1. Arithmetic with Literal Equations ***February 1993***

1. Solve $AB/R = R + RT$ for R, where A, B and $T > 0$.

Ans. _____

2. A merchant bought 20 pens at $1.50 each. He kept some of them for himself, and sold the rest charging 30 cents more for each pen, than he paid for them. He still made a profit of $2.40. How many pens did he keep for himself?

Ans. _____

3. List all the integers between 200 and 400 which when divided by:
   (1) 6 have a remainder of 1
   (2) 5 have a remainder of 2
   (3) 4 have a remainder of 3.

Ans. _____

1. Arithmetic with Literal Equations ***February 1994***

1. Jan bought several items all at the same price. If the cost of each was at least $12, and the total for all the items was exactly $209, excluding tax, how much did each item cost? Give all possible answers.

Ans. _____

2. A gallon of gas costs $1.13. Part of this cost is from the oil company, and the rest is for taxes. The price of crude oil drops from the current price of $20 per barrel to $17 per barrel. The oil company passes this savings directly to the consumer, which lowers the price to $1.04 per gallon. How much tax is there on each gallon of gas?

Ans. _____

3. A tank can be emptied by a drain in 4 ½ hours and filled by its fill pipe in 3 hours. With a full tank at 11:00 AM, the drain is opened and left open. At 2:00 PM the fill pipe is turned on with the drain still open. At exactly what time will the tank be filled up again?

Ans. _____

1. Arithmetic with Literal Equations ***February 1995***

1. A single elimination softball tournament is to be played by 16 teams. Two umpires are to be hired for each game. The homeplate umpire is to be paid $20 per game, while the umpire for the bases is to be paid $15 per game. How much money should be allotted for the umpires for all the games?

Ans. _____

2. Solve for a in terms of b in the equation: $\frac{a^2}{2ax+bx} = \frac{-b}{x}$, where a, b and x are not equal to zero.

Ans. _____

3. Solve for the following equation for the numerical value of x: $\frac{-rx^2+4r-sx^2+4s}{rx-2r+sx-2s} = 1$

Ans. _____

1. Arithmetic with Literal Equations ***February 1996***

1. For every 2 degrees rise in temperature, the volume of a certain gas expands 3cc. If the volume of the gas is 36cc when the temperature is 42 degrees, what was the volume of the gas when the temperature was 20 degrees?

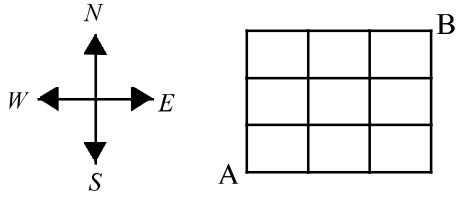
Ans. _____

2. Solve for y: $y(a-7)+2a(y/2+a)=16$

Ans. _____

3. Given the following map, how many different ways are there of traveling from A to B, if a person never travels westerly or southerly.

Ans. _____



1. Arithmetic with Literal Equations ***February 1997***

1. A group of teachers are surveyed about church attendance and playing golf. The results were:

   15 attend church and play golf
   20 play golf but do not attend church
   3 attend church but do not play golf
   5 do not attend church and do not play golf

   To the nearest 10th of a percent, what percent of the teachers attend church?

   Ans. _____

2. What is the unit's digit of 47^{34} when multiplied out?

   Ans. _____

3. If, $5n = \frac{7}{2}(a+p)$ *and* $\frac{1}{3}(p-a) = 2(n-1)$ find a in terms of n. Express answer in simplest form.

   Ans. _____

1. Arithmetic with Literal Equations ***February 1999***

1. If $ax + by - cx = d$, solve for x.

   Ans. _____

2. Solve the following equation for x. Express answer(s) in simplest form.
   $x^2 + 2ax - 3xy - 6ay = 0$

   Ans. _____

3. Find the smallest possible sum of three distinct positive integers if their greatest common factor is 1 and their least common multiple is 391.

