

Math Power

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Sample

MIDTERM EXAM 2

Midterm Exam

- The first tread of a flight of stairs is 24 cm above the ground. If each tread after the first is 16.5 cm above the level of the previous step, how high above the ground is the tread of the fifteenth step?
- A child's toy consists of eight rings. The first ring has a diameter of 12.4 cm and the eighth ring has a diameter of 4 cm. What is the diameter of the third ring if the difference between the diameters of any two consecutive rings is all the same?
- Let $f(x)$ is a quadratic function. Given that f has two roots 1.5 and -2.5. If $f(1) = 7$, find $f(10)$.
- A dietician has sufficient milk to feed 13 infants for 4 weeks. How many days will this supply last if 13 more infants are added?

Sample Only

- If 6 men can clear the snow near a school in 8 hours, how many hours will it take 12 men working at the same rate to perform this task?
- A rectangle is formed by two congruent squares. If the area of the rectangle is a^2 , what is the perimeter of the rectangle?



- Mr. Power averages 12 television service calls per day, and Mr. Fixit averages 16 service calls per day. If Mr. Power's average charge is $\frac{3}{2}$ as much as that of Mr. Fixit, who earns \$7,200 per year, what are the annual earnings of Mr. Power?
- A furniture salesman averages \$400 in commissions during a normal 40 - hour week. During a special sale his rate of commission is increased by 25 percent. What is his average weekly commission during this period if he works 60 hours per week while the special sale is in progress?

9. If $3^{0.03} = a$, express $3^{0.7}$ in terms of a .

14. $\frac{5}{7x-3} = \frac{3}{4x-5}$

Question set [10 - 14]

Solve each of the following equations.

10. $\frac{x+3}{2} - \frac{x-4}{7} = 1$

Question set [15 - 19]

Simplify each of the following.

15. $(x^2 \cdot x^{-8})^{-2}$

11. $\frac{5}{x} + \frac{1}{3} = \frac{7}{x}$

16. $(6x^2 \cdot y^{-3})^{-4} \cdot (12x^5 \cdot y^{-8})^3$

12. $3x^3 - 17x^2 + 10x = 0$

17. $(10x^2 \cdot y^{-2})^{-3} \cdot (5x^4 \cdot y^5)^6 (2x^3 \cdot y^{-8})^6$

13. $n - \frac{2}{n} = \frac{23}{5}$

18. $\frac{3x}{x^2-6x} + \frac{4}{x}$

19. $\frac{4x^2}{5y^2} \cdot \frac{15xy}{24x^2y^2}$

25. If $8^{m+1} = 16$, find the value of m .

Question set [20 - 27]

Advanced Exponents.

20. If $x^3 = 10$, then $x^9 =$ _____

26. If $4^{3 \cdot 21} = a$, then $4^{21} =$ _____
(in terms of a).

21. If $7^{25} = b$, then $b^8 =$ _____

27. Let $4^{10} = M$, then $2^{64} =$ _____
(in terms of M)

22. If $x^{-3} = c$, then $x^3 =$ _____

Question set [28 - 29]

A brick staircase has a total of 30 steps. The bottom step requires 100 bricks. Each successive step requires two less bricks than the prior step.

28. How many bricks are required for the top step?

23. If $x^{-3} = c$, then $(10x)^3 =$ _____
(in terms of c)

29. How many bricks are required to build the staircase?

24. If $6^{1-2y} = 2$, then $6^{1+2y} = ?$

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30. The enrollment at Lincoln High School this year is 25 percent greater than last year's enrollment. If this year's enrollment is k students, what was last year's enrollment in terms of k ?

Question set [31 - 33]

Logarithm.

31. $\log_2 16 =$

32. $\log_3 \frac{1}{9} =$

33. $\log_{10} 0.0001 =$

Question set [34 - 35]

$a_2 = -2, a_5 = -18$

34. $r =$ _____

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35. $a_8 =$ _____

Question set [36 - 39]

Factor the following polynomials.

36. $3b^2 - 75 =$

37. $3abc^2 - 3abd^2 =$

38. $1 - a + b - ab$

39. $x^4 - 2x^3 + x - 2$

Question set [40 - 44]

Given $f(x) = \frac{3x-4}{x+2}$.

