

Name: Key

1. Which expression is equivalent to $\frac{2x + 6}{x^2 + 2x - 24} \cdot \frac{x^2 + 2x - 24}{x^2 - 7x + 12}$

- A. $\frac{2}{x-4}$
 B. $\frac{2(x+3)}{x-3}$
 C. $\frac{2(x+3)}{(x-4)(x-3)}$
 D. $\frac{2(x+3)}{(x+4)(x-3)}$

2. Which expression is equivalent to

$$\frac{x + 3}{6x - 3} \div \frac{x^2 + 2x - 3}{2x - 1}$$

- A. $3(x-1)$
 B. $\frac{x-1}{3}$
 C. $\frac{3}{x-1}$
 D. $\frac{1}{3(x-1)}$

3. Multiply: $\sqrt[3]{12x^2} \cdot \sqrt[3]{126x^2}$

- A. $6x(\sqrt[3]{7x})$
 B. $6x(\sqrt[3]{21x})$
 C. $6x^2(\sqrt[3]{42})$
 D. $6x^2(\sqrt[3]{63})$

4. If $h(x) = 2x$ and $g(x) = 3x^2 + 1$, what is $h(g(x))$?

- A. $6x^2 + 1$
 B. $6x^2 + 2$
 C. $12x^2 + 1$
 D. $12x^2 + 2$

5. What are the zeros of the polynomial $p(x) = x^3 - 2x^2 - 23x + 60$?

- A. $\{-15, -2, 2\}$
 B. $\{-5, 3, 4\}$
 C. $\{2, 3, 10\}$
 D. $\{1, 2, 30\}$

6. In 1950, a U.S. population model was $y = 151 \cdot (1.013)^{t-1950}$ million people, where t is the year. What did the model predict the U.S. population would be in the year 2000?

- A. 247 million
 B. 255 million
 C. 263 million
 D. 288 million

7. Which equation describes the circle with center $(5, -1)$ and radius 7?

- A. $(x-5)^2 + (y+1)^2 = 7$
 B. $(x-5)^2 + (y+1)^2 = 49$
 C. $(x+5)^2 + (y-1)^2 = 7$
 D. $(x+5)^2 + (y-1)^2 = 49$

8. Solve for x : $-\frac{1}{2}(2x + 6) + 2 = 0$

- A. $x = 5$ or $x = 1$
 B. $x = 5$
 C. $x = -5$ or $x = -1$
 D. $x = -1$

9. Which circle has the smallest area?

- A. $x^2 + y^2 = 12$
 B. $(x-2)^2 + y^2 = 8$
 C. $(x+1)^2 + (y+3)^2 = 6$
 D. $(x+8)^2 + (y-9)^2 = 3$

10. The profit P , in dollars, for a company is modeled by the function $P(x) = -750x^2 + 15,000x$, where x is the number of items produced. For which values of x will the company lose money?

- A. $x < 2$
 B. $2 < x \leq 10$
 C. $10 \leq x < 20$
 D. $x > 20$

11. In which direction is the graph of $f(x) = \frac{5}{x+b}$ translated when b increases?

- A. left
 B. right
 C. up
 D. Down

12. A company that manufactures jeans estimates that the profit for selling a particular style is given by the equation: $P = -250x^3 + 1,505x^2 - 300$, for $0 < x < 6$

where P is profit in tens of thousands of dollars and x is the advertising expense in tens of thousands of dollars. What does an x -intercept mean in the context of the problem?

- A. the number of times the company spent zero dollars on advertising
 B. the profit when the company spent zero dollars on advertising
 C. the advertising expense when the company had the most profit
 D. the advertising expense when the company's profit was zero dollars

13. Copper production increased at a rate of about 4.9% per year between 1988 and 1993. In 1993, copper production was approximately 1.801 billion kilograms. If his trend continued, which equation best models the copper production P , in billions of kilograms, since 1993? (Let $t = 0$ for 1993.)

