.




**78.** A line perpendicular to the axis of symmetry of a parabola is called the ______.

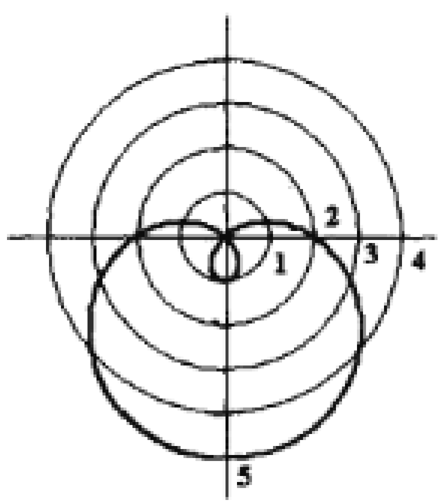
**79.** A laser beam from the top of a 30-ft building hits an object on the ground 100 ft from the base of the building. The angle of depression of the laser to the object is: (nearest second)

**80.** Find the largest value of $\theta$ is $6\cos^2\theta + \cos\theta = 2$ and $\pi \le \theta \le 2\pi$.

**81.** Simplify $\sin\theta\cot\theta\sec\theta - \cos^2\theta$.

**82.** The directrix of the parabola $8y = x^2 - 4x + 12$ is:

**83.** Which of the following polar equations will produce this graph on the polar grid?




**84.** Pop Eye takes his family sailing. They leave dock A and sail 1.5 miles on a course of 30° to buoy B. They turn and travel 1.75 miles on a bearing of $110°$ to buoy C. How far is it from buoy C to dock A? (nearest tenth)

**85.** Use the angle of rotation, $\theta$ (nearest degree), where $0° < \theta < 90°$, to transform the conic $x^2 + xy + y^2 = 3$ into an equation that does not contain an $xy$ term. The equation is:

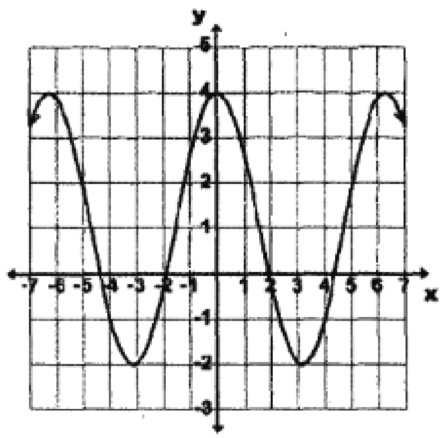
**86.** The circles $x^2 + y^2 + 3x - 6y + 5 = 0$ and $2x^2 + 2y^2 + 5x - 6y + 3 = 0$ intersect in two points. The slope of the line through the two points of intersection is:

**87.** It is precisely 2:45 pm on a circular clock. What is the measure of the smaller angle formed by the minute hand and the hour hand of the clock?

**88.** $y^2 - x^2 = 0$ is an equation of a degenerate conic. Which of the following is the best graphical representation of this equation?

**89.** Vector $v = (2, 9)$ is perpendicular to vector $w = (4, k)$. Find $k$.

**90.** The graph shown is the graph of which of the following equations.




**91.** Point $P$ has polar coordinates of $(4, \frac{2\pi}{3})$ and rectangular coordinates of $(x, y)$. Where does point $P$ lie on the Cartesian coordinate plane?

**92.** Willie Dublett deposits \$500 in a bank account with an interest rate of 2.5% compounded monthly. How many months will it take for his balance to reach \$750?

**93.** Determine the range of $f(x) = 2 + 3\cos(4x - 5)$.

**94.** A ramp is 18 ft. long and the angle of elevation of the ramp from the ground to the platform is 15° 10' 5". Find the height of the platform. (nearest approximation)

**95.** The point $P(2, 1)$ is rotated clockwise around the origin to point $(-1, -2)$. The angle of rotation, to the nearest degree, is:

**96.** The center of the circle, $x^2 + y^2 - 4x - 6y + 9 = 0$, is ______units from the origin. (nearest tenth)

**97.** A Ferris wheel has a radius of 7 meters and turns at 6 revolutions per minute. The bottom of the Ferris wheel is 1 meter above the ground. The height $h$ of a passenger above the ground varies sinusoidally with time $t$. Which of the following equations best describes the relationship between $h$ and $t$?

**98.** Which of the following is true about the relation $f(x) = x^2 + 2x + 2$?

**99.** How many leafs are in the "rose" curve graph of the polar equation $r = 3 - 4\sin(2\theta + 5)$?

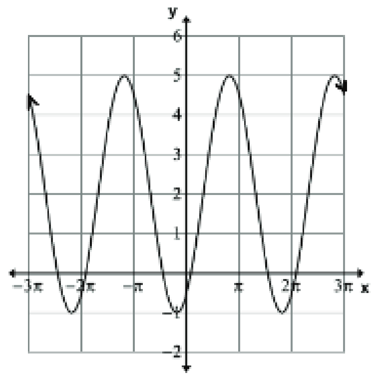
**100.** Which of the following is a reference angle for $1645°$?

**101.** If you start at $(-1.5, 0)$ on the $x$-axis and travel horizontally 12 radians to the right, how many times will you cross the graph of $y = \sin(3x)$?

**102.** Tye Guhr drops a golf ball from a height of 10 feet. It bounces back to a height of 60% of the distance it fell. How far has it traveled when it hits the ground the fourth time? (nearest inch)

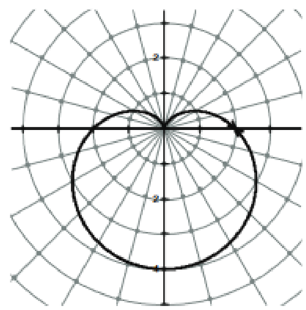
**103.** Babe, Dizzy, and Yogi are playing "toss and catch" with a baseball. The bearing from Babe to Dizzy is $254°$. The bearing from Yogi to Dizzy is 344°. The bearing from Yogi to Babe is $32°$. The distance from Yogi to Dizzy is 20 feet. How far is it from Yogi to Babe? (nearest inch)

**104.** The equation $y =$ ______ will produce this graph.




**105.** WHich of the following is a reference angle for $456^{\circ}$?

**106.** Which of the following polar equations will produce this graph on a polar grid?



**107.** The graph of $4x^2 + 9y^2 - 16x + 18y = 2$ is a(n):

**108.** The eccentricity of the hyperbola $4x^2 - y^2 = 4$ is:

**109.** If $\cos\theta < 0$ and $\tan\theta < 0$ which quadrant will $\theta$ terminate in?

**110.** Let $||V_1|| = 15$ and $||V_2|| = 9$, where the direction angles of $V_1$ and $V_2$ are $20^{\circ}$ and $80^{\circ}$, respectively. Find $||V_1 + V_2||$. (nearest tenth)

**111.** $\sin\theta\sec\theta + \cos\theta\csc\theta$ is equivalent to:

**112.** Willie Ketchit drops a golfball from a height of 10 meters. Each time it hits the ground it rebounds to a height of 50% of the distance it fell. Find the total distance the golfball travels when it reaches the ground the third time. (nearest tenth)

**113.** The graph of $x^2 - 2xy + y^2 + 0x + 0y + 0 = 0$ is a ______.

**114.** Which of the following is equivalent to $\frac{\sin\theta\tan\theta}{\sin(90^{\circ}-\theta)} + \frac{\cot\theta}{\tan(90^{\circ}-\theta)}$?

**115.** If $\cos x - \sin x = a$ and $\cos x + \sin x = b$, then $\cos^2 2x =$?

**116.** Let $||V_1|| = 9, ||V_2|| = 8$, where the direction angles of $V_1$ and $V_2$ are $60^{\circ}$ and $150^{\circ}$, respectively. Find the direction angle of $||V_1 + V_2||$. (nearest degree)

**117.** The focus of the figure given by the equation $x^2 + 6x - 12y + 57 = 0$ is $(x, y)$. Find $x$.

**118.** Sir Vayor is trying to find the height of a flagpole. His eyes are 1.7 meters above the ground and he is standing 10 meters from the base of the pole. The angle of elevation from his eyes to the top of the pole is 60°. Using this information, Sir Vayor computes the top of the flagpole to be: (nearest meter)

**119.** Using the equation $y = \frac{3}{4}\cos(2x - \frac{\pi}{3}) - 1$ which of the following has the largest numeric value?

**120.** The circles $(x-3)^2+(y+1)^2=16$ and $(x-4)^2+(y-2)^2=9$ intersect in two points. The slope of the line through the two points of intersection is:

**121.** Determine the range of $f(x)=2-4\cos(x+3)$.

**122.** $\frac{\sin\theta}{1+\cos\theta}+\frac{1+\cos\theta}{\sin\theta}$ is equivalent to:

**123.** Captain Ed Inberg went sailing on Lake Falcon. He sailed his scow from the dock 8 km on a bearing of $40°$. Then he changed course and sailed 5 km on a bearing of $120°$. Then he decided to return to the dock. What bearing will Captain Ed have to sail to go straight back to the dock?

**124.** Given: $f(x)=2-4\sin(x+3)$. What quadrant(s) would the graph of $f(x)$ be in if the amplitude is cut in half, the vertical displacement is decreased by 5 and the phase shift is increased by 1?

**125.** The Hole-In-One golf shop has periodic sales given by the function $G(m)=5+5\cos((\frac{\pi}{3})(m+3))$ where $m$ is the number of months and $G(m)$ is the number of golf sets sold. If the store opened on Jan. 1, when did the maximum sales first occur?

**126.** If you start at $\left(\frac{7\pi}{2},0\right)$ on the $x$-axis and travel horizontally 15.7 radians to the left, how many times will you cross the graph of $y=2\sin(3x)$?

**127.** Given: $f(x)=3\cos[4\pi(x+1)]-2$. Find the sum of the numeric values of the period and the vertical displacement.

**128.** Meagan Money invested some money in the stock market. Her investment increased 8% by the end of the first year, decreased 2% by the end of the second year, and increased 12% by the end of the third year. What was Meagan's average rate of return over the three year period? (nearest tenth)

**129.** The vertex of a parabola is located at $(3,1)$ and the focus is located at $(3,3)$. Find the directrix of the parabola.

**130.** Given the function $f(x)=\sin x$, find the slope of the secant line between $x=0$ and $x=\frac{\pi}{2}$.

**131.** Sir Benjamin Hall was looking at the circular face of the famous Big Ben clock. He noted that the time was 5:43 pm. What was the measure of the acute angle formed by the big hand and the little hand at that time?

