

NC Final Quiz Bowl

Math 3

Name: _____



Directions: The following questions are sample items similar to those found on the EOC Exam. Answer each to the best of your ability. Show all work on a separate sheet of paper.

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

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

4. Which expression is equivalent to

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

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

7. 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 $\ln 21x = \ln 10$

The following list shows the number of people (in millions) in the United States whose only means of getting to work was walking.

10.

Year (x)	Number (y)
1940	7.6
1950	7.0
1960	6.4
1970	5.7
1980	5.4
1990	4.5

If $x = 0$ for the year 1940, which equation is the best-fit linear model for the data?

- A $y = -16.5x + 125$
- B $y = -0.06x + 7.6$
- C $y = 0.06x + 10$
- D $y = 7.6x - 0.06$

Which expression is equivalent to

2. $\frac{2x+6}{x^2+2x-24} \cdot \frac{x^2+2x-24}{x^2-7x+12}$

- A $\frac{2}{x-4}$
- B $\frac{2(x+3)}{x-8}$
- C $\frac{2(x+3)}{(x-4)(x-3)}$
- D $\frac{2(x+3)}{(x+4)(x-3)}$

5. 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 $12x^2 + 2$

8. 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 $(x+5)^2 + (y-1)^2 = 49$

11. 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 $3x^2 + 4x - 20$

3. 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. Which polynomial function has zeros 3 and $4 + i$?

- A $f(x) = x^3 - 11x^2 + 41x - 51$
- B $f(x) = x^3 - 6x^2 - 7x + 51$
- C $f(x) = x^3 + 5x^2 - 7x - 51$
- D $f(x) = x^3 + 11x^2 + 41x + 51$

9. 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

12. 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

13. A company that manufactures jeans estimates that the profit for selling a particular style is given by the equation:

$$P \approx -250x^3 + 1,505x^2 - 300, \text{ for } 0 < x < 6$$

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

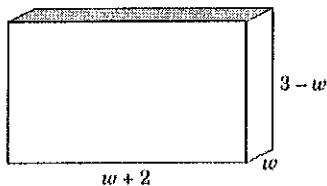
16. Which circle has the smallest area?

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

19. In the function $f(x) = a(x-4)^3$, 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.

22. 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

14. 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 this 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 $P = 1.801(0.049)^t$

17. 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 $x = -1$

20. 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

23. 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

15. 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 $x > 20$

What is the solution set of the system below?

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

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

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

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

24. 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

25. 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 $x = -3, x = \frac{5}{2}, x = \frac{20}{3}$
26. Which is the solution set of the equation $x + 2 = \frac{4}{x - 2}$?
- A $\{\pm 2\sqrt{2}\}$
- B $\{2\sqrt{2}\}$
- C $\left\{\frac{-1 \pm \sqrt{17}}{2}\right\}$
- D $\left\{\frac{-1 + \sqrt{17}}{2}\right\}$
27. 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 $y = (x + 1)^2 - 2$
28. 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
29. What are the zeros of $f(x) = x^3 + 7x + 5$?
- A $\left\{\frac{7 \pm 2\sqrt{5}}{2}\right\}$
- B $\left\{\frac{-7 \pm 2\sqrt{6}}{2}\right\}$
- C $\left\{\frac{7 \pm \sqrt{20}}{2}\right\}$
- D $\left\{\frac{-7 \pm \sqrt{29}}{2}\right\}$
30. Solve: $3x - 7\sqrt{x} + 2 = 0$
- A $x = \frac{1}{9}, x = 4$
- B $x = \frac{1}{9}, x = 4$
- C $x = \frac{1}{9}, x = -\frac{1}{9}$
- D $x = \frac{1}{9}, x = \frac{1}{9}$
31. 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 \$26,193
- D \$27,440
32. Which binomial is a factor of $(x^3 - x^2 + 3x - 3)$?
- A $x - 3$
- B $x + 1$
- C $x^2 - 1$
- D $x^2 + 3$
33. 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 $x + 3$
34. If 5 tractors can plow a field in 4 hours, how many hours will it take 3 tractors to plow the field?
- A $6\frac{2}{3}$
- B $6\frac{1}{2}$
- C $5\frac{2}{3}$
- D $5\frac{1}{2}$
35. 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
36. 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