- A. $P = 1.801(4.900)^t$
 B. $P = 1.801(1.490)^t$
 C. $P = 1.801(1.049)^t$
 D. $P = 1.801(0.049)^t$

14. Divide: $6x^3 - 11x^2 - 47x - 20 \div 2x + 1$

- A. $3x^2 - 7x - 20$
 B. $3x^2 + 7x - 20$
 C. $3x^2 - 4x - 20$
 D. $3x^2 + 4x - 20$

15. Which equation is equivalent to $\ln 7 + 3 \ln x = 5 \ln 2$?

- A. $\ln 7x^3 = \ln 25$
 B. $\ln 7x^3 = \ln 32$
 C. $\ln 10x = \ln 10$
 D. $\ln 21x = \ln 10$

16. Simplify:

- $\frac{\frac{1}{y} - \frac{1}{x}}{\frac{1}{y} + \frac{1}{x}}$
- A. $\frac{x-y}{x+y}$
 B. $\frac{x+y}{x-y}$
 C. 0
 D. -1

17. If $f(x) = 2x + 1$ and $g(x) = x^3$, what is $f(g(3))$?

- A. 343
B. 189
C. 55
D. 34

18. In which direction does the graph of $y = (x + 2)^{\frac{1}{2}} + c$ shift as c decreases?

- A. Right
B. Left
C. Up
D. Down

19. What is the domain of $f(x) = -2x^3 + x^2 + 1$?

- A. the set of all real numbers
B. $\{x | -3 < x < 2\}$
C. $\{x | -2 < x < 3\}$
D. the empty set

20. The population of a small town in North Carolina is 4,000, and it has a growth rate of 3% per year. Which expression can be used to calculate the town's population x years from now?

- A. $3(4,000)^x$
B. $4,000(1.03)^x$
C. $4,000x^{1.03}$
D. $4,000x^3$

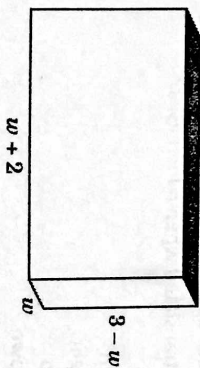
21. The graph of $f(x) = x^2 + 3$ is translated to produce the graph of $g(x) = (x + 2)^2 + 3$. In which direction was the graph of f translated?

- A. up
B. down
C. left
D. right

22. Solve for x :
$$\frac{x-1}{x+5} = \frac{x}{2(x+5)}$$

- A. -5
B. 2
C. -5 or 2
D. 5 or -2

23. The dimensions of this rectangular prism are given algebraically.



What is the **approximate** width (w) that will maximize the volume?

- A. 1 unit
B. $1\frac{1}{2}$ units
C. $1\frac{3}{4}$ units
D. 2 units

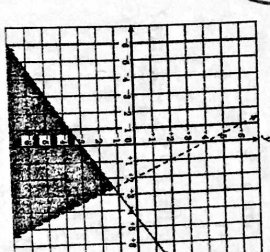
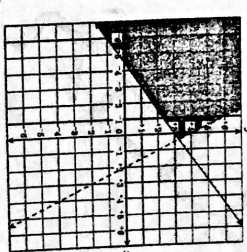
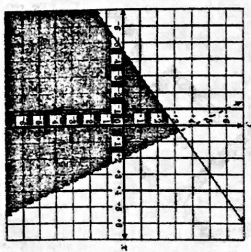
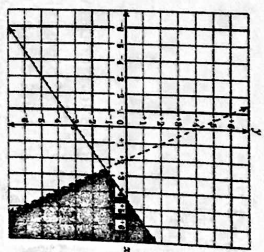
24. A single microscopic organism divides into two organisms every 3 days. Use the formula $N(t) = N_0(2)^{\frac{t}{3}}$, where t is the time in days, $N(t)$ is the number of organisms at t days, and N_0 is the number of organisms at $t = 0$. **Approximately** how long would it take one organism to produce a population of about 10,000 organisms?