**132.** Chip Shought hit his gold ball over a pond onto the edge of the green. He had to walk around the pond to his ball. He walked 70 yards on a bearing of $250°$ from the tee. Then he walked 90 yards on a bearing of $50°$ to his ball. What was the straight line distance from the tee to his ball? (nearest yard)

**133.** I. C. Itt spotted a plane flying over his house. He noted that the angle of elevation from him to the plane was $32°40'$ and he was 1,530 meters from his house. Using this information I. C. was able to determine the altitude of the plane. What was the altitude of the plane? (nearest meter)

**134.** If $x$ is in QIII then $\frac{1-\cos(2x)}{\sin(2x)}=\tan kx$ and $k$ equals:

**135.** Given: $f(x)=3-2\sin(x+4)$, where the domain is $x|x\in$ Reals and the range is $f(x)|a\le f(x)\le b$ and $y\in$ Reals. Which of the following is not in the range?

**(A)** $1.5$ **(B)** $3.124$ **(C)** $2.04$ **(D)** $5.333\ldots$ **(E)** $4.75$

**136.** The expression $(1-\cos\theta)(1+\cos\theta)(1+\cot^2\theta)$ is equivalent to:

**137.** $e^{3i}=\cos(3)+i\sin(3)$ is an example of ______formula.

**138.** A circle with its center at the origin or the Cartesian x-y coordinate system has a radius of 3 units. If you start at $(-3,0)$ and travel on the circle $\frac{8\pi}{3}$ radians in a clockwise direction, where on the x-y coordinate plane will you stop at?

**139.**

# Solutions

1. 6.3 units
2. $-\frac{24}{25}$
3. 2
4. 9
5. 217 ft
6. $\sec\theta$
7. $x^2 - y^2 = 2$
8. $6\frac{1}{4}$
9. 0.66
10. $2\csc(x)$
11. 76.0 s
12. 148
13. 203 ft
14. cardioid
15. 4
16. 81
17. -3.4
18. 294 rpm
19. -5.00
20. 24i
21. 1286
22. 16 in
23. 21
24. 6
25. D
26. 69.8°
27. cardioid
28. 24
29. 523.6
30. 11
31. D
32. 19.9 min
33. -4
34. $-\frac{57}{8}$
35. 4

**36.** 1.8

**37.** 68 ft

**38.** 40.6

**39.** 33.66

**40.** 153.9

**41.** 1.07 ft

**42.** 11.1

**43.** $2\pi$

**44.** not a function

**45.** 62 ft

**46.** $400

**47.** -34

**48.** 175

**49.** 556 mi

**50.** 75.4

**51.** 8.9

**52.** 39.75

**53.** 1.2

**54.** $40°$

**55.** eccentricity

**56.** $69.8°$

**57.** $-3\frac{3}{7}$

**58.** D

**59.** $8+8i$

**60.** $1.2°$

**61.** $\frac{3}{4}$

**62.** -3.75

**63.** 1

**64.** $520.00

**65.** $5-2\sin\frac{1}{3}(-4x+5\pi)$

**66.** line

**67.** $8\pi$

**68.** 1

**69.** 2

**70.** 15°

**71.** 6

**72.** 11' 2"

**73.** $x + 2y = 17$

**74.** $(\frac{8}{17}, \frac{15}{17})$

**75.** $-\frac{1}{2}$

**76.** 3.6 km

**77.** $2\sec(\frac{\pi}{2}x)$

**78.** directrix

**79.** 16° 41' 57"

**80.** $\frac{5\pi}{3}$

**81.** $\sin^2\theta$

**82.** $y = -1$

**83.** $r = 2 - 3\sin\theta$

**84.** 2.5 miles

**85.** $3x^2 + y^2 = 6$

**86.** $\frac{1}{6}$

**87.** $172.5°$

**88.** intersecting lines

**89.** $-\frac{8}{9}$

**90.** $y = 1 + 3\cos(x)$

**91.** QII

**92.** 195

**93.** $[-1, 5]$

**94.** 4' 8.52"

**95.** 143°

**96.** 3.6

**97.** $h = 8 - 7\cos\left(\frac{\pi}{5}t\right)$

**98.** neither even nor odd function

**99.** 4

**100.** $25°$

**101.** $11$

**102.** 33' 6"

**103.** 29' 11"

**104.** $2 + 3\sin(x - 1)$

**105.** $84°$

**106.** $r = 2 - 2\sin\theta$

**107.** ellipse

**108.** $\sqrt{5}$

**109.** QIII only

**110.** 21.0

**111.** $\frac{\sec^2\theta}{\tan\theta}$

**112.** 25.0 m

**113.** hyperbola

**114.** $\sec^2\theta$

**115.** $2ab$

**116.** $48°$

**117.** $(-3, 4)$

**118.** 13 m

**119.** period

**120.** $-\frac{1}{3}$

**121.** $[-2, 6]$

**122.** $2\csc\theta$

**123.** $249°$

**124.** III & IV

**125.** 3 months

**126.** 15

**127.** -1.5

**128.** 5.8%

**129.** $y = -1$

**130.** $\frac{2}{\pi}$

**131.** $86.5°$

**132.** 34 yds

**133.** 981 meters

**134.** 1

**135.** D

**136.** 1

**137.** Euler's

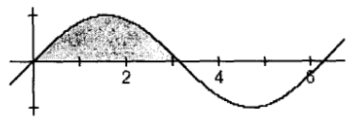
**138.** Quadrant I

**139.**

# 4 Calculus

## Problems

**1.** Find the area of the shaded region (nearest square unit)




**2.** Which of the following sequences is divergent?

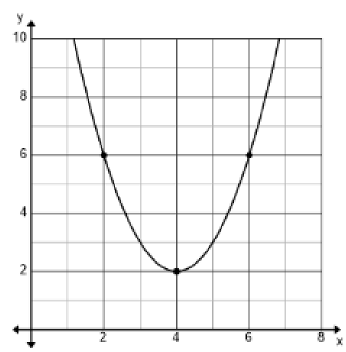
**(A)** $\left\{\frac{2n+1}{3n-2}\right\}$ **(B)** $\left\{\frac{-1^n}{n^2+n}\right\}$ **(C)** $\left\{\frac{(-1)^n(n+1)}{n+2}\right\}$ **(D)** $\left\{\frac{4n^2-n^3}{10+2n^3}\right\}$ **(E)** $\left\{\frac{6n^2+3n-1}{n^2+8n+16}\right\}$

**3.** If $f'(x) = 6x^2 - 4x + 1$ and $f(1) = 0$, find $f(-1)$.

**4.** $f(x) = 2x^3 - 6x + 1$ has an inflection point at:

**5.** Find the area (in square units) of the region bounded by $x = \frac{y^2+2}{2}$ and $x = y + 5$.

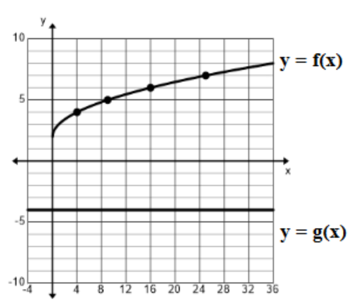
**6.** The graph of $f'(x)$ is shown below. If $f(1) = 2\frac{1}{3}$, then $f(2) =$ ______.



**7.** The point of inflection for the graph of $f(x)$ has coordinates $(a, b)$. $a + b =$ ______. (nearest tenth)

| **x** | **-3** | **-2** | **-1** | **0** | **1** | **2** |
|---|---|---|---|---|---|---|
| **f(x)** | **10** | **-9** | **-10** | **-5** | **-6** | **-25** |

The following graph is used for problems 8 and 9.



**8.** Find the area between the curves $y = f(x)$ and $y = g(x)$ shown on the right over the interval $[4, 24]$. (nearest whole number)

**9.** Find the volume of the solid generated by revolving the region bounded by $y = f(x)$, the $x$-axis, the line $x = 4$ and the line $x = 24$ about the line $y = g(x)$. (nearest whole number)

**10.** Find the area of one petal of the rose curve $r = 6\cos(2\theta)$. (nearest tenth)

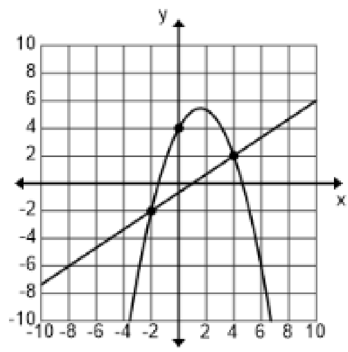
**11.** Find the interval of convergence for the power series $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}x^n}{4^n}$.

**12.** Find the value of $c$ in the open interval $(-8, 2)$ that satisfies the mean value theorem for the function $f(x) = \sqrt{6 - x}$. (nearest hundredth)

**13.** If you were going to evlauate $\int \frac{\cos x}{\sin^3 x} \mathrm{d}x$ using $u$-substitution, the best choice for $u$ is ______.

**14.** If $f(x) = x^2 - 8x + 9$, then $\frac{f(x+h)-f(x)}{h} =$ ______.

**15.** Find the area bounded by thw two curves shown below. (nearest tenth)

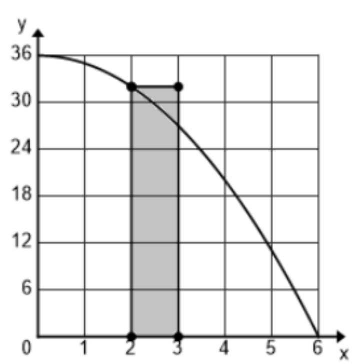



**16.** Consider the function $f(x) = \frac{1}{2}\cos(2x) + \frac{3}{2}\sin(x)$. Find the slope of the line tangent to the graph of $y = f(x)$ when $x = \pi$. (nearest tenth)

**17.** A balloon is rising straight up from a point on the ground 150 feet from a curious mouse. If the balloon is rising at a rate 8 ft/s, what is the rate of change of the angle of elevation of the balloon from the mouse when the balloon is 200 ft above the groud. (nearest hundredth)

**18.** A rectangular solid with a square base has a total surface area of 330 in$^2$. Find the maximum volume possible for such a solid. (nearest tenth)

Use the following graph for questions 19 and 20.




**19.** Find an approximation of the area bounded by the graph of $f(x) = 36 - x^2$ and the $x$-axis between $x = 1$ and $x = 5$. Use four rectangles of equal width and find the height of each rectangle using the left endpoint of the interval. One of the rectangles is shown above.