37. Simplify:

$$\left(x^{\frac{3}{4}}\right)^3$$

- A $x^{\frac{27}{64}}$
- B $x^{\frac{9}{4}}$
- C $x^{\frac{9}{12}}$
- D $x^{\frac{15}{4}}$

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

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

43. 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 $(x - 2)^2 + (y + 3)^2 = 25$

46. Which function is equivalent to $y = x^2 - 6x + 10$?

- A $y = (x + 3)^2 - 1$
- B $y = (x - 3)^2 + 1$
- C $y = (x + 6)^2 - 10$
- D $y = (x - 6)^2 + 10$

38. 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 $4,000x^3$

41. 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

44. Which expression is equivalent to $\frac{\cos(\theta)}{1 - \sin(\theta)} \cdot \tan(\theta)$?

- A $\sec(\theta)$
- B $\sin(\theta)$
- C $\cos(\theta)$
- D $\csc(\theta)$

47. Where is the vertex of $y = |x + 2|$?

- A on the negative x -axis
- B on the positive x -axis
- C on the negative y -axis
- D on the positive y -axis

39. What is the domain of $f(x) = \sqrt{-2x^3 + x^2 + 1}$?

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

42. Let x and y be real numbers. If $(x + yi) - (2 - 3i) = -6 + 4i$, what are the values of x and y ?

- A $x = 8, y = 7$
- B $x = 8, y = 1$
- C $x = -4, y = 7$
- D $x = -4, y = 1$

45. Which is the inverse of $f(x) = 1.5^x + 4$?

- A $f^{-1}(x) = \frac{x - 4}{1.5}$
- B $f^{-1}(x) = \frac{\log(x) - 4}{1.5}$
- C $f^{-1}(x) = \frac{\log(x - 4)}{\log(1.5)}$
- D $f^{-1}(x) = \frac{4 - \log(x)}{\log(1.5)}$

48.

What is the domain of $f(x) = \sqrt{-x + 2}$?

- A $\{x \mid x \geq -2\}$
- B $\{x \mid x \leq 2\}$
- C $\{x \mid -2 < x < 2\}$
- D $\{x \mid 0 < x < 2\}$