- A. 1,667 days
B. 333 days
C. 126 days
D. 40 days

25. Which graph represents the system of inequalities below?

$$2x - 3y \geq 9$$

$$4x + 2y < 8$$



26. What is an equation of the circle that has center $(-2, 3)$ and passes through $(-1, 1)$?

- A. $(x + 2)^2 + (y - 3)^2 = 5$
B. $(x - 2)^2 + (y + 3)^2 = 5$
C. $(x + 2)^2 + (y - 3)^2 = 25$
D. $(x - 2)^2 + (y + 3)^2 = 25$

27. Simplify: $(x^{\frac{3}{4}})^3$

- A. $x^{\frac{64}{9}}$
B. $x^{\frac{3}{4}}$
C. $x^{\frac{12}{15}}$
D. $x^{\frac{3}{4}}$

28. The area of a rectangular window is $(4x^2 - 21x - 18)$. Both the length and the width are polynomials with integer coefficients. Which of the following could represent the length of the window?

- A. $4x + 6$
B. $4x + 3$
C. $x + 6$
D. $x + 3$

29. Which binomial is a factor of $(x^3 - x^2 + 3x - 3)$?

- A. $x - 3$
B. $x + 1$
C. $x^2 - 1$
D. $x^2 + 3$

30. $x = \frac{1}{3}, x = 4$
 B. $x = \frac{1}{3}, x = 4$
 C. $x = \frac{1}{9}, x = \frac{-1}{3}$
 D. $x = \frac{1}{3}, x = \frac{1}{9}$

31. What is the approximate value of the greatest zero of $f(x) = x^3 - 6x^2 - x + 3$?

- A. -0.75
 B. 2.84
 C. 6.08
 D. 6.31

32. What are the vertical asymptotes of the function

$$f(x) = \frac{4x^2 - 100}{2x^2 + x - 15}$$

- A. $x = -5, x = 5$
 B. $x = -5, x = 4, x = 5$
 C. $x = -3, x = \frac{5}{2}$
 D. $x = -3, x = \frac{5}{2}, x = \frac{20}{3}$

33. Which equation represents the graph of $y = x^2$ translated 1 unit right and 2 units down?

- A. $y = -(x-1)^2 - 2$
 B. $y = (x-1)^2 - 2$
 C. $y = -(x+1)^2 + 2$
 D. $y = (x+1)^2 - 2$

34. Which is the solution set to the equation $x + 2 = \frac{4}{x-2}$?

- A. $\{\pm 2\sqrt{2}\}$
 B. $\{2\sqrt{2}\}$
 C. $\left\{\frac{-1+\sqrt{17}}{2}\right\}$
 D. $\left\{\frac{-1+\sqrt{17}}{2}\right\}$

35. When interest is compounded n times a year, the accumulated amount (A) after t years is given by the formula

$$A = P \left(1 + \frac{r}{n}\right)^{nt}$$

where P is the initial principal and r is the annual rate of interest.

Approximately how long will it take \$2,000 to double at an annual interest rate of 5.25% compounded monthly?

- A. 13.98 years
 B. 13.71 years
 C. 13.23 years
 D. 13.08 years

36. Alan has just started a job that pays a salary of \$21,500. At the end of each year of work, he will get a 5% salary increase. What will his salary be after getting his fifth increase?

- A. \$22,631
 B. \$24,889
 C. \$26,133
 D. \$27,440

37. In the function $f(x) = a(x-4)^2$, where $a > 0$, what happens to the graph of f as the value of a increases?

- A. The graph narrows.
 B. The graph widens.
 C. The graph shifts up.
 D. The graph shifts right.

38. Which is the inverse of the function $f(x) = x - 9$?

- A. $f^{-1}(x) = \frac{1}{x}$
 B. $f^{-1}(x) = x + 9$
 C. $f^{-1}(x) = 9 - x$
 D. $f^{-1}(x) = \frac{1}{x-9}$

39. The table below shows the number of families living in the city of Sunnyvale from 1965 to 2000.

Year (after 1900)	65	70	76	80	86	90	96	100
Number of Families (thousands)	91.1	90.5	90.1	88.7	87.1	85.7	83.2	80.3

According to the best-fit quadratic model, approximately how many families will live in Sunnyvale in 2010?