40. f is not continuous at _____.

$$46. \begin{vmatrix} x & 6 \\ 6 & x-10 \end{vmatrix}$$

41. Find the x -intercept of f .

$$47. \begin{vmatrix} x & -1 & 0 \\ 2 & x & -3 \\ 2 & 2 & 1 \end{vmatrix}$$

42. Find the y -intercept of f .

$$48. \begin{vmatrix} 1 & -1 & x \\ 2 & x & -3 \\ 0 & 3 & 2 \end{vmatrix}$$

43. Find the horizontal asymptote for f .

49. Find the determinant.

$$\begin{vmatrix} 1 & 3 & 9 \\ 1 & 5 & 25 \\ 1 & -1 & 1 \end{vmatrix}$$

44. Find the vertical asymptotes for f .

Question set [45 - 50]

Each of the following matrices has a determinant of 3. Find the value of x .

$$45. \begin{vmatrix} 1 & 2 \\ 2 & x \end{vmatrix}$$

50. Solve the following equation:

$$\begin{vmatrix} 3-x & 6 \\ 6 & 3-x \end{vmatrix} = 0$$

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Question set [51 - 52]

Convert each of the following quadratic equations into the form as

$$a(x - b)^2 + k$$

51. $\frac{1}{3}x^2 + 2x + 2$

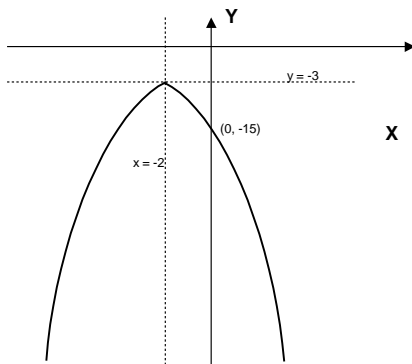
52. $3x^2 - 4x - 1$

Question set [53 - 54]

Quadratic functions.

53. Find quadratic function $y = f(x)$ with -3 and -5 as its roots and satisfies $f(-4) = 1$.

54. Given the graph below, a parabola, determine the quadratic function.



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Question set [55 - 56]

Convert each of the following quadratic equations into the form as

$$a(x - b)^2 + k$$

55. $\frac{1}{3}x^2 + 2x + 2$

56. $3x^2 - 4x - 1$

Question set [57 - 61]

Solve each of the following equations.

57. $\frac{x+3}{2} - \frac{x-4}{7} = 1$

58. $\frac{5}{x} + \frac{1}{3} = \frac{7}{x}$

59. $3x^3 - 17x^2 + 10x = 0$

60. $n - \frac{2}{n} = \frac{23}{5}$

66. $\frac{4x^2}{5y^2} \cdot \frac{15xy}{24x^2y^2}$

61. $\frac{5}{7x-3} = \frac{3}{4x-5}$

Question set [67 - 74]

Advanced Exponents.

67. If $x^3 = 10$, then $x^9 =$ _____

Question set [62 - 66]

Simplify each of the following.

62. $(x^2 \cdot x^8)^{-2}$

68. If $7^{25} = b$, then $b^8 =$ _____

63. $(6x^2 \cdot y^3)^{-4} \cdot (12x^5 \cdot y^8)^3$

69. If $x^{-3} = c$, then $x^3 =$ _____

64. $(10x^2 \cdot y^2)^{-3} \cdot (5x^4 \cdot y^5)^6 (2x^3 \cdot y^8)^6$

70. If $x^{-3} = c$, then $(10x)^3 =$ _____
(in terms of c)

65. $\frac{3x}{x^2-6x} + \frac{4}{x}$

71. If $6^{1-2y} = 2$, then $6^{1+2y} = ?$

72. If $8^{m+1} = 16$, find the value of m .

78. Find the horizontal asymptote for f .

73. If $4^{3 \cdot 2^1} = a$, then $4^{2^1} =$ _____
(in terms of a).

79. Find the vertical asymptotes for f .

74. Let $4^{10} = M$, then $2^{64} =$ _____
(in terms of M)

Question set [80 - 85]

Each of the following matrices has a determinant of 3. Find the value of x .

80. $\begin{vmatrix} 1 & 2 \\ 2 & x \end{vmatrix}$

Question set [75 - 79]

Given $f(x) = \frac{3x-4}{x+2}$.

75. f is not continuous at _____.

81. $\begin{vmatrix} x & 6 \\ 6 & x-10 \end{vmatrix}$

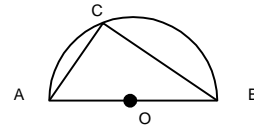
76. Find the x -intercept of f .

82. $\begin{vmatrix} x & -1 & 0 \\ 2 & x & -3 \\ 2 & 2 & 1 \end{vmatrix}$

77. Find the y -intercept of f .

83.
$$\begin{vmatrix} 1 & -1 & x \\ 2 & x & -3 \\ 0 & 3 & 2 \end{vmatrix}$$

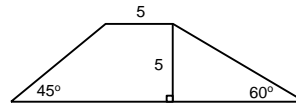
87. AB is a diameter of circle O. AC = 10, CB = 24. What is the area of the semicircle?



84. Find the determinant.

$$\begin{vmatrix} 1 & 3 & 9 \\ 1 & 5 & 25 \\ 1 & -1 & 1 \end{vmatrix}$$

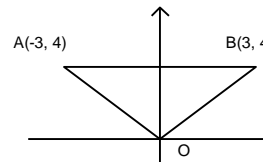
88. Find the area of the following trapezoid.