**20.** Find the exact area of the region bounded by the graph of $f(x) = 36 - x^2$ and the $x$-axis between $x = 1$ and $x = 5$. (nearest tenth)

**21.** Find the derivative of $F(x)$ if $F(x) = \int_0^{4x} \sin(t)\mathrm{d}t$.

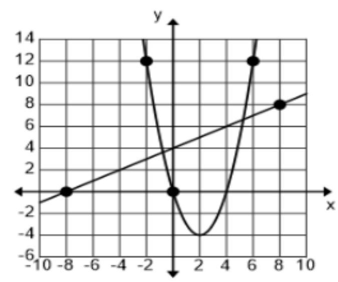
**22.** When evaluating $\int x^2 \cos(x)\mathrm{d}x$ using a $u$-substitution, the best choice for $u$ is ______.

**23.** Let $f(x) = \sin(x)$ and let $P_5(x)$ be the fifth Maclaurin polynomial for $f(x) = \sin(x)$. Find the value of $\left|P_5\left(\frac{\pi}{6}\right) - f\left(\frac{\pi}{6}\right)\right|$. (nearest ten-millionth)

**24.** Find the length of the arc from $\theta = \frac{\pi}{6}$ to $\theta = \frac{\pi}{3}$ for the polar curve $r = 4 - 4\cos(\theta)$. (nearest tenth)

**25.** The point $A(6, b)$ lies on the graph of the parametric equations $x(t) = \sqrt{2t}$ and $y(t) = \frac{10}{t+2}$, $0 \leq t \leq 60$. $b =$ ______.

The following graph is used for problems 26 and 27.




**26.** The points of intersection of the curves shown on the right are $P$ and $Q$. $PQ =$ ______. (nearest tenth)

**27.** Find the area bounded by the two curves shown on the right. (nearest tenth)

**28.** The ______Theorem states that "If $f$ is a continuous, real valued function defined on an interval $[a, b]$, with $f(a) \neq f(b)$, and $k$ is a real number between $f(a)$ and $f(b)$, then there exists some $c \in (a, b)$ such that $f(c) = k$."

**29.** Emmitt won the lottery and decided to purchase some land near Lubbock and raise emus. He wanted to build a pen in the shape of a rectangle to keep his emus. He has 480 feet of fencing to use for three sides of the pen. He will use one side of his large barn as the fourth side. What is the maximum area of the pen? (nearest square foot)

**30.** An 18-ft-long ladder rests against the wall of a building. The foot of the ladder begins to slide away from the building at a constant rate of 6 in/s. How fast is the top of the ladder sliding down the wall at the instant the ladder makes an angle of $30°$ with the wall? (nearest hundredth)

**31.** Find the area of the region in the first quadrant bounded by the graphs of $y_1 = 3+\cos(x)$ and $y_2 = 2-\cos(x)$ and the $y$-axis. (nearest tenth)

**32.** Find the slope of the line tangent to the curve $2y^2 - 6xy + 3x^3 - 4y = 8$ when $x = 1$ and $y > 0$. (nearest hundredth)

**33.** To evaluate $\int \sin^5(x)\cos(x)\mathrm{d}x$ using a $u$-substitution, the best choice for $u$ is ______.

**34.** To evaluate $\int x^2 \sin(x)\mathrm{d}x$ using integration by parts, the best choice for $u$ is ______.

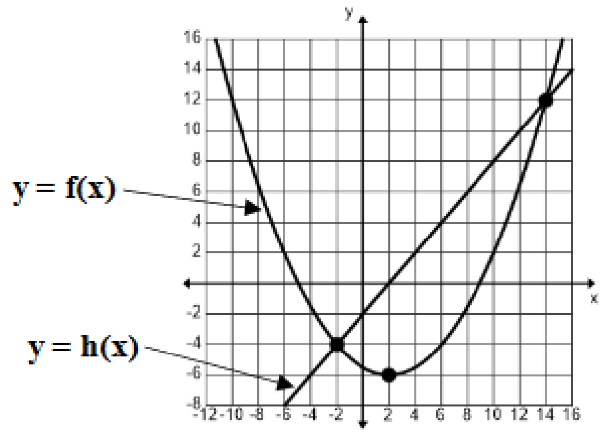
**35.** Experts from Texas Tech believe that Newberry State Park in Seminole is capable of supporting no more than 250 prairie dogs. On April 1, 2012, Anthony introduced the first pair of prairie dogs. On April 1, 2020 the population had reached 60 prairie dogs. Professor Cravens commissioned Carter to develop a logistic model of the prairie dog population. The logistic model predicts that there should be about ______prairie dogs in 2030.

For problems 36 and 37, consider the curve given by $x(t) = \sin(t)$ and $y(t) = t+\cos(t)$, $\frac{\pi}{2} \leq t \leq \frac{5\pi}{2}$. (rad)

**36.** Find the length of the curve. (nearest hundredth)

**37.** The tangent line when $t = \pi$ intersects the tangent line when $t = 2\pi$ at the point $P(a, b)$. $a + b =$ ______. (nearest hundredth)

For problems 38-41, consider the following graph.




**38.** The graphs of $y = f(x)$ and $y = h(x)$ intersect at the points $P$ and $Q$. $PQ =$ ______. (nearest tenth)

**39.** The point $F(2, b)$ is the focal point of the parabola. $b =$ ______.

**40.** The area bounded by the graphs of $y = f(x)$ and $y = h(x)$ is ______. (nearest tenth)

**41.** If the area bounded by the graphs of $y = f(x)$ and $y = h(x)$ is revolved around the line $x = -6$, then the volume of the solid generated is ______. (nearest whole number)

**42.** Consider the graph of $h(x) = 2\ln(x) - \frac{1}{e^x}$. The slope of the line tangent to the graph of $h(x)$ at $x = 9$ is ______. (nearest thousandth)

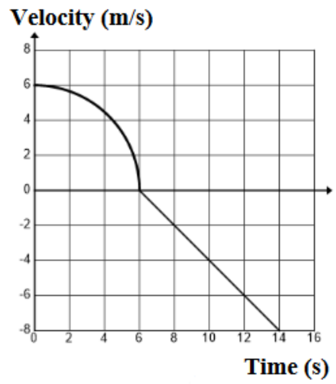
**43.** Consider the graph of $2xy^2 - 3y + 4x^2 = 13$. The $y$-intercept of the line tangent to the curve at the point where $y = 3$ and $x > 0$ is ______. (nearest tenth)

**44.** Farmer Fred wants to make a rectangular holding area for his dairy cattle using 640 feet of fence. He plans to use the back side of his barn as one of the sides. The maximum possible value of the holding area is ______square feet.

**45.** A 25-ft-long ladder rests against the wall of a building. The foot of the ladder begins to slide away from the building at a constant rate of 2 ft/s. How fast is the top of the ladder sliding down the wall at the instant the foot of the ladder is 7 feet from the wall? (nearest whole number)

**46.** The position of a particle is given by the parametric equations $x(t) = e^{.4t}$ and $y(t) = \ln(t^2 + 2)$ for $0 \le t \le 12$. Find the total distance traveled by the partial from $t = 2$ to $t = 10$. (nearest tenth)

Use the following graph for problems 47 and 48.




The graph consists of a quarter circle and a line segment. The graph represents the velocity of an object during a 14-second time interval.

**47.** Find the object's average velocity during the 14-second time interval $[0, 14]$. (Nearest hundredth)

**48.** Find the objects acceleration at $t = 10$ s.

| Time | 11:00 AM | 12:00 PM | 2:00 PM | 6:00 PM | 8:00 PM |
|---|---|---|---|---|---|
| People/minute | 6 | 9 | 7 | 11 | 5 |

**49.** Suppose that Larry's Cafeteria in Millersview opens their doors at 11:00 AM and closes their doors at 8:00 PM. The table above shows the rate at which people entered the cafeteria, in people per minute, at various times on Saturday. Use a trapezoidal approximation with four subintervals to estimate the total number of people who dined at Larry's on Saturday.

**50.** The rate of change of a population of horned lizards at any time $t$, $t \geq 0$, is changing at a rate proportional to its population at time $t$. The population on March 1, 2000 was 180. On March, 1, 2004 the population was 210. What should the population be on March 1, 2033?

**51.** Consider the curve given by $f(x) = x^3 + 6x^2 - 4x + 2$. The local maximum of $f(x)$ is ______. (nearest tenth)

**52.** $\int 2^{-x} \mathrm{d}x =$ ______ $+ C$, where $C$ is an arbitrary constant.

**53.** $\int \frac{13}{144+25\cos^2 x} \mathrm{d}x = \frac{1}{b} \tan^{-1}(\frac{b}{c} \tan x) + C$ where $C$ is an arbitrary constant, $c > b > a > 0$ and $a, b, c$ form a primitive Pythagorean triple. Find $a$.

**54.** The function $f(x) = x^3 - 3x^2 + 3$ has an inflection point at:

**55.** The area (in square units) of the region bounded by $y = 1 - x^2$ and the $x$-axis is:

**56.** Let $f$ be a function such that it is continuous on $[a, b]$ and it is differentiable on $(a, b)$. Then there exists at least one number $c$ in $(a, b)$ such that $f'(c) = \frac{f(b)-f(a)}{b-a}$. This theorem is known as:

**57.** Let $f(x) = \begin{cases} x & \text{if } x \leq 0 \\ x^2 & \text{if } 0 < x \end{cases}$ Which of the following statements is a false statement.

**(A)** $f$ is continuous at 0 **(B)** the right hand derivative at 0 is 0
**(C)** the left hand derivative at 0 is 1 **(D)** $f$ is not differentiable at 0 **(E)** $f(-1) = f(1)$

**58.** Find the area, in square units, of the figure bounded by $y = x^2 - x - 2$ and below the $x$-axis.

**59.** Let $f(x) = \frac{x-2}{3x+5}$. Find $f'(-1)$.

**60.** Find the digit in the ten-thousandths place of the series $1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots$, when $x = \pi$.

**61.** A function $y = f(x)$ is continuous on $[a, b]$, if $f(a) < y_0 < f(b)$ then $y_0 = f(c)$ for some $c$ in $[a, b]$. This theorem is the:

**62.** Let $f(x) = ax^5 - bx^4 - bx^3 + ax^2 + ax - b$. Find $f''(1)$.

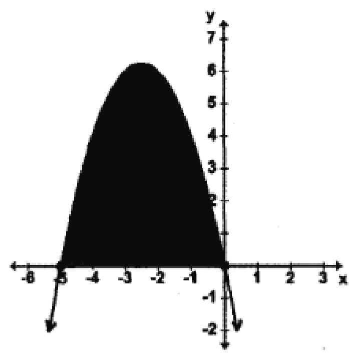
**63.** If $a_1 = -4, a_3 = -9$, and $a_4 = 13.5$ are terms of a geometric sequence, then $a_2 =$ ______.

**64.** How many points of intersection occur when $r = 2\cos\theta + 1$ and $\theta = \pi$ are graphed on a polar coordinate system?