- A. 14,000
 B. 15,000
 C. 18,000
 D. 19,000

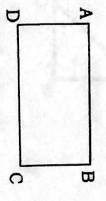
40. What is the solution set of the system below?

$$\begin{cases} x = 2y \\ x - y^2 = -2y \end{cases}$$

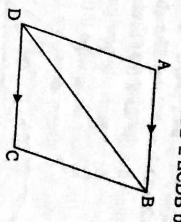
- A. $\{(0, 0)\}$
 B. $\{(0, 4)\}$
 C. $\{(0, 0), (4, 0)\}$
 D. $\{(0, 0), (8, 4)\}$

41. ABCD is a parallelogram. Which of the following pieces of information would suffice to prove ABCD is a rectangle?

- A. $AC = BD$
 B. $AB = BD$
 C. $m\angle B = m\angle D$
 D. $\angle A$ and $\angle D$ are supplementary

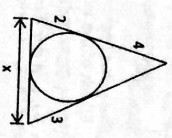


42. What additional information would be needed to prove $\triangle ABD \cong \triangle CDB$ by SAS?



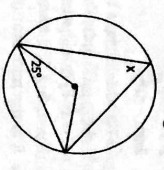
- A. $\angle ABD \cong \angle CBD$
 B. $\overline{AD} \cong \overline{CB}$
 C. $\angle DAB \cong \angle DCB$
 D. $\overline{AB} \cong \overline{CD}$

43. In the diagram, the segments shown are tangent to the circle. Find the value of x .



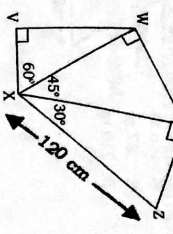
- A. 5
 B. 6
 C. 7
 D. 9

44. Solve for x given the diagram.



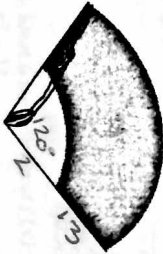
- A. 130°
 B. 65°
 C. 55°
 D. 50°

45. Polygon VWYXZ is shown below. What is the length of \overline{VX} ?



- A. $10\sqrt{3}$
 B. $10\sqrt{6}$
 C. $15\sqrt{3}$
 D. $15\sqrt{6}$

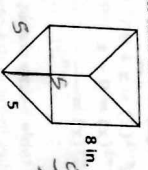
46. A right windshield wiper on a car has a length of 15" as shown. The rubber wiper blade itself is 1.3" long. The shaded region represents the area that is cleared by the wiper. Approximately how great an area does the rubber blade wipe if the arc through which it moves measures 120°?



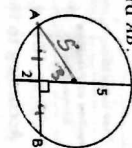
- A. $\frac{56\pi}{3}$ in²
 B. $\frac{221\pi}{3}$ in²
 C. 1560π in²
 D. 6720π in²

$(\pi(15)^2 - \pi(1.3)^2) \times \frac{120}{360}$

49. The right triangular prism has bases that are equilateral triangles. Using the dimensions shown find the volume of the prism.

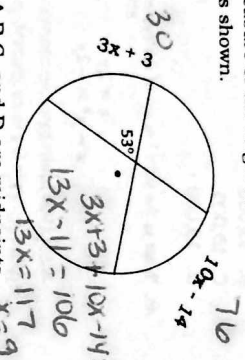


- A. 120 in³
 B. 200 in³
 C. $50\sqrt{3}$ in³
 D. $330\sqrt{3}$ in³



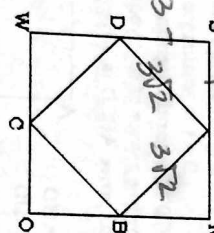
- A. 4
 B. 5
 C. 8
 D. $\sqrt{10}$

51. Two chords intersect within a circle to form an angle whose measure is 53°. Find the measure of the larger of the two arcs shown.



- A. 9°
 B. 13°
 C. 30°
 D. 76°

52. Points A, B, C, and D are midpoints of the sides of square SNOW. If the area of SNOW is 36, the area of ABCD is:



- A. $9\sqrt{2}$
 B. $18\sqrt{2}$
 C. 9
 D. 18

$A_{SNOW} = 36$

$SN = 6$

$SD = 3$

$(3\sqrt{2})(3\sqrt{2})$

$9(2) = 18$

53. A cylinder and a cone each have a radius of 3 in. and a height of 8 in. What is the ratio of the volume of the cone to the volume of the cylinder?