85. Solve the following equation:

$$\begin{vmatrix} 3-x & 6 \\ 6 & 3-x \end{vmatrix} = 0$$

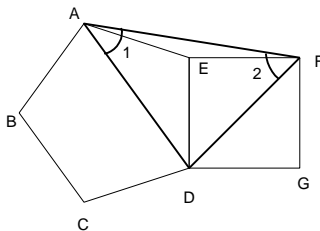
89. In the figure, what is the perimeter of $\triangle OAB$?



Question set [86 - 90]

Geometry review.

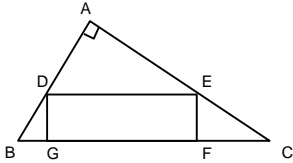
86. ABCDE is a regular pentagon. DEFG is a square. Find the measure of $\angle DAF$.



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90. $\triangle ABC$ is a right triangle. $DEFG$ is a rectangle. It is given that $BG = 3$, $CF = 12$ and $BC = 30$. Find the area of the rectangle $DEFG$.

(Hint: $DG^2 = BG \times CF$, why?)



91. The enrollment at Lincoln High School this year is 25 percent greater than last year's enrollment. If this year's enrollment is k students, what was last year's enrollment in terms of k ?

92. What is the average rate, in miles per hour, for a motorist who goes 2 miles in 3 minutes?

Question set [93 - 101]

Sequence problems.

93. If the 6th term of an arithmetic sequence is 8, and the common difference is $-\frac{3}{2}$, what is the 26th term?

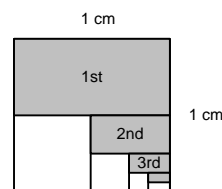
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94. In an arithmetic sequence, if the 100th term is 5 and the 50th term is -3, what is the sum of all the terms starting at 50th and ending at 100th term?

95. The first term of an arithmetic sequence is 2, and the fourth term is 4. What is the 7th term?

96. The first term of a geometric sequence is 27, and the fourth term is 0.27. What is the 7th term?

97. The following square has a side of 1 cm. What is the area of the 3rd shaded rectangle?



98. $\sum_{i=10}^{20} 2i$

99. $\sum_{i=6}^{36} 2i + 1$

100. Starting from 5th term of an arithmetic sequence, $2x$, $3x + 2$, and $5x + 3$ are given. Find the 100th term of the sequence.

Sample Key

Complete key will be provided on order

1. 255(cm)

$$\begin{aligned} & 24 + (15 - 1) \times 16.5 \\ & = 24 + 260 \\ & = 255 \end{aligned}$$

$$\frac{12.4-4}{8-1}$$

3. -425

$f(x) = a(x-1.5)(x+2.5)$. Since $f(1) = 3$, it leads to

$$a(-.5)(3.5) = 7 \Rightarrow a = -4.$$

$$\text{Thus, } f(10) = -4(8.5)(12.5) = -425.$$

5. 4 hours

The amount of work is $6 \times 8 = 48$, which needs 4 hours for 12 men.

$$\sqrt{2}$$

$$\frac{a}{\sqrt{2}}$$

$$\frac{a}{\sqrt{2}} \quad \sqrt{2}$$

7. \$8,100

Mr. Power only works $\frac{12}{16}$ as much as Mr. Fixit, however, charging $\frac{3}{2}$ as much, so he deserves $\$7,200 \times \frac{12}{16} \times \frac{3}{2} = \$8,100$

9. $3/a^{10}$

$$3^{0.7} = 3^{1-0.3} = 3/3^{0.3} = 3/a^{10}$$

11. 6

13. $n = 5$, or $-\frac{2}{5}$

15. x^{12}

17. $10^3 y^{-12}$

$$\frac{3x+4(x-6)}{x^2-6x}$$

$$\frac{7x-24}{x^2-6x}$$

19. $\frac{x}{2y^3}$

21. 49

$$b^8 = (7^{25})^8 = 7^2 = 49$$

23. $1000c^{-10}$

Note that $x^3 = (x^{-3})^{-10} = c^{-10}$, therefore,
 $(10x)^3 = 1000x^3 = 1000c^{-10}$