**65.**

$$\sum_{k=0}^{2}(kx + (k+1)y) =$$

**66.** Find the area of the shaded region in square units.



**67.** If $f(x) = \frac{2x+3}{4x-5}$, then $f'(1) =$ ______

**68.** The slope of the line tangent to the curve $y = 2x^3 - 3x^2 - 5$ at $x = 2$ is 12. The point of intersection of the tangent line and curve is:

**69.** Evaluate $\int_{-n}^{n}(x^3 - 3x^2 - 5)\mathrm{d}x$

**70.** Find $f(2)$ when $f(x) = 1 - \frac{x^2}{2} + \frac{x^4}{24} - \frac{x^6}{720} + \ldots$. (nearest thousandth)

**71.** Let $f$ be a function such that it is differentiable on $(a, b)$ and continuous on $[a, b]$, and $f(a) = f(b) = 0$. Then there is a number $c$ in $(a, b)$ for which $f'(c) = 0$. This theorem is known as:

**72.** The function $f(x) = \frac{2}{x-1} + 18x$ is increasing at which of the following values of $x$?

**73.** Find the area (in square units) of the region bounded by $y = -x^2$ and $y = -4$.

**74.** Let $f(x) = \frac{4x+5}{3x}$. Find $f'(2)$.

**75.** Find an equation of the tangent line to the curve $y = \sqrt{9 - 4x}$ at the point $(-4, 5)$.

**76.** The point of inflection on the graph of $f(x) = 2x^3 - 6x^2 + 6x - 6$ is $(a, b)$. Find $b$.

**77.** Find an equation of the line tangent to the curve $y = x^3 - 2x^2$ at the point $(1, -1)$.

**78.** The area (in square units) of the region bounded by $y = -x^2 - 4x$ and $y = 0$ is:

**79.** $\int(-x\sin x)\mathrm{d}x =$ ______ $+ C$, where $C$ is some arbitrary constant.

**80.** If $f''(x) = 6$ and $f'(-1) = -8$ and $f(1) = 2$, then $f(-2) =$ ______ .

**81.** Find the instantaneous rate of change of the reciprocal of a number with respect to the number when the number is 4.

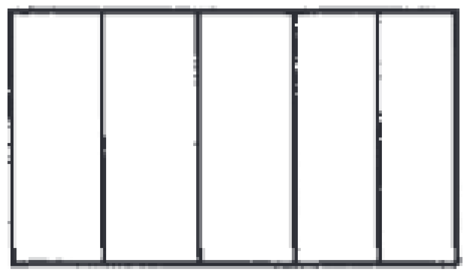
**82.** Let $f(x) = \frac{1}{x-1}$. Find the average rate of change of $f(x)$ over the interval $[2, 5]$.

**83.** Find the first term of the geometric sequence: $a, b, 44, c, 19\frac{5}{9}, \ldots$

**84.** If $f'(x) = 15x^2 - 6x + 2$ and $f(-1) = -9$, find $f(1)$.

**85.** $\int \sin(2x)\cos(2x)\mathrm{d}x =$ ______ $+ C$, where $C$ is an arbitrary constant.

**86.** Elmoor Fudd is building a rectangular shaped pen for his porkie pigs. It will have 4 parallel fences dividing the pen into 5 sections as shown. If he has 600 feet of fencing, what is the maximum area of his pig pen?



**87.** Find the area of the region bounded by the graphs of $x = 4 - y^2$ and $x = 4 - 4y$.

**88.** If $f'(x) = 3x^2 - 5$ and $f(-1) = 4$, find $f(1)$.

**89.** Let $\frac{1}{x} + \frac{1}{y} = 1$. Find $D_x y$.

**90.** What is the instantaneous rate of change at $x = 2$ of the function $f$ given by $f(x) = \frac{x^2-2}{x-1}$

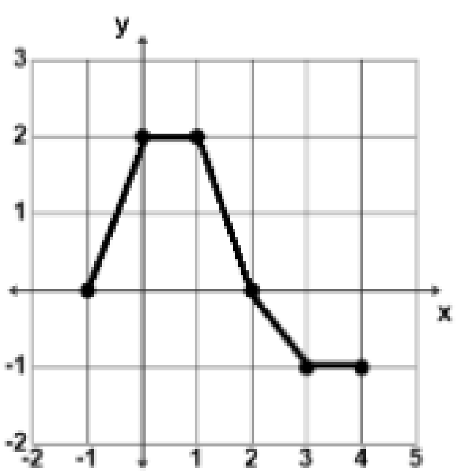
**91.** Let $f(x) = \begin{cases} 3 + x & \text{if } x \le 1 \\ 3 - x & \text{if } 1 < x \end{cases}$. Which of the following is/are true?

$1. \lim\limits_{x\to 1^+} f(x)$ exists $\qquad$ $2. \lim\limits_{x\to 1^-} f(x)$ exists $\qquad$ $3. f(x)$ is continuous

**92.** The function $f(x) = \begin{cases} nx^3 - x \text{ if } x \le 1 \\ mx^2 + 5 \text{ if } 1 < x \end{cases}$ is differentiable everywhere. Find $n$.

**93.** Let $f(x) = \frac{5x-2}{4+3x}$. Find $f'(-2)$.

**94.** Find the value of $\int_{-1}^{4} f(x)\mathrm{d}x$ for the piecewise-linear function, $f$, $-1 \le x \le 4$, shown below?




**95.** Mei Chado is 5' 4" tall. She is walking at a rate of 3 ft/sec toward a street light that is 16 feet tall. At what rate is the tip of her shadow moving? (nearest tenth)

**96.** Let $f(x) = 4x^2 - 4x + 1$. The tangent to $f(x)$ at $(x, y)$ is parallel to $y = 4x - 2$. Find $x + y$.

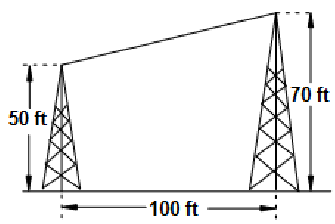
**97.** Let $f(x) = \begin{cases} -x+5 & x < -2 \\ x^2+1 & -2 \le x \text{ and } x \le 1 \\ 2x^3 - 1 & 1 \le x \end{cases}$. Which of the following is/are true?

(a) $f$ is continuous at $-2$

(b) $f$ is differentiable at $x = 1$

(c) $f$ has a local minimum at $x = 0$

**98.** A cable is connected from the shorter tower to the taller tower. What is the minimum length of the cable? (nearest inch)




**99.** Find the area bounded by $f(x) = x^3, f(y) = -2$, and $f(y) = 1$. (square units)

**100.** What is the slope of the secant line to the graph of $f(x) = 2x^2 + 3x - 4$ passing through the points $(1, m)$ and $(-3, n)$?

**101.** Rusty Pipes has a leaky pipe dripping water onto the floor forming a circular pool. The radius of the pool increases at a rate of 4 cm/min. How fast is the area of the pool increasing when the radius is 5 cm? (nearest cm$^2$/min)

**102.**

## Solutions

**1.** 2

**2.** C

**3.** -6

**4.** $(0, 1)$

**5.** 18

**6.** $10\frac{2}{3}$

**7.** -8.0

**8.** 193

**9.** 4890

**10.** 14.1

**11.** $(-4, 4)$

**12.** -2.24

**13.** $\sin x$

**14.** $2x + h - 8, h \neq 0$

**15.** 21.0

**16.** -1.5

**17.** 0.02 rad/s

**18.** 407.9 in$^3$

**19.** 114

**20.** 102.7

**21.** $4\sin(4x)$

**22.** $x^2$

**23.** 0.0000021

**24.** 1.6

**25.** $\frac{1}{2}$

**26.** 6.7

**27.** 36.4

**28.** Intermediate Value

**29.** 28,800 ft$^2$

**30.** 3.46 in/s

**31.** 3.8

**32.** 2.01

**33.** $\sin(x)$

**34.** $x^2$

**35.** 242

**36.** 8.00

**37.** 2.14

**38.** 22.6

**39.** -4.0

**40.** 85.3

**41.** 6434

**42.** 0.222

**43.** 5.9

**44.** 51,200

**45.** 7 in/s

**46.** 52.7

**47.** -0.27 m/s

**48.** -1.0 m/s$^2$

**49.** 4530

**50.** 642

**51.** 50.6

**52.** $-\frac{2^{-x}}{\ln 2}$

**53.** 5

**54.** $(1,1)$

**55.** $1\frac{1}{3}$

**56.** Mean-value Theorem

**57.** E

**58.** $4\frac{1}{2}$

**59.** $2\frac{3}{4}$

**60.** 6

**61.** Intermediate Value Theorem

**62.** $22a - 18b$

**63.** 6

**64.** 1

**65.** $3x + 6y$

**66.** $20\frac{5}{6}$

**67.** -22

**68.** $(2, -1)$

**69.** $-2n(n^2 + 5)$

**70.** -.416

**71.** Rolle's Theorem

**72.** $1\frac{2}{3}$

**73.** $10\frac{2}{3}$

**74.** $-\frac{5}{12}$

**75.** $2x + 5y = 17$

**76.** -4

**77.** $y = -x$

**78.** $10\frac{2}{3}$

**79.** $x \cos x - \sin x$

**80.** 17

**81.** $-\frac{1}{16}$

**82.** $1\frac{1}{3}$

**83.** $222\frac{3}{4}$

**84.** -6

**85.** $-\frac{1}{8}\cos(4x)$

**86.** 7000 sq. ft.

**87.** $10\frac{2}{3}$

**88.** -4

**89.** $\frac{y-1}{1-x}$

**90.** 2

**91.** 1 & 2 but not 3

**92.** -11

**93.** 6.5

**94.** 2.5

**95.** 4.5 ft/sec

**96.** 2

**97.** 3 only

**98.** 102'0"

**99.** 4.25

**100.** -1

**101.** 126 cm$^2$/min

**102.**

# 5 Statistics

## Problems

**1.** A box contains 5 green balls, 4 blue balls, and 3 red balls. Two balls are randomly selected, one at a time, without replacement. What is the probability that both are blue?

**2.** If two dice are rolled at one time, what is the probability that both dice show a prime number?

**3.** OVer the last few years, the length of Randy's drives at the local driving range follows a normal distribution with a mean of 225 yards and a standard deviation of 6 yards. Approximately what percentage of his drives are between 219 yards and 231 yards? (nearest whole number)

**4.** A fair die is rolled four times. What is the probability of getting an even number, a prime number, a Fibonacci number, and a perfect number, in that order?