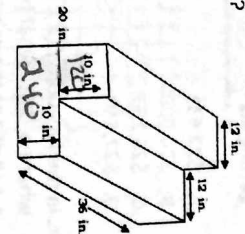
- A. 1 : 2
 B. 1 : π
 C. 1 : 1
 D. 1 : 3

54. Find the area of a circle formed when a plane passes 6 cm from the center of a sphere with radius 10 cm.



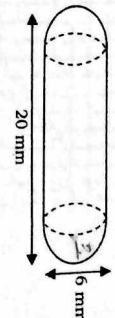
- A. 8 cm²
 B. 8π cm²
 C. 64π cm²
 D. $64\pi^2$ cm²

55. The figure below shows the dimensions of solid concrete steps. How many cubic inches of concrete are needed to create these steps?



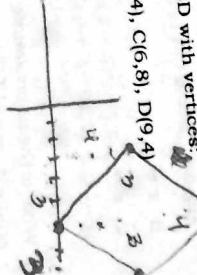
- A. 2,304
 B. 3,168
 C. 12,960
 D. 17,280

56. The medical capsule shown is composed of two hemispheres and a cylinder. The capsule has a length of 20 mm and a width of 6 mm. Find the exact volume of the capsule.



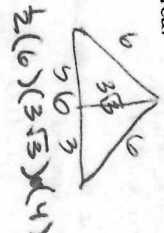
$\frac{4}{3}\pi(3)^3 + \pi(3)^2(20)$

57. Give the coordinates of quadrilateral ABCD with vertices:



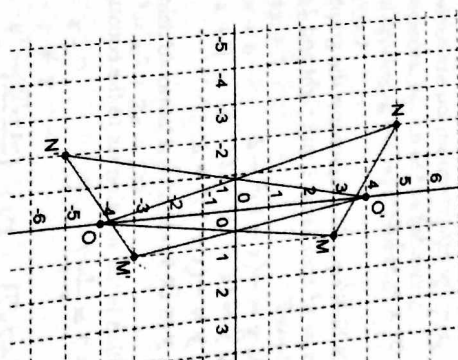
- A. parallelogram
 B. trapezoid
 C. rhombus
 D. square

- A. $36\sqrt{3}$ m²
 B. $108\sqrt{3}$ m²
 C. $180\sqrt{3}$ m²
 D. 72 m²



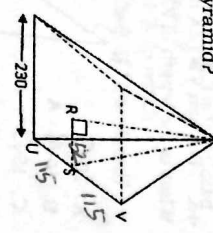
58. A tetrahedron has sides of length 6. Find the surface area.

59. What transformation maps AMNO to AM'N'O'?

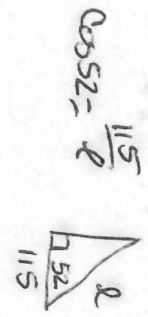


- A. reflection over the x-axis
 B. reflection over the y-axis
 C. reflection over the line $y = x$
 D. reflection over the line $y = -x$

48. The Great Pyramid was a square pyramid measuring 230 m on each side of its base. S is the midpoint of \overline{UV} and $m\angle RST = 52^\circ$. What is the approximate slant height of the pyramid?

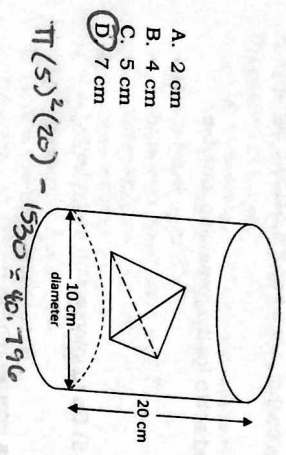


- A. 90 m
 B. 146 m
 C. 187 m
 D. 219 m



A regular tetrahedron is placed in a cylindrical container as shown below. The container is then filled to the top with 1530 cm³ of water. Assuming the tetrahedron remains completely submerged under the water, find the length of the side of the tetrahedron to the nearest cm. The formula for the volume of a tetrahedron is:

$$V = \frac{1}{12} \sqrt{2} s^3$$

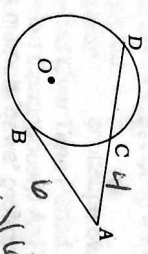


- A. 2 cm
- B. 4 cm
- C. 5 cm
- D. 7 cm

61. A square is a quadrilateral that is **NOT** also a

- A. parallelogram
- B. rectangle
- C. rhombus
- D. trapezoid

62. In the diagram below, tangent \overline{AB} and secant \overline{AD} are drawn to circle O from A . If $AB = 6$ and $AC = 4$, find AD .