43. $y = 3$

45. 7

$x - 4 = 3$

$x = 7$

25. $m = \frac{1}{3}$

$$8^{m+1} = 16 \Rightarrow 2^{3(m+1)} = 2^4 \Rightarrow 3(m+1) = 4 \Rightarrow$$

$$m = \frac{1}{3}.$$

$\frac{a}{64}$

27. $2^{64} = 4^{32} = 4^2 \times (4^{10})^3 = 16M$

47. -1 or -5

$x^2 + 6x + 8 = 3$

$x^2 + 6x + 5 = 0$

$(x + 1)(x + 5) = 0$

$x = -1 \text{ or } -5$

29. 2130

$$\text{The total} = \frac{1}{2}(100 + 42) \times 30 = 2130$$

49. 48

31. 4

33. -4

$\sqrt[3]{9}$

35. $-18 \times 9 = -162$

37. $3ab(c + d)(c - d)$

39. $(x - 2)(x + 1)(x^2 - x + 1)$

$x^4 - x^3 + x - 1$

$= x^3(x - 2) + x - 2$

$= (x - 2)(x^3 + 1)$

$= (x - 2)(x + 1)(x^2 - x + 1)$

41. $\frac{3}{4}$

51. $\frac{1}{3}(x^2 + 6x) + 2$

$= \frac{1}{3}\{(x + 3)^2 - 9\} + 2$

$= \frac{1}{3}(x + 3)^2 - 1$

$\frac{7}{3}$

53. $-(x+3)(x+5)$

Any quadratic function with two roots -3 and -5 must be like

$f(x) = a(x+3)(x+5),$

where a is a non-zero constant.

Since $f(-4) = 1$, we have

$a(-1)(1) = 1$

$a = -1$

$$\begin{aligned}
 55. & \frac{1}{3}(x^2 + 6x) + 2 \\
 & = \frac{1}{3}\{(x + 3)^2 - 9\} + 2 \\
 & = \frac{1}{3}(x + 3)^2 - 1 \\
 & \qquad \qquad \qquad \frac{7}{3}
 \end{aligned}$$

$$57. -3$$

$$\begin{aligned}
 59. & x(3x^2 - 17x + 10) = 0 \\
 & x(3x - 2)(x - 5) = 0 \\
 & x = 0, \frac{2}{3} \text{ or } 5 \\
 & \qquad \qquad \qquad \frac{2}{5}
 \end{aligned}$$

$$61. x = -16$$

$$63. 2^2 3^{-1} x^7 y^{-12}$$

$$\begin{aligned}
 65. & \frac{3x+4(x-6)}{x^2-6x} \\
 & = \frac{7x-24}{x^2-6x} \\
 & \qquad \qquad \qquad \frac{x}{2y^3}
 \end{aligned}$$

$$\begin{aligned}
 67. & 1000 \\
 & x^9 = (x^3)^3 = 10^3 = 1000
 \end{aligned}$$

$$\begin{aligned}
 69. & c^{-10} \\
 & x^3 = (x^{-3})^{-10} = c^{-10}
 \end{aligned}$$

$$71. 18$$

$$\begin{aligned}
 & 6^{1-2y} = 2 \\
 & 6^{-1+2y} = \frac{1}{2} \\
 & 6^{1+2y} = 6^2 \times 6^{-1+2y} \\
 & = 36 \times \frac{1}{2} = 18
 \end{aligned}$$

$$73. \frac{a}{64}$$

$$75. -2$$

$$77. -2$$

$$79. x = -2$$

$$81. 13 \text{ or } -3$$

$$\begin{aligned}
 & x^2 - 10x - 36 = 3 \\
 & x^2 - 10x - 39 = 0 \\
 & x = 13 \text{ or } -3
 \end{aligned}$$

$$83. -5$$

$$\begin{aligned}
 & 2x + 6x + 9 + 4 = 3 \\
 & 8x = -10 \\
 & x = -1.25
 \end{aligned}$$

85. 3 or -6
 $(3 - x)^2 - 36 = 0$
 $(x - 3)^2 = 36$
 $x - 3 = \pm 6$
 $x = 3 \pm 6$
 $x = 9$ or -3

$$\sqrt{3 \times 12}$$

91. $0.8k$
 $k/1.25 = 0.8k$

$$\text{speed} = \frac{\text{distance}}{\text{time}} \quad \frac{1}{20} \quad \frac{2}{\frac{1}{20}}$$

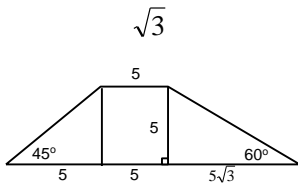
87. $\frac{1}{2}(169\pi)$

Note that $\triangle ABC$ is a right triangle since $\angle C = 90^\circ$. Recall that inscribed angle = $\frac{1}{2} \times$ (central angle) now that the central angle of $AOB = 180^\circ$, so $\angle C = 90^\circ$. Applying Pythagorean theorem we conclude that $AB^2 = AC^2 + BC^2$, thus, $AB = \sqrt{AC^2 + BC^2} = \sqrt{10^2 + 24^2} = 26$. The radius is 13 and the area of the semicircle is $\frac{1}{2}(169\pi)$.

$$\frac{1}{32}$$

$$\sum_{i=10}^{20} 2i$$

$$\sum_{i=6}^{36} 2i + 1$$



89. 16
 $OB = OA = 5, AB = 6$.