**5.** Mel is throwing darts at a circular target with a diameter of 24. On the raget are two concentric circles with diameters 8 and 16. A dart landing in the small circle earns 10 points. A dart landing inside the circle with a diameter of 16, but outside the small circle earns 6 points. A dart landing on the target outside of the two concentric circles earns 2 points. Find the expected value of the points earned on any randomly selected toss that lands on the target. (nearest tenth)

Use the table below for problems 6 and 7. Karen owns the Kwik Stop in Sundown. She believes that the number of water bottles sold each day varies with the temperature. She made a table of the high temperature and the number of water bottles sold on the 15th day of the month, for the months of April through September.

| **Temperature** | **64°** | **72°** | **86°** | **94°** | **96°** | **92°** |
|---|---|---|---|---|---|---|
| **Bottles Sold** | **420** | **450** | **500** | **530** | **540** | **520** |

**6.** Find the sum of the mean, median, and range for the number of water bottles sold on these six days.

**7.** Use the data from the table to create an appropriate mathematical model and predict the high temperature on a day that Karen sold 354 water bottles. (nearest whole number)

**8.** The preferred swimming pool temperature of adult females follows a normal distribution with a mean of 82° F with a standard deviation of $3$° F. Find the probability that a random selected adult female will prefer a temperature between $26$° C and $29$° C. (nearest thousandth)

**9.** A researcher took a random sample of 1,000 teenage males in order to estimate the mean number hours of sleep a typical teenage boy gets each night. A 90% confidence interval would be ______than a 98% confidence interval and would involve ______risk of being incorrect.

**10.** A one-stample $t$ statistic from a sample of 40 observations for the two-sided test of

$$H_0 = 26 \qquad H_a \neq 26$$

has the value $t = -1.44$. Find the $p$-value for this test. (nearest thousandth)

**11.** When analyzing data, statisticians often report the five-number summary. Which of the following are included in the five-number summary?
I. mean   II. standard deviation   III. median   IV. quartiles   V. maximum and minimum

**12.** A shipment of twenty refurbished computers contains four defective computers. In how many ways can Rocket purchase five of these computers and get two defective ones?

**13.** James has 6 calculus books and 8 physics books on his bookshelf at home. How many arrangements are possible if he keeps the calculus books together and the physics books together?

| | Math | English | Science | History | Elective 1 | Elective 2 |
|---|---|---|---|---|---|---|
| Freshman | 94 | 92 | 96 | 98 | 97 | 95 |
| Sophomore | 93 | 94 | 97 | 99 | 95 | 91 |
| Junior | 95 | 93 | 98 | 97 | 96 | 93 |

Use the table above for problems 14 and 15.
The table shows the grades for Carolyn her first three years at HPHS.

**14.** What is Carolyn's cumulative average after three years of school? (nearest hundredth)

**15.** If Carolyn needs to have a cumulative average of 95.45 or higher to graduate in the top 10, what is the minimum average required during her senior year to meet this goal? She plans to take 6 courses her senior year. (nearest hundredth)

**16.** Suppose the distribution of the heights of adult males in Nevada is approximately normal with a mean height of 70 inches and a standard deviation of 2.7 inches. A height of 72 inches corresponds to what percentile in the distribution?

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Time (wk) | 0 | 2 | 5 | 8 | 11 | 14 | 17 |
| Population | 12 | 47 | 388 | 3060 | 24600 | 200000 | 1580000 |

Use the table above for problems 17 and 18.
Sam was doing research for his master's thesis at Harvard. He estimated the population of an isolated group of flies at seven different times. He started at $t = 0$ with 12 flies. He finished at $t = 17$ weeks with 1,580,000 flies.

**17.** Sam entered the data into a list he called $L_1$ and the populations into a list he called $L_2$ on his computer. Which of the following transformation equations will linearize the data?

**(A)** $(L_1, (L_2)^3)$ **(B)** $((L_1)^3, L_2)$ **(C)** $(\log(L_1), L_2)$ **(D)** $(L_1, \log(L_2))$ **(E)** $(\log(L_1), \log(L_2))$

**18.** Sam was successful in using one of the transformations listed in problem 17 to calculate a regression equation that fit the data. Use this equation to predict how many days after $t = 0$ that the population reaches 100,000 flies. (nearest tenth)

**19.** Four-hundred students at Texas Tech were randomly selected and asked if they had worked out at the Recreation Center by using a treadmill or an elliptical trainer the past week. The results showed that 75 had worked out on both, 190 had worked out on a treadmill, and 260 had worked out on an elliptical trainer. How many of the 400 students stampled had not worked out on either training device the previous week?

**20.** Amarillo Slim was playing five card poker. He had a full house, but lost to the dealer who had a royal flush. This is where a player has the ten, jack, queen, king and ace of the same suit. Slim thought the dealer was cheating because the probability of being dealt a royal flush from a standard deck of 52 cards is only ______. (9 decimal places)

**21.** Assume that Luka Doncic makes 35.3% of his 3-point shots regardless of the opponent or where the game is being played. He is unaffected by previous attempts. If he attempts ten 3-points shots in a game, what is the probability that he makes 4, 5, or 6 of the shots? (nearest thousandth)

**22.** A survey asked a random sample of 500 U.S. teenagers whether music from the 1970s is superior to music from the 2020s. Of the sample, 312 responded with "yes". Construct a 95% confidence interval for the proportion of U.S. teenagers who would say "yes" if asked this question.

**23.** The average lifetime of battery packs for the Williams Electric vehicle was 4.9 years in 2004. In 2012, they introduced a new battery pack that they believed would last longer. A simple random sample of 50 of the 2012 vehicles with the new battery packs was selected. The mean lifetime of the battery packs turned out to be 5.1 years with a standard deviation of 0.86 years. An appropriate test was performed and the resulting $P$-value was ______. (nearest thousandth)

**24.** Andrew has 12 marbles that are identical in size, but vary in color. Three are red, four are blue and five are green. If he wishes to place them in a straight line on a table, how many distinct arrangements can be made?

**25.** The "on base percentage" for Maury Wills of the Portland Beavers is 0.355. If he has 10 at bats in a doubleheader against the Billings Broncos, what is the probability that he will safely get on base exactly 4 times. (Nearest hundredth)

| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
|---|---|---|---|---|---|---|---|
| **212** | **224** | **239** | **166** | **202** | **272** | **218** | **188** |

Brent loves to bowl. The table above shows the scores from the eight games he bowled on Friday night at Salado Lanes. Use this table for problems 26 and 27.

**26.** Find the positive difference between Brent's mean score and median score.

**27.** How many of his scores are classified as outliers?

| **Week** | **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|
| **Miles** | **22** | **27** | **31** | **37** | **40** | **46** |

Use the table above for problems 28 and 29.

**28.** Carmen began her 10-week buildup for cross country in June. She ran at 7-minute pace over hilly terrain and gradually increased her mileage each week. The table above shows her mileage total for each of the first six weeks of her buildup. When she plotted her data, she believed a linear model fit her data pretty well. Use a linear model to predict her mileage for week 10. (nearest tenth)

**29.** If she actually ran 58 miles in week 8, what is the residual for week 8? (nearest hundredth)

**30.** Four hundred seniors are enrolled in the Patton Springs Stem Academy. Two hundred sixteen are taking Calculus, one hundred eighty-four are taking Statistics, and one hundred forty-eight are taking Physics. Thirty-six are taking Statistics and Calculus, but not Physics. Sixty-four are taking Calculus and Physics, but not Statistics. Twenty-two are taking Statistics and Physics, but not Calculus. Sixty-two are not taking any of these three classes. How many seniors are taking all three of these classes?

**31.** There are so many students applying to attend the Patton Springs Stem Academy that a math readiness test is given to all applicants and the scores on these tests are used as part of the admission process. The mean score on math readiness test is 856 with a standard deviation of 48. If Kyle scored 915 on the math readiness test, what percentile does that place him at? (nearest tenth)

**32.** Assume that the mean distance for the men's shot in Diamond League competition is 65 ft 2 in with a standard deviation of 4 ft 1 in. For women, assume the mean distance is 58 ft 3 in with a standard deviation of 3 ft 11 in. If Ryan's best is 77 ft and 3.75 in and Valerie's best is 69 ft 8 in, who had a better performance based on $z$-scores? Ryan's performance was slightly better because his $z$-score minus Valerie's $z$-score = ______. (nearest thousandth)

A large Supermarket chain requires that no more than 10% of apples they receive have defects. When a recent shipment came in, inspectors took a random sample of 400 apples and they determined that 50 of the apples had defects. The data was given to a highly paid analyst. She performed an appropriate test at the $\alpha = 0.05$ level and made a recommendation.

**33.** The appropriate test was the ______Test.

**34.** Based on a $P$-value of ______(nearest thousandth), she recommended the shipment be rejected.

**35.** Andrew has 12 marbles that are identical in size, but vary in color. Six are red, four are blue and two are green. If he wishes to place them in a straight line on a table, how many distinct arrangements can be made?

**36.** The "on base percentage" for Bobby Richardson of the Yankees is 0.328. If he has 9 at bats in a doubleheader against the Dodgers, what is the probability that he will safely get on base exactly 5 times? (nearest hundredth)

Use the following table for problems 37 and 38.

| Day | Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|---|---|---|---|---|---|---|---|
| Minutes | 45 | 65 | 57 | 71 | 53 | 56 | 73 |

Joe tries to exercise every day at the gym. He runs, lifts weights, and uses a Stair Master. Last week, he recorded the time he spent at the gym as shown in the table above.

**37.** Find the positive difference between the mean and the median of the data.

**38.** A modified box plot shows that there are ______outliers.

Use the following table for problems 39 and 40.

| Miles | 35 | 48 | 65 | 72 | 86 | 100 |
|---|---|---|---|---|---|---|
| Time | 3 hr 22 min | 3 hr 6 min | 2 hr 55 min | 2 hr 44 min | 2 hr 30 min | 2 hr 18 min |

Six men of similar abilities spent 6 months preparing for the Houston marathon. Their average weekly mileage and their times for the race are shown in the table above. Coach Salazar plotted the data in the table and decided that a linear relationship existed between the average weekly mileages of his runners and their times at the Houston Marathon. He used statistical software to generate a least squares regression line (LSRL).

**39.** The LSRL predicts that for each increase of one mile in a runner's weekly mileage, there is a corresponding decrease of ______seconds in their marathon time. (nearest whole number)

**40.** According to the model, what should a runner's average weekly mileage be in order to run a marathon in 2 hr 10 min? (nearest whole number)

**41.** In a random sample of 32 adult male wild turkeys found in Hemphill County, the average weight was 20 pounds with a standard deviation of 2 pounds. Construct a 96% confidence interval for the mean weight of adult male turkeys found in Hemphill County. (nearest hundredth)

**42.** At Aberdeen High School, 58% of the students are girls and 42% are boys. Suppose that 72% of the girls select soccer as their sport compared to 36% for the boys. If a randomly selected student selects soccer as his/her favorite sport, what is the probability that the student is a girl? (nearest hundredth)

For problems 43 and 44, assume that the average drive for a 74-year-old male golfer is 226 yards with a standard deviation of 12 yards.