- A. 2
- B. 3
- C. 9
- D. 13

Handwritten work for problem 62:

$$(x+4)(4) = (6)^2$$

$$4x+16 = 36$$

$$4x = 20$$

$$x = 5$$

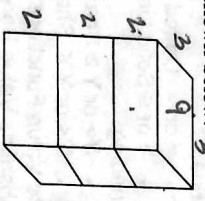
63. Which statement is true about ALL parallelograms?

- A. The diagonals are congruent.
- B. The area is the product of 2 adjacent sides.
- C. The diagonals are perpendicular to each other.
- D. The opposite angles are congruent.

64. Find the volume of a chocolate cake with a 60° slice removed if the height of the cake is 6 inches and the diameter is 8 inches.

- A. 50.3 in³
- B. 251.3 in³
- C. 301.5 in³
- D. 1005.3 in³

65. At the post office, boxes are being stacked for shipping. Each box is a square prism with base area of 9 ft² and height of 2 ft. The stacks must be covered in shrink wrap to prevent them from falling apart. The shrink wrap will cover the sides and top but not the bottom of each stack. How many square feet of shrink wrap will be needed to completely cover the stack shown below?



- A. 36 ft²
- B. 45 ft²
- C. 81 ft²
- D. 99 ft²

Handwritten work for problem 65:

$$9 \times 3 \cdot 2 \cdot 12$$

$$9 \cdot 72$$

$$648$$

66. Which quadrilateral has diagonals that always bisect its angles and also bisect each other?

- 1) rhombus
- 2) rectangle
- 3) parallelogram
- 4) isosceles trapezoid

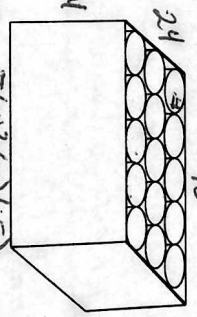
67. Each of 2 spherical tanks has a radius of 4 meters. One tank is filled with water to a height of 2x meters. The other tank is filled with water to a height of x meters. The volume of each tank when filled to a height of h meters is:

$$V = \pi h^2 (4 - \frac{h}{3})$$

Which expression represents the difference between the volumes of water in the two tanks?

- A. $\pi x^2 (4 - x)$
- B. $\pi x^2 (4 - \frac{5}{3}x)$
- C. $\pi x^2 (12 - \frac{7}{3}x)$
- D. $\pi x^2 (12 - 3x)$

68. A box in the shape of a rectangular prism will hold 15 congruent solid cylinders, each with radius of 4 inches and a height of 14 inches. The cylinders are arranged as shown below, with the cylinders touching all sides of the box, including the top and bottom of the box. To the nearest whole number, what is the volume of the empty space in the box?



- A. 2,884 in³
- B. 5,275 in³
- C. 7,190 in³
- D. 9,590 in³

Handwritten work for problem 68:

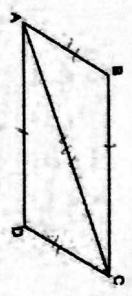
$$14 \cdot 24 \cdot 40 - \pi (4)^2 (14) (15)$$

69. Given three distinct quadrilaterals, a square, a rectangle, and a rhombus, which quadrilaterals must have perpendicular diagonals?

- 1) the rhombus, only
- 2) the rectangle and the square
- 3) the rhombus and the square
- 4) the rectangle, the rhombus, and the square



70. Given that $ABCD$ is a parallelogram, a student wrote the proof below to show that a pair of its opposite angles are congruent.