   Ans. _____

2. Logs and Log Equations ***February 1989***

1. Find x if $27^{\log_{27} 9} = 8x + 5$

Ans. _____

2. Solve for x: $\log_{10}(x^2 + 3x) + \log_{10} 5x = 1 + \log_{10} 2x$

Ans. _____

3. For what value(s) of x, where x is a real number, is $\log_9 16 \cdot \log_8 3 + \log_8 x = \log_8 3$

Ans. _____

2. Logs and Log Equations ***February 1990***

1. Find x if $\log(x-4) \cdot \log 3 = -2$

Ans. _____

2. Find the numerical value of N if $N = (\log_6 24 - \log_6 12) \cdot \log_8 36$

Ans. _____

3. If $\log_{10} 2 = b, \log_{10} 3 = a$, *and* $5^x \cdot 6^{1-x} = \frac{1}{2}$, find x in terms of a and b.

Ans. _____

2. Logs and Log Equations ***February 1992***

1. Solve: $\log_6(x+2)+\log_6(x-3)=1$

Ans. _____

2. Find $\log_b \sqrt[3]{7/8}$, if $\log_b 7 = .6263$ and $\log_b 4 = .4462$ Round your answer to 4 decimal places.

Ans. _____

3. Express $\log_{13} 462$ as a number correct to four decimal places.

Ans. _____

2. Logs and Log Equations ***February 1993***

1. Find the exact value of x, if $\log x$ is the average of $\log 3$ and $\log 16$.

Ans. _____

2. Solve for x: $\log_3(x+3)-\log_3(x-5)=2$

Ans. _____

3. If \$3,000 is invested at 7.25% to be compounded annually, how many years will it take before it is quintupled?

Ans. _____

2. Logs and Log Equations ***February 1994***

1. Express $\log_3 8 + \log_3 6 - \log_3 4 + \log_3 10$ as the log of a single number in simplest form.

Ans. _____

2. Find the value of $\frac{1992^{1991}}{1993^{1990}}$ to the nearest hundredth.

Ans. _____

3. Evaluate $4^{(2\log_8 7)}$ express answer in simplest, exact form.

Ans. _____

2. Logs and Log Equations ***February 1995***

1. Evaluate the expression $\frac{\log_{64} 8 - \log_7 49}{\log_3 1/3 + \log_2(2^{-4})}$

Ans. _____

2. The average score A for a group of students who took a test t months after the completion of a course is given by the equation $A = 80 - \log (t + 1)^{12}$. Determine how long it would take the average score to fall to 72. Find answer to nearest tenth of a month.

Ans. _____

3. Solve for x in terms of y, where $y > 0$: $100^x - 4y(10^x) + 3y^2 = 0$

Ans. _____

2. Logs and Log Equations ***February 1996***

1. Find x if $\log_x 1/8 = -3/4$.

Ans. _____

2. If $6^x = 600$, find x to the nearest 1000th.

Ans. _____

3. If $\log_2 x + \log_4 x - \log_8 x = 7$ solve for x.

Ans. _____

2. Logs and Log Equations ***February 1997***

1. If $\log_8 2 = k$, what does $\log_2 8$ equal in terms of k?

Ans. _____

2. If $\log \sqrt[3]{x^2} = .2738$, determine the value of $\log x\sqrt[3]{x^2}$

Ans. _____

3. Solve for x: $\log_{27} x + \log_3 \frac{1}{x} = \frac{4}{3}$

Ans. _____

2. Logs and Log Equations ***February 1999***

1. Find A if, $A = \log_9 3 + \log_2 8 + \log_{16} 8$

Ans. _____

2. If $4^x = 8$, find $\log_x\left(\frac{3}{4}\sqrt{6}\right)$

Ans. _____

3. If $\log x = n$ and $\log y = n^2$, then solve for n in the equation
$\log x^2 y^2 - \log x^{2n} + (\log y)^{\frac{1}{2}} = \log_y x$

Ans. _____

3. Linear Coordinate Geometry ***February 1989***

1. Find k so that the point (-9, k) lies on the line AB where $A(1, 4)$ and $B(-3, -8)$.

Ans. _____

2. If $L_1: 3x + ky - 7 = 0$ and $L_2: 27kx - 16k^2y = -1$, find k so L_1 is perpendicular to L_2

Ans. _____

3. If the distance from point $A(1, t)$ to the line through the points (-1, -2) and (3, 1) is 2 units, find the value(s) of t.