49. What translations should be applied to the graph of $y = \frac{4}{x}$ to produce the graph of $y = \frac{4}{x-5} + 3$?
- A a shift 5 units to the right, and then a shift 3 units down
 B a shift 5 units to the right, and then a shift 3 units up
 C a shift 5 units to the left, and then a shift 3 units up
 D a shift 5 units to the left, and then a shift 3 units down
50. An airplane travels 1,400 miles in the same amount of time it takes a car to travel 210 miles. The car travels at a speed of 340 mph less than the airplane. What is the speed of the airplane?
- A 390 mph
 B 400 mph
 C 405 mph
 D 410 mph
51. What are the zeros of $y = \frac{x^2 + 2x - 3}{x^2 + 5x - 14}$?
- A 3 and -1
 B 1 and -3
 C 7 and -2
 D 2 and -7
52. Which sentence describes the transformation of the graph of $f(x) = 2x^2$ to the graph of $g(x) = \frac{1}{2}x^2$?
- A The graph becomes wider.
 B The graph becomes narrower.
 C The graph shifts down.
 D The graph shifts up.
53. The height, h (in feet), of a ball t seconds after it is thrown upward is given by the equation $h = -16t^2 + 60t + 5$. What does the constant term 5 in the equation represent?
- A time required for the ball to hit the ground
 B time required for the ball to reach the highest point
 C height after 5 seconds
 D height when first thrown
54. If $f(x) = \frac{4}{3}x - 9$, what is $f^{-1}(-3)$?
- A -13
 B -9.5
 C -7
 D 4.5
55. Simplify: $\frac{4 - \sqrt{3}}{2 - \sqrt{3}}$
- A 2
 B $5 + 2\sqrt{3}$
 C $11 - 6\sqrt{3}$
 D $-11 + 6\sqrt{3}$
56. Simplify: $\frac{(3 + 6i)^2}{2i}$
- A $\frac{27i}{2}$
 B $9 + 18i$
 C $18 + 27i$
 D $\frac{36 + 27i}{2}$
57. Which equation is equivalent to $3 \log x + \log 2 = \log 3x - \log 2$?
- A $\log x^2 + 2 = \log (3x - 2)$
 B $\log (3x + 2) = \log (3x - 2)$
 C $\log 6x = \log \left(\frac{3x}{2}\right)$
 D $\log (2x^3) = \log \left(\frac{3x}{2}\right)$
58. In which direction does the graph of $y = \sqrt{x+a}$ shift as the value of a decreases?
- A upward
 B downward
 C to the right
 D to the left
59. The pressure, P , measured in pounds per square inch (psi), on an object under water varies directly with its depth, d , measured in feet. If the pressure on an object at a depth of 20 feet is 8.6 psi, what is the pressure on an object at a depth of 25 feet?
- A 6.88 psi
 B 9.85 psi
 C 10.75 psi
 D 13.60 psi
60. What are the vertical asymptotes of $y = \frac{2x^2 - x - 1}{6x^2 - x - 1}$?
- A $x = -1, x = \frac{1}{2}$
 B $x = -\frac{1}{2}, x = 1$
 C $x = -\frac{1}{2}, x = \frac{1}{3}$
 D $x = -\frac{1}{3}, x = \frac{1}{2}$

61. The length of a rectangular prism is $4\sqrt{3}$ units. The height is $3\sqrt{6}$ units. If the volume is irrational, which could be the measure of the width of the rectangular prism?
- A $2\sqrt{50}$
 B $4\sqrt{12}$
 C $5\sqrt{6}$
 D $7\sqrt{18}$

63. Which expression is equivalent to $\frac{x+7}{x^2+4x-21} + \frac{x+5}{x^2+8x+15}$ when x is restricted so that the expressions are defined?
- A $\frac{x+3}{x-3}$
 B $\frac{x-3}{x+3}$
 C 1
 D -1

65. What is the *approximate* value of the sum:

$$8 - \frac{8}{7} + \frac{8}{49} - \dots + 8 \cdot \left(\frac{-1}{7}\right)^{2400} ?$$

(Note: The sum of a series can be calculated using the formula $S_n = \frac{a_1(1-r^n)}{1-r}$, where $r \neq 1$.)

- A 1
 B 7
 C 8
 D 9

67. The volume of a rectangular prism is represented by the expression $(x^3 - 2x^2 - 20x - 24)$. If the length is $(x - 6)$ and the height and width are equal, what is the width of the prism?
- A $x + 2$
 B $x - 2$
 C $x + 4$
 D $x - 4$

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

Year (after 1900)	65	70	75	80	85	90	95	100
Number of Families (thousands)	31.1	30.5	30.1	29.7	27.1	25.7	23.2	20.3

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

- A 14,000
 B 16,000
 C 18,000
 D 19,000

71. William put the tip of his pencil on the outer edge of a graph of the unit circle at the point $(0, -1)$. He moved his pencil tip through an angle of $\frac{4\pi}{3}$ radians in the counterclockwise direction along the edge of the circle. At what angle of the unit circle did William's pencil tip stop?
- A $\frac{\pi}{3}$
 B $\frac{5\pi}{6}$
 C $\frac{7\pi}{6}$
 D $\frac{5\pi}{3}$

62. What is the *approximate* length of the arc subtended by an angle of $\frac{4\pi}{3}$ radians on a circle with a radius of 6.00 meters?
- A 12.57 meters
 B 14.14 meters
 C 25.13 meters
 D 28.27 meters