**43.** If Randy is 74 years old and his average drive is 237 yards, what percentile does that place him at among 74-year-old golfers?

**44.** If a 74-year-old male golfer wanted to be at the 96th percentile, what average drive is required? (nearest whole number)

**45.** Iva Gottadele bought an autographed bat on Ebay for \$28.00. She estimates that there is a 35% probability that she can resell it for \$36.00 and a 65% probability that she will only be able to resell it for \$23.00. What is the mathematical expectation of this deal?

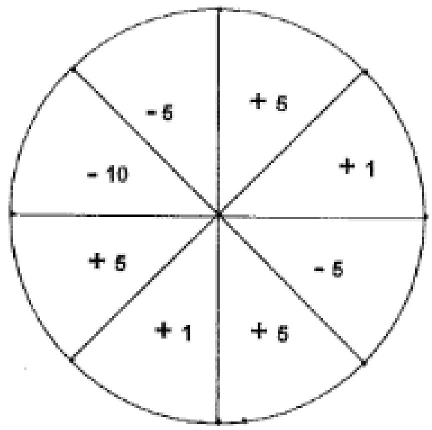
**46.** The following test scores are listed in order from least to greatest: $75, x, 85, y, 88, 91, z$. Find the mean of the scores if the median score is 86, the mode score is 75, and the range is 20.

**47.** Coach Barton has 10 students on his math team. He wants to arrange them into practice teams of 3 or 4 students. How many practice teams can he make?

**48.** The odds of losing an event is $\frac{a}{b}$. The probability of winning the event is:

**49.** If the probability that a student in a Statistics class studies for an exam is 75%, and the probability that a student who studies passes the test is 90%, then the probability that a student both studies and passes the test is:

**50.** Betty Wheel spins the Wheel of Fun. The wheel consists of eight congruent sectors as shown. What is the mathematical expectation on any one spin?




**51.** The probability of scoring less than 200 on this test is 75%. What are the odds of a student scoring greater than or equal to 200 on this test?

**52.** Berry Kold Creamery has four flavors of ice cream: vanilla, pistachio, black walnut, and strawberry. The daily sundae has three scoops of ice cream. How many variations of sundaes are there?

**53.** Fifty-Fifty High School has five male teachers and five female teachers. How many ways are there to form a committee of three female teachers and two male teachers?

**54.** Six boys and twelve girls are in the senior class. Half the boys and 25% of the girls wear glasses. What is the probability that a student chosen randomly is a boy, wears glasses, or both?

**55.** Let $E = 0, 2, 4, 6, 8$. Two elements of set $E$ are selected at random without replacement. What is the probability that the mean of the two numbers selected is an odd number?

**56.** Seymore Endelite randomly selects two socks from his drawer to wear to school. The socks are identical except for their color and are not paired up. He has 8 blue socks, 6 black socks, and 4 white socks. What is the probability that he selects two black socks? (nearest percent)

**57.** Lotta Dough has a bag that contains one $100 bill, two $20 bills, three $10 bills, four $5 bills, and five $1 bills. The odds of her pulling out a $10 bill is 25%. How many $10 bills would have to be added to the bag to change the odds to 50%?

**58.** Find the ratio of the median to the mean of the following list of numbers:

2, 3, 5, 2, 4, 3, 2, 0, 5, 3, 5, 2

**59.** Betty Luzes rolls a fair die 4 times. What is the mathematical expectation of the sum of the outcomes of the 4 rolls?

**60.** Five married couples attend the square dance planning meeting. How many committees of four people can be chosen if no committee is to include a husband-and-wife pair?

**61.** A regular deck of 52 cards is shuffled and the top five cards are dealt face up. What is the probability, nearest $\frac{1}{1000}$%, that all 5 cards are face cards (Jacks, Queens, Kings)?

**62.** Ronald Tuwin is playing a special dice game. He rolls two dice. If he rolls a double $(1-1, 2-2, 3-3$, etc.) he gets 20 points. If he does not roll a double and the sum of the dice is a prime number he gets 10 points.

If he does not roll a double and the number is not a prime, he loses 5 points. What is the mathematical expression on any one roll?

**63.** Betty Cheetz flips a fair coin and rolls a fair six-sided die. What are the odds that she will get a head and a prime number?

**64.** Let $L = 2, 1, 3, 4, 7, 11$. Two elements of set $L$ are selected at random without replacement. What is the probability that the median of the two numbers selected is a whole number?

**65.** How many different ways can you select 5 bills from a cash box containing $1, $2, $5, $10, $20, $50, and $100 bills?

**66.** A bag contains yellow golf balls and orange golf balls. The probability of selecting a yellow ball is $\frac{2}{5}$. If 20 yellow balls are added to the bag, the probability of selecting a yellow ball becomes $\frac{4}{7}$. How many orange balls are in the bag?

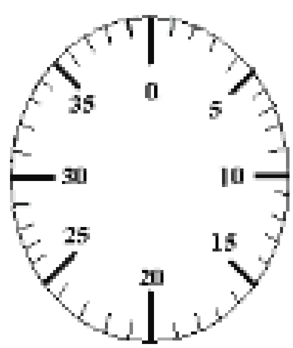
**67.** The Buddy System motorcycle testing company is testing a motorcycle with a side car. They hire 4 cyclists to do the testing in pairs. How many arrangements of driver and rider are possible?

**68.** A box contains four rods whose lengths are 2", 3", 5", and 7". How many different triangles can be made using only three rods at a time.

**69.** A box contains circular poker chips that are congruent in shape but not color. There are red ones, white ones, and blue ones. Drew Goode randomly draws out a chip. He gets 5 points if it is a blue one, 1 point for a white one, and he loses 3 points for a red one. The probability of drawing out a red one is 25%, a blue one is 6%, and a white one is 15%. What is his mathematical expectation on any one draw?

**70.** How many different letter arrangements can be made by rearranging the letters in the word 'LETTER'?

**71.** Willie Lawkit can't remember the combination to the padlock shown. He knows that the first number is greater than 30, the second number is a positive Fibonacci number, and the third number is a factor of 30. How many combinations can he try to open the lock?




**72.** Coach Winters has 4 seniors, 5 juniors, 3 sophomores, and 4 freshman on her math team. How many ways can she form practice groups of four members consisting of one member from each of the grade levels?

**73.** Romeo, Juliet, and three classmates are randomly assigned seats in a row of five chairs. What is the probability that Romeo and Juliet will be seated next to each other?

**74.** Ronald Bones found a die with 6 blank faces on it. He painted the numbers $1, 1, 2, 3, 5, \&8$, one number per face, on the die. He created a game such that he gets 10 points if he rolls a composite number, he gets 5 points if he rolls a prime number, and he loses 7 points if he rolls a unit. What would the mathematical expectation be for any given roll?

**75.** Two distinct numbers are selected randomly from the set $2, 1, 3, 4, 7, 11$. What is the probability that their sum is an odd number?

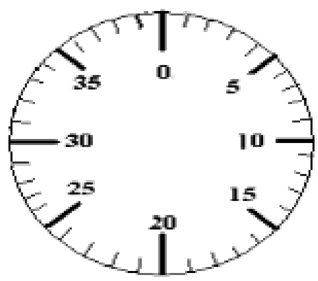
**76.** Coach Fuhrmann has 8 boys and 6 girls in his math and science club. He needs to send a delegation to a UIL planning conference. How many possible delegations can he send if each delegation must contain exactly 2 boys and exactly 2 girls?

**77.** Willie Bettit has 5 plain red poker chips, 3 plain white poker chips, and 2 plain blue poker chips. How many ways can he line all of them up in a row?

**78.** How many 5 digit numbers can be made using the digits $1, 2, 3, 4\&5$ where the digits in the tens place and the hundreds place must be a prime number. Each digit can only be used once in a number.

**79.** The Cowboys and the Texans will play twice this season. The Cowboys are twice as likely to win any game as the Texans. What is the probability that they will each win one of the two games?

**80.** P-Q-R is the combination needed to open the safe with the combination dial shown below. How many distinct combinations exist if $P$ is a triangular number, $Q$ is a square number greater than 0, $R$ is a pentagonal number.




**81.** Roland Bones rolls a pair of dice. What are the odds that the sum of top faces he rolls is a $7$ or an $11$?

**82.** Arnie has a bag with 3 white golf balls and 2 yellow golf balls. Jack has a bag with 4 yellow golf balls and 2 white golf balls. Tiger picks a bag and a ball at random. The probability that the ball will be white is: (nearest whole percent)

**83.** Twenty-five seniors took the state math test last year. Fifteen of them were boys and ten were girls. All of them had an equal chance to win one of the top three medals. What was the probability that one girl and two boys won one of the top three medals? (nearest whole percent)

**84.** If the probability that a student in a Statistics class studies for an exam is 70%, and the probability that a student who studies passes the test is 85%, then the probability that a student both studies and passes the test is: (nearest whole percent)

**85.** In how many ways can the letters of the word 'DIVIDE' be arranged in such a way that the vowels always come together?

**86.** Find the average of the arithmetic mean, the median, and the mode of these quiz grades: 75, 95, 75, 100, 95, 80, 75, & 70. (nearest whole number)

**87.** At a company, ten employees and ten interns line up to visit the CEO in ten randomly selected pairs. If each pair of employees receives a copper ring, each pair of interns receives a brass ring, and each employee-intern pair receives a silver ring, what is the probability that the number of copper rings received equals the number of brass rings received?

**88.** In a triple play game, Willie When performs three tasks. He flips a quarter, and success would be heads. He rolls a single die, and success would be a six. He picks a card from a standard deck of cards, and success would be picking a heart. If any of these tasks are successful, He will win the game. What is the probability he will win? (nearest whole percent)

**89.** If two dice are tossed, what is the probability that the sum of the faces is a prime number?

**90.** The Blow Upp balloon company package 6 balloons per pack. The company has red, blue, white, pink, yellow, green, and magenta colored balloons. How many different packs of 6 balloons can they package?

**91.** 14 out of 17 Millersviewites have spouses. 4 out of 6 Millersviewites own at least 3 acres and a travel trailer. What is the probability that a Millersviewite has a travel trailer given that a Millersviewite has a spouse? (nearest whole percent)

**92.** Anthony and Chuck take three number sense tests. Anthony is twice as likely to s core higher than Chuck. What are the odds that Anthony scores higher on all three tests? Due to an unknown tiebreaker, there are no ties.