Ans. _____

3. Linear Coordinate Geometry ***January 1990***

1. Find the value of k so that the two straight lines $x - y = 6$ and $kx + 2y = -3$ are parallel.

Ans. _____

2. The vertices of a right triangle are $P(3, -3)$, $Q(2, 0)$, and $R(-3, -5)$. Find the length of the line segment joining the vertex of the right angle to the midpoint of the hypotenuse.

Ans. _____

3. Find the equation(s) of the angle bisectors of the lines whose equations are $12x + 5y = 5$ and $3x - 4y = 3$. Express your answer in $ax + by + c = 0$ form.

Ans. _____

3. Linear Coordinate Geometry ***February 1992***

1. Find the equation of the line that passes through the midpoint of (3,4) and (-2,1) and is perpendicular to the line that connects these points. Leave answer in $Ax + By + C = 0$ form, where A, B and C are integers and the gcf(A, B, C) = 1

Ans. _____

2. Find the value(s) for k so that the lines $kx + y + 2 = 0$ and $2x - ky - 5 = 0$ intersect at (1,1).

Ans. _____

3. Find the equation(s) of the line(s) that contain the point (-2,3) and whose intercepts add up to 6. State your answer in $Ax + By + C = 0$ form, where A, B and C are integers and the gcf (A,B,C) = 1

Ans. _____

3. Linear Coordinate Geometry ***February 1993***

1. Find the value of k so that the line $6x - 4y - 5 = 0$ is perpendicular to the line $-5x + ky + 20 = 0$.

Ans. _____

2. The vertices of a triangle are A(-3,4), B(2,-1) and C(9,-2). Write the equation of the line containing the median from B. Express your answer in $y = mx + b$ form.

Ans. _____

3. Write the equation of the line with a slope of $-\frac{4}{5}$ and whose y-intercept is 4 more than its x-intercept. Express your answer in $y = mx + b$ form.

Ans. _____

3. Linear Coordinate Geometry ***February 1994***

1. Line P has an x-intercept of 5 and a y-intercept of 2. Find the equation of the line perpendicular to P which passes through the origin. Express answer in intercept-slope form.

Ans. _____

2. A circle is tangent to the lines $y = 2x - 37$ and $4x - 2y = -26$. How long is the radius of the circle? Give answer in exact form.

Ans. _____

3. Three of the vertices of a parallelogram are (-6,4), (9,-3) and (-7,-6). Find all possibilities of the fourth vertex.

Ans. _____

3. Linear Coordinate Geometry ***February 1995***

1. Find the value of k so that the points (3, 3), (-12, -22) and (k, 7) are on the same line. Express k as a mixed number.

Ans. _____

2. The line $3x + ky = c$ is parallel to the line $5x + 7y = 15$ and contains the point (8,-5). Find the ordered pair (k,c).

Ans. _____

3. Triangle ABC with vertices A(-1,-2), B(2,5) and C(5,1) is reflected about the x-axis and then about the line $y = x$. The new triangle $A'B'C'$ is congruent to triangle ABC. Find the equation of the line through C' which is parallel to the line through A' and B'. Give answer in slope-intercept form.

Ans. _____

3. Linear Coordinate Geometry ***February 1996***

1. Determine the equation(s) of the vertical line(s) which intersect the line $y = \frac{2}{3}x - 6$ at the point (a, a).

Ans. _____

2. Find the value of k so that $kx - 3y = 10$ contains the point of intersection of the diagonals of the parallelogram $ABCD$ determined by $A(-9,-4)$, $B(-4,-3)$, $C(-1,8)$ and $D(-6,7)$.

Ans. _____

3. Quadrilateral $ABCD$ is a rhombus with A having coordinates (-4, -2) and C having coordinates (2, 2). If side AD is contained in the line $y = -8x - 34$, find the coordinates of D.