64. Which expression is equivalent to $\frac{\frac{\sin(\theta) + \cos(\theta)}{\cos(\theta)} + \frac{\cos(\theta)}{\sin(\theta)}}{\frac{1}{\sin(\theta)}}$?
- A $\frac{1}{\cos(\theta)}$
 B $\sin(\theta)$
 C $\cos(\theta)$
 D $\frac{1}{\sin(\theta)}$

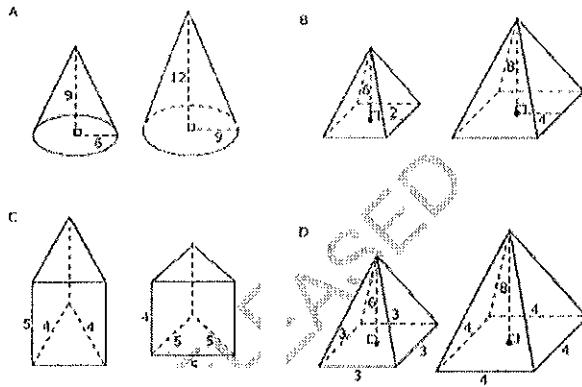
66. Which expression is equivalent to $(4 - 3i)^2 + (6 + i)^2$?
- A 30
 B $42 - 12i$
 C 50
 D $62 - 12i$

68. What value of h is needed to complete the square for the equation $x^2 + 10x - 8 = (x - h)^2 - 33$?
- A -25
 B -5
 C 5
 D 25

70. A shipping company is designing boxes to meet specific requirements.
- Each box must be a completely closed rectangular prism with no overlapping material.
 - The boxes must hold 24 cans in two layers of 12 cans each.
 - The cans are 3 inches in diameter and 5 inches in height.
- What is the smallest amount of cardboard needed to meet the specifications?
- A 1,080 in.²
 B 840 in.²
 C 636 in.²
 D 540 in.²

72. Which choice shows the solutions to the equation $8x^2 + 3x = -7$?
- A $\frac{-3 \pm i\sqrt{215}}{16}$
 B $\frac{3 \pm i\sqrt{215}}{16}$
 C $\frac{-3 \pm \sqrt{233}}{16}$
 D $\frac{3 \pm \sqrt{233}}{16}$

73. Which choice shows a pair of similar figures?



75. A student wants to determine the most liked professor at her college. Which type of study would be the most practical to obtain this information?

- A a simulation
- B an experiment
- C a survey
- D an observation

77. A system of equations is shown below.

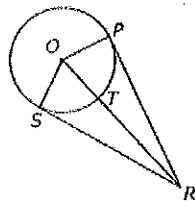
$$y = |x - 3|$$

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

What is the distance between the points of intersection of the system?

- A $\sqrt{6}$
- B $\sqrt{20}$
- C $\sqrt{48}$
- D $\sqrt{80}$

79. In the figure below, \overline{PR} and \overline{SR} are tangent to circle O .



If $OT = 11$ cm and $PR = 60$ cm, what is the length of \overline{OR} ?

- A 61 cm
- B 59 cm
- C 50 cm
- D 48 cm

81. Which is an equation of a parabola that has a directrix of $y = -5$ and a focus at $(2, -1)$?

- A $y = \frac{1}{2}(x + 2)^2 + 2$
- B $y = \frac{1}{6}(x + 2)^2 + 3$
- C $y = \frac{1}{8}(x + 2)^2 - 3$
- D $y = \frac{1}{2}(x - 2)^2 - 2$

74.

Samantha invested \$10,000 in each of two different financial plans in 2013. The predicted value of each plan is modeled below.

- Plan M: a rate of 7.5%, compounded continuously.
- Plan N: The value is determined by the function $y = 5x^3 - 50x^2 + 4x + 10,000$, where x is the number of years after 2013.

Plan N has a greater predicted value than Plan M during which years?

- A from 2014 to 2041
- B from 2028 to 2055
- C from 2042 to 2073
- D Plan N never has a greater value than Plan M.