**93.** Thirty seniors took the state math test last year. Twenty-two of them were boys and eight were girls. All of them had an equal chance to win one of the top three medals. What was the probability that two girls and one boy won one of the top three medals? (nearest whole percent)

**94.** A box of golf balls contains 6 white ones, 4 pink ones, and 2 blue ones. Three balls are randomly drawn from the box, without replacement. What are the odds that they are all the same color?

**95.**

## Solutions

**1.** $\frac{1}{11}$

**2.** 25%

**3.** 68%

**4.** $\frac{1}{36}$

**5.** 4.2

**6.** $1123.\overline{3}$

**7.** $46^\circ$

**8.** 0.625

**9.** narrower, a greater

**10.** 0.158

**11.** III, IV, V

**12.** 3360

**13.** 58,060,800

**14.** 95.17

**15.** 96.30

**16.** 77th

**17.** D

**18.** 91.1 days

**19.** 25

**20.** .000001539

**21.** 0.467

**22.** $(.5815, .6665)$

**23.** 0.053

**24.** 27,720

**25.** 0.24

**26.** 0.125

**27.** 0

**28.** 64.5 mi

**29.** 2.95 mi

**30.** 44

**31.** 89th

**32.** 0.060

**33.** One Sample $z$ Test for a Proportion

**34.** 0.048

**35.** 13,860

**36.** 0.10

**37.** 3 min

**38.** 0

**39.** 59

**40.** 108 mi

**41.** $19.24, 20.76$

**42.** 0.73

**43.** 82nd

**44.** 247 yd

**45.** $27.55

**46.** 85

**47.** 330

**48.** $\frac{b}{a+b}$

**49.** 67.5%

**50.** -.375

**51.** 1 to 3

**52.** 20

**53.** 100

**54.** 50%

**55.** 60%

**56.** 10%

**57.** 3

**58.** 1:1

**59.** 14

**60.** 80

**61.** $\frac{3}{100}$%

**62.** 5 points

**63.** $\frac{1}{3}$

**64.** $46\frac{2}{3}$%

**65.** 462

**66.** 30

**67.** 12

**68.** 1

**69.** 2.4

**70.** 180

**71.** 576

**72.** 240

**73.** 40%

**74.** $-2\frac{1}{3}$ pts

**75.** $46\frac{2}{3}$%

**76.** 1,680

**77.** 3,628,800

**78.** 48

**79.** $66\frac{2}{3}$%

**80.** 240

**81.** $\frac{2}{7}$

**82.** $47\%$

**83.** $46\%$

**84.** $60\%$

**85.** 36

**86.** 79

**87.** 1

**88.** 69%

**89.** $\frac{5}{12}$

**90.** 924

**91.** 81%

**92.** $\frac{8}{19}$

**93.** 15%

**94.** 12%

**95.**

# 6 Extra Topics

## Problems

1. Which equality axiom of addition is demonstrated by $(ax + by) + c = ax + (by + c)$?
2. Which of the following numbers is considered to be an "abundant" number?

   **(A)** $26$ **(B)** $28$ **(C)** $30$ **(D)** $32$ **(E)** $34$
3. $ABC1_{16} + ABC1_{15} = \_\_\_\_\_\_{}_{14}$
4. Let $P = 2, 3, 5, Q = 2, 4, 6$, and $R = 3, 5, 7$. How many elements are in $(P \cap R) \cup (R \cap Q)$?
5. Which of the following sets is closed under addition and subtraction?

   **(A)** Positive Even Numbers **(B)** Integers **(C)** Positive Odd Numbers **(D)** Primes **(E)** Wholes
6. Find the harmonic mean of 4 and 9.
7. Which of the following numbers is considered to be an "deficient" number?

   **(A)** $24$ **(B)** $56$ **(C)** $66$ **(D)** $92$ **(E)** $112$
8. In the decimal number $2x3y4z$, the letters $x$, $y$, and $z$ represent digits where all six digits are distinct. If the number is divisible by 30 then $x + y + z$ could be:
9. $888_9 + 555_6 + 222_3 = \_\_\_\_\_\_{}_3$
10. Use the Fibonacci characteristic sequence $\cdots - 1.5, p, q, 3, r, \ldots$ to Find $p + q + r$.
11. One of Eratosthenes of Cyrene's main contributions to mathematics involved a method for finding ______.
12. I'm an unhappy deficient number but a number that is lucky to be prime. Which of the following numbers am I?
13. Which equality axiom of multiplication is demonstrated by $(a)(a)^{-1} = 1$?
14. How many subsets containing 4 members can be made from the set $2, 1, 3, 4, 7, 11$?
15. Which of the following was the first Nigerian woman to be awarded a doctorate in mathematics?
16. Find the harmonic mean of the roots of $x^3 - 7x^2 + 14x - 8 = 0$.
17. If $R$, $S$, and $T$ are distinct digits then $RST_2 - ST_3 - R_4$ has a numeric value in base 10 of:
18. The set $\ldots, -6, -4, -2, 0, 2, 4, 6, \ldots$ is closed under which of the following operations:

    I. addition II. subtraction III. multiplication IV. division
19. $F_0 = 0$ and $F_1$ are the first two Fibonacci numbers. Find $F_{10}$.
20. Let $R = 1, 3, 5, S = 0, 2, 4$, and $T = 1, 2, 3$. How many elements are in $(R \cup T) \cap (S \cup T)$?
21. $(p - q) \times r = pr - qr$ is an example of which property of equality?
22. The 8th Fibonacci number is 13. The 10th Fibonacci number is 34. Find the 9th Lucas number.
23. Find $L_9$ if $L_0 = 2, L_1 = 1$, and $L_n = L_(n - 1) + L_(n - 2)$, where $n \geq 2$.
24. The universal set $U = 2, 3, 5, 7, 11, 13, 15, 17, 19$. Subset $L = 5, 7, 15, 17$, subset $M = 3, 13$. How many elements are in the complement set of $L \cup M$?

**25.** Which of the following mathematicians was most remembered as the inventor of logarithms?

**26.** In the binomial expansion of $(3x-1)^5$, the coefficient of the fourth term is:

**27.** What are the odds that a factor of 2010 is a prime number?

**28.** The formula $e^{ix} = \cos x + i \sin x$, where $e$ is the base of the natural logarithm and $i$ is the imaginary unit, is named after:

**29.** The odd numbers from 1 to 17 are to be placed in this magic square in which the rows and columns have the same sum. Find the value of $x$.

| | | |
|---|---|---|
| | 1 | |
| 5 | | 13 |
| x | | |

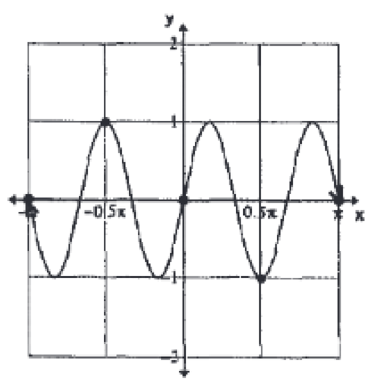
**30.** $P = p, l, u, s, Q = m, i, n, u, s,$ and $R = t, i, m, e, s$. How many elements are in $(P \cup Q) \cap (P \cup R)$?

**31.** The number 12010 in base 3 is equivalent to the number $wxyz$ in base 5, where $w$, $x$, $y$, and $z$ are digits. Find $w + x + y + z$.

**32.** $3(x+4) = 5$ and $3(4+x) = 5$ is an example of the ______property.

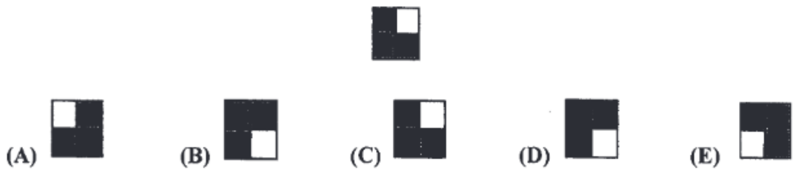
**33.** If $ax + b = c$ and $c = dx + e$, then $ax + b = dx + e$ is an example of the ______property.

**34.** Which of the following is true about the relation graphed below?




**35.** Integers $x$ & $y$ exist such that $x = 2y$ and the arithmetic mean of $x$ & $y$ is 1 more than the harmonic mean of $x$ & $y$. Find the geometric mean of $x$ & $y$.

**36.** The figure shown is reflected over a negative diagonal. Which of the following figures is the result of that single transformation?

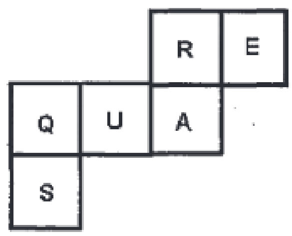



**37.** A recent visit to the planet Strangebase discovered that the equation, $3S^2 - 25S + 66 = 0$, has two solutions, 4 and 9. What base was being used for the number system on planet Strangebase?

**38.** Evaluate: $\prod_{n=2}^{6}(1 + \frac{1}{n})$

**39.** Which of the following mathematicians created an abacus for calculating products and quotients and extracting square roots that was based on Arab mathematics and lattice multiplication.

**40.** Polly Euler folds the net shown into a cube. What letter will be on the opposite side of side $S$?




**41.** If $\sqrt{x\sqrt[3]{x\sqrt[4]{x}}} = \sqrt[n]{x^k}$, where $k$ and $n$ are relatively prime, then $k =$?

**42.** The universal set $U = 1, 2, 3, 5, 8, 13, 21, 34$. Subset $A = 1, 3, 8, 21, 34$ and subset $B = 2, 3, 5, 13, 21$. How many elements are in the complement set of $A \cap B$?

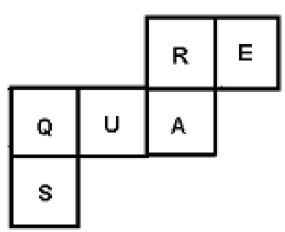
**43.** Which of the following numbers is an unhappy number and evil number?

**(A)** $7$ **(B)** $8$ **(C)** $9$ **(D)** $10$ **(E)** $11$

**44.** $2 \times 4 \times 8 = 8 \times 8 = 64$ and $2 \times 4 \times 8 = 2 \times 32 = 64$ are examples of the ? property of equality.

**45.** If $2(3 + 5) = 16$ and $16 = 4^2$ then $2(3 + 5) = 4^2$. Which of the following properties does this example illustrate?

**46.** Pauline Gone folds the net shown into a cube. What letter will be on the opposite side of face $E$?




**47.** Find $a + b + c + d$ given the Fibonacci characteristic sequence: $3, a, b, 17, c, d, 71, \ldots$.

**48.** Which of the following mathematicians is known for developing a "machine" that uses a system of rules, states, and transitions used to decide a language or to solve mathematical functions? It is a powerful tool used in computer science and code breaking?