Ans. _____

3. Linear Coordinate Geometry ***February 1997***

1. Three vertices of rectangle $ABCD$ have coordinates: $A(0, 3)$, $B(9, 0)$ and $C(0,-27)$. Find the coordinates of D.

Ans. _____

2. A circle has center at (2, 3). A tangent line is drawn to the circle intersecting it at (-1, 4). Find the equation of the tangent line. Leave your answer in simplest $y = mx + b$ form.

Ans. _____

3. Find the equation(s) of the line(s) passing through (2,-16) whose slope is 2 times the x-intercept. Write your answer(s) in $y = mx + b$ form.

Ans. _____

3. Linear Coordinate Geometry ***February 1999***

1. Find the equation of the perpendicular bisector of the segment joining $A(3, 7)$ and $B(-1, 5)$. Put your answer in standard form($Ax + By = C$, where $A \geq 0$, and A, B, and C are integers).

Ans. _____

2. Find an equation in standard form of the segment joining the midpoints of segments AC and BC, given $A(3, 7)$, $B(-1, 5)$ and $C(6, -2)$.

Ans. _____

3. Given the points $A(3, 7)$, $B(-1, 5)$ and $C(6, -2)$, find the center of the circle containing all three points.

Ans. _____

4. Functions ***February 1989***

1. Find $f(-5)$ *if* $f\left(3x^2\right) = 9x^4 + 6x^2 - 2$

Ans. _____

2. If $f(x) = 3x - 1$ and $g(t) = \dfrac{2t-5}{4}$, find the value(s) of a so that $f^{-1}\left(g(a)\right) = g^{-1}\left(f(a)\right)$.

Ans. _____

3. If $f(n+1) = \dfrac{2 \cdot f(n) + 1}{2}$ and $f(1) = 2$, find $f(101)$.

Ans. _____

4. Functions ***February 1990***

1. If function f is defined $f(x) = x - 2$ and relation F is defined $F(x,y) = y^2 + x$, find $F\left(3, f(4)\right)$.

Ans. _____

2. Given $f : f(x) = \sqrt{4 + 3x - x^2}$ and $g : g(x) = \sqrt{9x^2 - 25}$. Find all values of x which belong to the domain of f that are also in the domain of g.

Ans. _____

3. Let $f(x) = tx + t$ where $t \neq 0$. If $f\left(f(x)\right) = 4t$ and $f^{-1}(x) = \dfrac{3}{t^2}$, then what is the numerical value of t?

Ans. _____

4. Functions ***February 1992***

1. Evaluate: $\dfrac{f(-2)+f(3)}{f(0)+f(10)}$ if $f(x)$ is defined as $f(x)=\begin{cases}3x \text{ if } x\le -2\\ 2x-2 \text{ if } -2<x\le 3\\ 7-x \text{ if } x>3\end{cases}$

Ans. _____

2. Let $f(x)=4x+6$ and $g(x)=3x+k$. Determine k so that $(f\circ g)(x)=(g\circ f)(x)$

Ans. _____

3. For certain intervals of x in the domain of f, where $f(x)=\sqrt[1/2]{x^2+1}$, the inverse function $f^{-1}(x)$ does not exist. Find the domain of $f^{-1}(x)$ for each interval.

Ans. _____

4. Functions ***February 1993***

1. Find the inverse of g if $g(x)=\dfrac{-2x+3}{5}$

Ans. _____

2. If $f(x)=x^2-5x+12-f(x)$, find $f(3)$.

Ans. _____

3. If $f(x)=\sqrt{x-a}+b$, find the value of a and b so that $f(13.5)=9$ and $f(4.5)=6$.

Ans. _____

4. Functions ***February 1994***

1. Farmer MacDonald has 180 feet of wire, all of which he intends to use to make a rectangular enclosure for his horse in one of his fields. He intends to use a stone wall as one of the sides. He sets a corner stake x feet from the stone wall. Define the area function A in terms of x of the enclosure for old MacDonald's horse. Assume the stone wall is straight.