76. The graph of the function $f(x) = x^3$ will be shifted down 2 units and to the right 3 units. Which is the function that corresponds to the resulting graph?

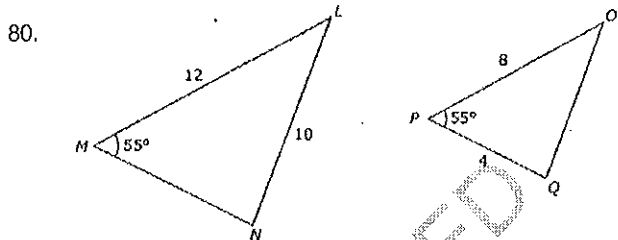
- A $g(x) = (x + 3)^3 + 2$
- B $g(x) = (x + 3)^3 - 2$
- C $g(x) = (x - 3)^3 + 2$
- D $g(x) = (x - 3)^3 - 2$

78.

A town has 685 households. The number of people per household is normally distributed with a mean, μ , of 3.67 and a standard deviation, σ , of 0.34. Approximately how many households have between 2.99 and 4.01 people?

- A 493 households
- B 520 households
- C 558 households
- D 575 households

Triangles LMN and OPQ are shown below.



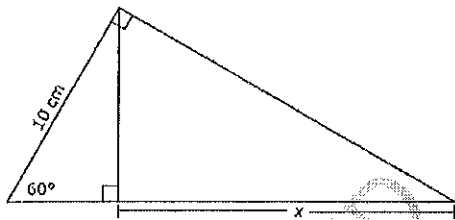
What additional information is sufficient to show that $\triangle LMN$ can be transformed and mapped onto $\triangle OPQ$?

- A $OQ = 6$
- B $MN = 9$
- C $\angle LMN \cong \angle QOP$
- D $\angle NLM \cong \angle QOP$

82. What is the approximate solution to the equation $3^{x-1} = 4^{2x+5}$?

- A 3.875
- B 1.262
- C -2.354
- D -4.797

83. What is the value of x in the triangle below?



- A $\frac{5\sqrt{3}}{2}$ cm
 B $5\sqrt{3}$ cm
 C 10 cm
 D 15 cm

85. A farmer wants to buy between 90 and 100 acres of land.

- He is interested in a rectangular piece of land that is 1,500 yards long and 300 yards wide.
- The piece of land is being sold as one complete unit for \$87,000.

If the farmer does not want to spend more than \$900 an acre, does the land meet all of his requirements? (1 acre \approx 43,560 ft^2)

- A Yes, the amount of land satisfies his needs, and the price is low enough.
 B No, the price is low enough, but there is too much land.
 C No, the price is low enough, but there is not enough land.
 D No, the amount of land satisfies what he needs, but the price is too high.

87. Which expression is equivalent to $\frac{\sin^4(\theta) - \cos^4(\theta)}{\sin^2(\theta) - \cos^2(\theta)}$, where $\sin^2(\theta) \neq \cos^2(\theta)$?

- A $\sin^2(\theta) - \cos^2(\theta)$
 B $\cos^2(\theta) - \sin^2(\theta)$
 C 2
 D 1

89. Which function goes to positive ∞ most quickly as x increases?

- A $y = \log(x) + 100$
 B $y = e^{x-9} - 3$
 C $y = x^2 + 5x + 6$
 D $y = 3x^5 + 4x^3 - 11x - 6$

91. Suppose $p(x) = x^3 - 2x^2 + 13x + k$. The remainder of the division of $p(x)$ by $(x + 1)$ is -8 . What is the remainder of the division of $p(x)$ by $(x - 1)$?

- A -8
 B 8
 C 16
 D 20

84. A function is shown below.

$$f(x) = \begin{cases} x^2 + 2x & \text{for } x \leq -3 \\ 2\left(\frac{1}{3}\right)^{2x} & \text{for } -3 < x < 4 \\ \frac{2x-5}{x-7} & \text{for } x \geq 4 \end{cases}$$

What is the value of the expression $f(-3) + 2f(-1) - f(4)$?