**49.** Mr. White's 'bath tub mat' pattern table consists of 19 columns and 12 rows. Only 7 rows are shown. Determine the sum of the numbers in the 8th row.

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | 1 | | | | 2 | | | | 3 | | | | 5 | | |
| | | | 2 | | | | 3 | | | | 5 | | | | 8 | | | |
| | | 3 | | | | 5 | | | | 8 | | | | 13 | | | | 21 |
| | 5 | | | | 8 | | | | 13 | | | | 21 | | | | 34 | |
| 8 | | | | 13 | | | | 21 | | | | 34 | | | | 55 | | |
| | | | 21 | | | | 34 | | | | 55 | | | | 89 | | | |
| | | 34 | | | | 55 | | | | 89 | | | | 144 | | | | 233 |

**50.** The harmonic mean of the real roots of $3x^3 + 2x^2 + 5x + 4 = 0$ is ______.

**51.** Which of the following pairs of numbers are considered to be 'fangs' of a 'vampire' number?

I. (35, 41) II. (21, 87) III. (72, 27) IV. (51, 63)

**52.** Let $4022_b - k_b = 1665_b$, where $k_b$ is a four digit number. Find $k_b$ in base 10.

**53.** 7,158,AB3 ÷ 9 has a remainder of 7. Find $A + B$.

**54.** A square-free semiprime is a composite number that is the product of two different primes. How many composite numbers less than 20 are considered square-free semiprimes?

**55.** Let $U$ (universal set) $= u, i, l, m, a, t, h, b$, $B = b, u, i, l, t$, and $T = t, h, u, m, b$. Let $I = (B \cap T)^C$. Set $I$ contains how many distinct elements?

**56.** Which of the following sets of numbers is closed under multiplication and addition?

I. Primes II. Integers III. Wholes IV. Rationals

**57.** For how many different positive integers $n$ is each of $n$, $n + 2$, and $n + 4$ a prime number?

**58.** What's the only positive integer whose two largest divisors have a sum of 111?

**59.** For how many different pairs of positive integers $(a, b)$, with greatest common factor 1, and with $a > b$, does $ab = 30!$? (Note: $30!$ is the product of the first 30 positive integers.)

**60.** Leonardo Pisano Bigollo was an Italian mathematician who referenced and made known which of the following special sequences of numbers to Western mathematics?

**61.** Which of the following numbers is an abundant, happy, and lucky number?

**(A)** $28$ **(B)** $31$ **(C)** $44$ **(D)** all of these **(E)** none of these

**62.** Find $a + b + c + d$ given the Fibonacci characteristic sequence: $a, 2, b, c, 20, d, 51, \ldots$.

**63.** The set of Lucas numbers is $1, 3, 5, 7, 11, \ldots$, where $L_1 = 1$. The set of Fibonacci numbers is $1, 1, 2, 3, 5, \ldots$, where $F_1 = 1 = F_2$. If $L_{10} = F_x + F_y$, where $y > x$, then $y$ is ______.

**64.** If the following pattern continues, determine which of the following numbers will be in row 10.

1 row 0
1 1 row 1
1 2 1 row 2
1 3 3 row 3
1 4 6 4 1 row 4
1 5 10 10 5 1 row 5

**65.** An "emirp" number is a prime number that becomes a new prime number when the digits are reversed. Single digit primes and palindromic primes cannot be emirp numbers. How many prime numbers less than 20 are considered to be emirp numbers?

**66.** Let $(131_b) \times 3_b = k_b$, where $k_b$ is a 3-digit number. Find $b$ if $k_b = 1323_4$.

**67.** If $P$, $Q$, and $R$ are different digits, then the largest possible three-digit sum for $PPP + QP + P =?$ has which of the following forms?

**68.** Let $A = a, c, u, t, e, O = o, b, t, u, s, e$, and $R = r, i, g, h, t$. The number of elements in $(A \cup R) \cap O$ is:

**69.** $111A09201B \div 9$ has a remainder of 5. Find the least value of $A + B$.

**70.** Which of the following mathematicians is noted for his work with sets, probability, and logic?

**71.**

## Solutions

1. Associative
2. C
3. 21411
4. 2
5. B
6. $5\frac{7}{13}$
7. D
8. 12
9. 689
10. 6.75
11. prime numbers
12. 37
13. Commutative
14. 15
15. Grace Alele Williams
16. $1\frac{5}{7}$
17. $3R - S$
18. I, II & III
19. 55
20. 3
21. distributive
22. 47
23. 76
24. 3
25. John Napier
26. -90
27. $\frac{1}{3}$
28. Leonard Euler
29. 7
30. 6
31. 6
32. commutative
33. distributive

**34.** It is a one-to-one function.

**35.** $3\sqrt{2}$

**36.** D

**37.** base 5

**38.** 11.39

**39.** Sophie Germain

**40.** A

**41.** 12

**42.** 6

**43.** C

**44.** associative

**45.** transitive

**46.** U

**47.** 88

**48.** Alan Turing

**49.** 898

**50.** -2.4

**51.** I & II

**52.** 1,117

**53.** 10

**54.** 4

**55.** 5

**56.** II, III, & IV

**57.** 1

**58.** 74

**59.** 512

**60.** $1, 1, 2, 3, 5, 8, \ldots$

**61.** E

**62.** 58

**63.** 11

**64.** 252

**65.** 2

**66.** 5

**67.** QQR

**68.** 3

**69.** 8

**70.** John Venn

**71.**

# 7 Tips and Strategies

## Conversions

- 1 hour = 60 minutes
- 1 minute = 60 seconds
- 1 foot = 12 inches
- 1 yard = 3 feet = 36 inches
- 1 pound = 16 ounces
- 1 gallon = 4 quarts = 128 ounces
- 1 quart = 2 pints = 32 ounces
- 1 pint = 2 cups = 16 ounces
- 1 cup = 8 ounces
- 1 gallon = 231 cubic inches
- 1 square mile = 640 acres
- 1 inch = 2.54 centimeters
- 1 foot = 30.48 centimeters
- Normal body temperature = 98.6°F = 37°C
- Boiling point of water = 212°F = 100°C
- Freezing point of water = 32°F = 0°C
- 1 cubic foot = 1728 cubic inches
- 1 cubic yard = 27 cubic feet
- 16 tablespoons = 1 cup
- 1 square foot = 144 square inches
- 1 square yard = 9 square feet
- 3 teaspoons = 1 tablespoon
- 1 mile = 1760 yards = 5280 feet
- 10 millimeters = 1 centimeter
- 100 centimeters = 1000 millimeters = 1 meter
- 1 hectometer = 100 meters
- 1000 meters = 1 kilometer
- 1 dekameter = 10 meters
- 10 decimeters = 1 meter
- 1 year = 12 months = 365 days

- Leap year = 366 days

## Days in Months

- January - 31
- February - 28 or 29
- March - 31
- April - 30
- May - 31
- June - 30
- July - 31
- August - 31
- September - 30
- October - 31
- November - 30
- December - 31

## Prime Numbers Under 100

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89. 97

## Geometry

1. Sum of exterior angles of a regular polygon is 360°.
2. Sum of interior angles of a regular polygon = $180°(n-2)$
3. Measure of exterior angle = $\frac{360°}{n}$
4. Measure of interior angle = $\frac{180°\cdot(n-2)}{n}$
5. Area of a regular polygon
   - Given side: $\frac{ns^2}{4\tan(180°/n)}$
   - Given apothem: $na^2\tan(180°/n)$
   - Given radius: $\frac{nr^2\sin(360°/n)}{2}$
6. Square
   - Area = side$^2$ = $\frac{(\text{diagonal})^2}{2}$
   - Perimeter = $4s$
   - Length of diagonal = $s\sqrt{2}$
7. Triangle
   - Area = $\frac{1}{2}bh$
8. Equilaterial Triangle

- Area $= \frac{s^2\sqrt{3}}{4} = \frac{h^2\sqrt{3}}{3}$
- Perimeter $= 3s$

9. Rectangle
   - Area = lw
   - Perimeter = 2(l+w)
10. Parallelogram
    - Area = bh
11. Trapezoid
    - Area $= \frac{\text{height}(\text{base}_1+\text{base}_2)}{2}$
12. Rhombus
    - Area $= \frac{(\text{diagonal})^2}{2}$
13. Circle
    - Area $= \pi r^2$
    - Circumference $= 2\pi r = \pi d$
14. Rectangular solid
    - Surface Area $= 2(lw + lh + wh)$
    - Inner diagonal $= \sqrt{\text{length}^2 + \text{width}^2 + \text{height}^2}$
    - Volume $= lwh$
15. Cube
    - Total surface area $= 6e^2$
    - Volume $= e^3$
    - Inner diagonal $= e\sqrt{3}$
16. Sphere
    - Surface area $= 4\pi r^2$
    - Volume $= \frac{4}{3}\pi r^3$
17. Right Circular Cylinder
    - Lateral Area $= 2\pi rh$
    - Total surface area $= 2\pi r^2 + 2\pi rh$
    - Volume $= \pi r^2 h$
18. Right Circular Cone
    - Lateral Area $= \pi rl$ ($l$ is the slant height)
    - Total Surface Area $= \pi rl + \pi r$
    - Volume $= \frac{1}{3}\pi r^2$

## More Advanced Formulas

1. Compound Interest: $A = P\left(1 + \frac{r}{n}\right)^{nt}$
2. Compound interest continuously: $A = Pe^{rt}$
3. Laws of Sines: $\frac{\sin(A)}{a} = \frac{\sin(B)}{b} = \frac{\sin(C)}{c}$
4. Laws of Cosines: $c^2 = a^2 + b^2 - 2ab\sin(c)$
5. Heron's Formula: Area $= \sqrt{s(s-a)(s-b)(s-c)}$, where $A$ is the area of a triangle with sides $a$, $b$, and $c$; $s =$ semi-perimeter $= \frac{a+b+c}{2}$
6. Radius (r) of circle inscribed in a triangle with sides $a$, $b$, and $c$:

   $r = \frac{\sqrt{s(s-a)(s-b)(s-c)}}{s}$
7. The area of a triangle given the length of two sides ($a$ and $b$) and an included angle, $C$.

   $A = \frac{1}{2}ab\sin(C)$
8. Area of a sector of a circle given the radius, $r$, of the circle and the measure of the intercepted arc in radians, $\theta = \frac{1}{2}r^2\theta$.
9. Area of a segment of a circle given the radius, $r$, of the circle and the intercepted arc in radius, $\theta = \frac{1}{2}r^2(\theta - \sin\theta)$

## Random Formulas