Ans. _____

2. If $f(x) = ax + 3$ and $g(x) = 4x + a$, find all value(s) of a such that $f \circ g(x) = g \circ f(x)$. Give answer in exact form.

Ans. _____

3. If the function Q, where $Q(x) = \log_{10} x$, is rotated 90 degrees counter-clockwise about the origin, what will the new function R(x) be?

Ans. _____

4. Functions ***February 1995***

1. Find the value of k such that $f(x) = x^2 + kx + 3$ satisfies $f(-1) = -2$.

Ans. _____

2. If $g(x) = x^2 - 2x$ and $h \neq 0$, simplify $\dfrac{g(-1+h) - g(-1)}{h}$

Ans. _____

3. If $f(x) = \dfrac{1}{x-1}$ and $g(x) = 3x - 2$, find the domain of h, if $h(x) = f \circ g^{-1}(x)$

Ans. _____

4. Functions ***February 1996***

1. If $f(x) = x^2 - 4x$ and $g(x) = x - 1$, find the zeros of $f(g(x))$.

Ans. _____

2. From the general form $f(x) = ax^2 + bx + x$, find the ordered triple(a,b,c) of the quadratic function whose graph contains the points (1,4), (-1,14) and (0,6).

Ans. _____

3. Find the inverse function for the subset of $f(x) = x^2 - 2x - 1$ where $f(x)$ is increasing as x increases.

Ans. _____

4. Functions ***February 1997***

1. If $f(x) = 3x^2 - 2x + 5$ and $f(1) = 6$, find $f(x + 1)$ in simplest form.

Ans. _____

2. If $f(x) = x^2 - 3x + 7$ and $f(2x + h) = 4x^2 - 26x + 47$, find h.

Ans. _____

3. Find the equations of all asymptotes of the function f, if $f(x) = \dfrac{x^3 + 2x^2 - 36x - 72}{2x^3 + 5x^2 - 42x}$

Ans. _____

4. Functions ***February 1999***

1. Given $f(x) = x^2 + 5$ and $g(x) = 3x - 2$, find the value of $g\big(f(3)\big) / f\big(g(3)\big)$. Express answer in simplest form.

Ans. _____

2. If $f(x) = [x]$ and $[x]$ means to take the greatest integer less than or equal to x, determine the following: $f\left(3 \cdot f\left(\frac{1}{2} \cdot f\left(\frac{1}{3} \cdot f\left(-\frac{2}{5}\right)\right)\right)\right)$

Ans. _____

3. A function f from the integers to the integers is defined as follows:

$$f(n) = \begin{cases} n + 3 \text{ if } n \text{ is odd} \\ \dfrac{n}{2} \text{ if } n \text{ is even} \end{cases}$$

Suppose that k is odd and $f(f(f(k))) = 27$. What is the sum of the digits of k?

Ans. _____

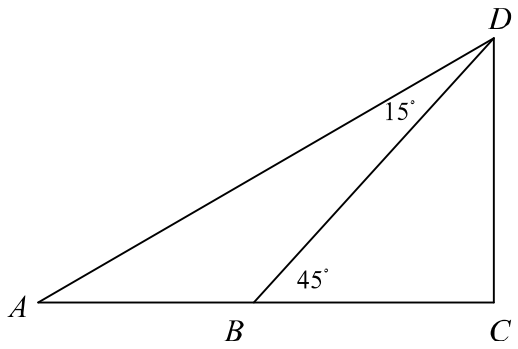
5. Trig Mechanics ***February 1994***

1. If A and B are acute angles such that $\sin A = 3/5$, $\cos B = 7/25$, find the value of $\sin(A-B)$. Write your answer as a fraction in simplest form.

Ans. _____

2. Given: $m\angle ADB = 15°$, $m\angle DBC = 45°$, $AB = 400$, $DC \perp AC$. Find the length of $\overline{DC}$ in exact form.

Ans. _____



3. Ship A leaves port C at 2:00 PM traveling 30 mph on a course of 48°. Ship B leaves port C at 3:00 PM at 15 mph traveling on a course somewhere between north and west. At 6:00 PM they are 109 miles apart. What is the bearing of ship B from ship A at this point? Give your answer to the nearest minute.