- A $\frac{101}{36}$
 B $\frac{32}{9}$
 C 4
 D 22

86. A principal wants to survey 150 students to determine which electives to offer during the next school year. There are 1,800 students in the school. Which procedure could the principal use to select a sample using a systematic random sample?

- A Obtain a list of all students. Start with the eighth student, and select every twelfth student until 150 students have been selected.
 B Select the first 150 students who enter the school.
 C Choose the fifth student to come into the cafeteria, and then select every third student who comes into the cafeteria until 150 students have been selected.
 D Place students' names on slips of paper and select 150 slips.

88. To completely cover a spherical ball, a ball company uses a total area of 36 square inches of material. What is the maximum volume the ball can have?

(Note: Surface area of a sphere = $4\pi r^2$. Volume of a sphere = $\frac{4}{3}\pi r^3$.)

- A 27π cubic inches
 B $36\sqrt{\pi}$ cubic inches
 C $\frac{36}{\sqrt{\pi}}$ cubic inches
 D $\frac{27}{\pi}$ cubic inches

90. Which expression is equivalent to $(x + 3)^3 - 9x(x + 3)$?

- A $x^3 + 27$
 B $x^3 - 27$
 C $x^3 - 9x^2 - 27x + 27$
 D $x^3 - 9x^2 + 27x + 27$

92. A reporter wants to know the percentage of voters in the state who support building a new highway. What is the reporter's population?

- A the number of people who live in the state
 B the people who were interviewed in the state
 C all voters over 25 years old in the state
 D all eligible voters in the state

93. A box with an open top will be constructed from a rectangular piece of cardboard.
- The piece of cardboard is 8 inches wide and 12 inches long.
 - The box will be constructed by cutting out equal squares of side x at each corner and then folding up the sides.

What is the entire domain for the function $V(x)$ that gives the volume of the box as a function of x ?

- A $0 < x < 4$
 B $0 < x < 6$
 C $0 < x < 8$
 D $0 < x < 12$

95. The diameter of a circle is 8 centimeters. A central angle of the circle intercepts an arc of 12 centimeters. What is the radian measure of the angle?

- A $\frac{3}{2}$
 B 3
 C 4
 D 8π

97. Let $f(x) = 14x^3 + 28x^2 - 46x + 7$ and $g(x) = 2x + 7$. Which is the solution set to the equation $\frac{1}{12}f(x) = g(x)$?

- A $\{-3, 0, 1\}$
 B $\{-3, -1, 2\}$
 C $\{-2, 1, 3\}$
 D $\{1, 5, 11\}$

99. A right triangle is shown below.



Which expression would result in an irrational number?

- A $x^2 + y^2$
 B $\frac{1}{2}xy$
 C $x + y + z$
 D $x^2 - z^2$

101. Over a 10-year period, two colleges raised their per-course tuitions (T_1 and T_2) each year. The tuitions can be modeled by the following equations:

College 1: $T_1 = 500(1.048)^x$

College 2: $T_2 = 446(1.068)^x$

In these equations, the tuitions are in dollars, and x represents elapsed time in years ($x = 0$ is the beginning of the 10-year period). Based on the model, at *approximately* what time during the 10-year period were the two tuitions equal?

- A $x = 5$ years
 B $x = 6$ years
 C $x = 7$ years
 D $x = 8$ years

94. The equation $2x^2 - 5x + 12$ is rewritten in the form of $2(x - p)^2 + q = 0$. What is the value of q ?

- A $\frac{167}{16}$
 B $\frac{71}{8}$
 C $\frac{23}{8}$
 D $\frac{23}{16}$

96. In a set of test scores that are normally distributed, a test score of 76 is 3 standard deviations below the mean. A score of 88 is 1 standard deviation above the mean. What is the mean of the data?