Statements	Reasons
1. $ABCD$ is a parallelogram.	1. Given
2. $\overline{BC} \parallel \overline{AD}$	2. Opposite sides of a parallelogram are congruent.
3. $\angle B \cong \angle D$	3. Parallelogram Theorem of Congruency
4. $\angle ABC \cong \angle CDA$	4. Side-Side-Side
5. $\angle B \cong \angle D$	5. CPCTC

What is the reason justifying that $\angle B \cong \angle D$?

- 1) Opposite angles in a quadrilateral are congruent.
- 2) Parallel lines have congruent corresponding angles.
- 3) Corresponding parts of congruent triangles are congruent.
- 4) Alternate interior angles in congruent triangles are congruent.

71.

The diagonals of a quadrilateral are congruent but do not bisect each other. This quadrilateral is

- 1) an isosceles trapezoid
- 2) a parallelogram
- 3) a rectangle
- 4) a rhombus

72.

Which quadrilateral does not always have congruent diagonals?

- 1) isosceles trapezoid
- 2) rectangle
- 3) rhombus
- 4) square

Handwritten work for problem 72:

$$\pi (2x)^2 (4 - \frac{2x}{3}) - \pi (x)^2 (4 - \frac{x}{3})$$

$$4x^2 \pi (4 - \frac{2x}{3}) - x^2 \pi (4 - \frac{x}{3})$$

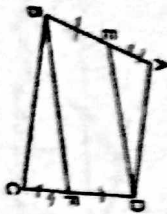
$$16x^2 \pi - 8x^3 \pi - 4x^2 \pi + \frac{x^3 \pi}{3}$$

Handwritten work for problem 72 (continued):

$$12x^2 \pi - \frac{7x^3 \pi}{3}$$

$$x^2 \pi (12 - \frac{7x}{3})$$

73. In the diagram below of quadrilateral $ABCD$, E and F are points on AB and CD , respectively, $EA = DF$, and $AF = CF$.



Which conclusion can be proven?

- 1) $\overline{AD} \cong \overline{FB}$
- 2) $\overline{AB} \cong \overline{CD}$
- 3) $\angle A \cong \angle C$
- 4) $\angle AED \cong \angle CFB$

74.

A quadrilateral whose diagonals bisect each other and are perpendicular is a

- 1) rhombus
- 2) rectangle
- 3) trapezoid
- 4) parallelogram

75.

If the diagonals of a quadrilateral do not bisect each other, then the quadrilateral could be a

- 1) rectangle
- 2) rhombus
- 3) square
- 4) trapezoid

Unit 1: Functions and Inverses

3 Methods for Solving Systems:

1. Substitution:
 - Solve one equation for a variable. ($Y = \text{or } X =$)
 - Substitute that equation into your other equation and solve for the remain
 - Plug your answer into either equation to solve for the remain
2. Elimination:
 - Make sure the equations are lined up with common variable constants.
 - If needed multiply an entire equation so that x or y has the same coefficient with opposite signs.
 - Add straight down and solve.
 - Plug answer into either equation and solve for the remain
3. Graphing:
 - Isolate for y in each equation.
 - Plug into $Y =$
 - Where do the equations intersect?
 - Calculator Steps (2nd \rightarrow Trace \rightarrow 5) Go to intersection a times.

Three Types of Solutions:

- Ordered Pair(s) - Where do the functions intersect?
- Infinitely Many - You have the same equation. Algebraically $y =$ statement. (Example: $0=0, 4=4, 2=2$)
- No Solution - The equations never intersect. Algebraically $y =$ statement. (Example: $3=6, -1=5, 0=9$)

Systems of Inequalities: We find the solutions to our system where overlaps.

Lines:

- $>$ or $<$ Dotted Line
- \geq or \leq Solid Line

Shading:

- $Y >$ or $Y \geq$ Shade Above
- $Y <$ or $Y \leq$ Shade Below

Absolute Value Functions:

- Absolute Value Bars in your Calculator (2nd \rightarrow 0 \rightarrow Enter)
 - 1. Isolate the absolute value
 - 2. Drop the absolute value symbol and set up two equations
 - One positive, one negative
 - 3. Solve both equations
- Inverses: Equations that undo one another and therefore "switch" and Y "flip" or change positions.
1. Change " $f(x)$ " notation to " y "
 2. Switch the x and y variables in the function.