Ans. _____

5. Trig Mechanics ***February 1995***

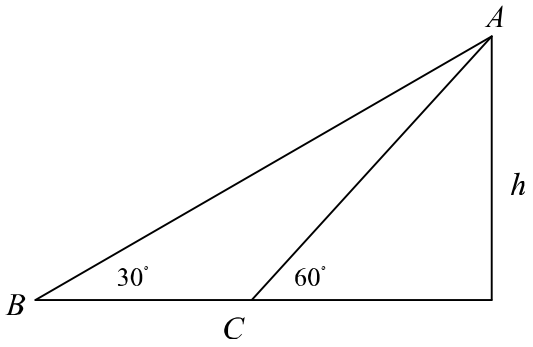
1. A rocket is fired at sea level and climbs at a constant angle of 75° through a distance of 10,000 feet. Approximate its altitude to the nearest foot.

Ans. _____

2. Find the exact value of h in the figure shown below.

Ans. _____

$m\angle B = 30°$
$m\angle C = 60°$
$BC = 100$ in.



3. From a set of railroad tracks running east and west, a curious surveyor wanted to find out how high above the tracks a rock was on a hill near the track. As she faced east, she turned to her left and noted that the angle formed by the tracks and the line of sight to the rock was 72°. She then moved 3000 feet east on the straight tracks, turned to face up the tracks to make a second reading, which was 58°. At this point she also found that the angle of elevation to the rock was 16°. How high above the tracks is the tock to the nearest foot.

Ans. _____

5. Trig Mechanics ***February 1996***

1. In a right triangle, *tan* φ= 1/8. Find *cos* φ in simplest radical form.

Ans. _____

2. A bug is sitting 6 cm from the center of a lazy Susan. Phil strolls along and gives it a spin. It spins at a rate of $7\pi/3$ radians in 2 sec. Find the exact speed of the bug in cm/min.

Ans. _____

3. Two ships in the ocean where sighted straight ahead by the pilot of an airplane. How far apart are the ships, if they are at angles of depression of $11° 10'$ and $15° 40'$. The plane is at an altitude of 6300 ft. Give answer to nearest 10 ft.

Ans. _____

5. Trig Mechanics ***February 1997***

1. If $A = -\frac{13}{6}\pi$ radians and $B = \frac{2}{5}\pi$ radians, express $A + B$ in degrees.

Ans. _____

2. The perimeter of a parallelogram is 30 cm. Find the area of the parallelogram to the nearest 100th square cm, if the longest side is 10cm and the smallest angle is 40 degrees.

Ans. _____

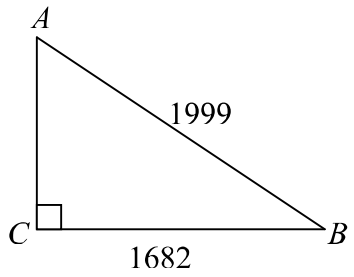
3. A bench saw rotates at 2400 RPM. If the blade is 8 inches in diameter, find its cutting speed in feet per second. Express answer to nearest 10th.

Ans. _____

5. Trig Mechanics ***February 1999***

1. Find the measure of angle B to the nearest minute.

Ans. _____



2. A geologist measured a 43° angle of elevation to the top of a volcano crater. After moving 0.25 km farther away, the angle of elevation was 38°. How high is the top of the volcano crater? Give answer to nearest 10^{th} of a km.

Ans. _____

3. Highway curves are usually banked or tilted inward, so that cars can negotiate the curve more safely. The proper banking angle θ for a car making a turn of radius r ft. at a velocity of v ft. per second is given by the equation $\tan\theta = \frac{v^2}{gr}$, where g = 32 ft/sec^2. An engineer is designing a curve with a radius of 1000 ft. If the speed limit on the curve will be 55 mph, at what angle should the curve be banked? Give answer to nearest 10^{th} of a degree.

Ans. _____