- A 79
 B 82
 C 84
 D 85

98. What is the solution to the equation $\frac{2x - 3}{x - 1} = \frac{8x + 1}{4x + 5}$?

- A $-\frac{14}{5}$
 B $-\frac{14}{9}$
 C $\frac{14}{9}$
 D $\frac{14}{5}$

100. Fred drives an average of 15,000 miles per year, and his car gets 20 miles per gallon of gasoline.

- The average cost of gasoline is \$3.25 per gallon.
- He buys a new car.
- In his new car, Fred continues to average 15,000 miles per year, and the average cost of gasoline remains the same.

Approximately how many more miles per gallon does the new car get if Fred has a savings of \$650 per year on gasoline?

- A 5.8 mpg
 B 7.3 mpg
 C 8.8 mpg
 D 10.3 mpg

102. Which equation describes a parabola that has vertex $(3, 1)$ and passes through point $(0, 4)$?

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

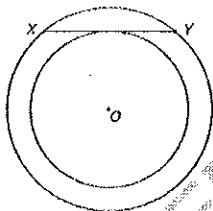
103. The table below shows the average weights for men 20–24 years of age.

Height (in inches)	Weight (in pounds)
62	130
64	138
66	148
68	156
70	167
72	176
74	186
76	197

If x represents height, and y represents weight, which linear equation *best* models these data?

- A $y = 5.01x - 181$
 B $y = 4.79x - 160$
 C $y = 0.21x + 35.2$
 D $y = 0.17x + 40.2$

105. The figure below shows concentric circles, both centered at O .



- Chord XY is tangent to the smaller circle.
- The radius of the larger circle is 15 cm.
- The radius of the smaller circle is 12 cm.

What is the length of chord XY ?

- A 27 cm
 B 24 cm
 C 18 cm
 D 10 cm

107. A city built an archway that can be modeled by the parabola $y = -x^2 + 8x + 20$. What are the coordinates of its vertex?

- A $(-4, 36)$
 B $(-2, 10)$
 C $(4, 36)$
 D $(2, 10)$

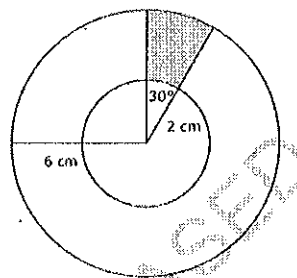
109. The graph of $y = ax^2$ is shifted up 3 units and right 5 units. Which equation represents the resulting graph?

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

111. What are the horizontal and vertical asymptotes of $f(x) = \frac{x^2 + 2x + 1}{x^2 + 3x - 4}$?

- A $x = 1$ and $y = -1$
 B $x = -4$, $y = -1$, and $y = 1$
 C $x = \pm 1$ and $y = 0$
 D $x = -4$, $x = 1$, and $y = 1$

104. In the figure below, the larger circle has a radius of 6 cm, and the smaller circle has a radius of 2 cm.



What is the *approximate* area of the shaded region?

- A 2.1 cm²
 B 3.4 cm²
 C 4.2 cm²
 D 8.4 cm²

- 106.

The table below represents the size, in acres, of the average farm.

Year	1950	1960	1970	1980	1997	1998
Size of Farm (acres)	213	297	374	426	436	435

- Choose which mathematical model below *best* fits the data.
- Using the model, predict the *approximate* size of the average farm in the year 2010.

- A linear; 650 acres
 B linear; 510 acres
 C quadratic; 400 acres
 D quadratic; 360 acres

- 108.

Zach purchased a stock. The value of the stock has been falling and rising as described by the polynomial function $V(x) = 2x^3 - 90x + 350$, where x is the number of weeks since the stock was purchased. What does the y -intercept of this function represent?

- A the number of weeks since the stock was purchased
 B the value of the stock at its maximum
 C the value of the stock when it was initially purchased
 D the week at which the value was at its maximum

- 110.

Approximately what is the smallest real zero of $f(x) = x^3 - 5x^2 + 2x + 6$?

- A -4.18
 B -1.68
 C -0.86
 D -0.46

- 112.

Where does the minimum value of the function $y = |x - 5| - 4$ occur?

- A at $y = -5$
 B at $y = 4$
 C at $x = 0$
 D at $x = 5$