

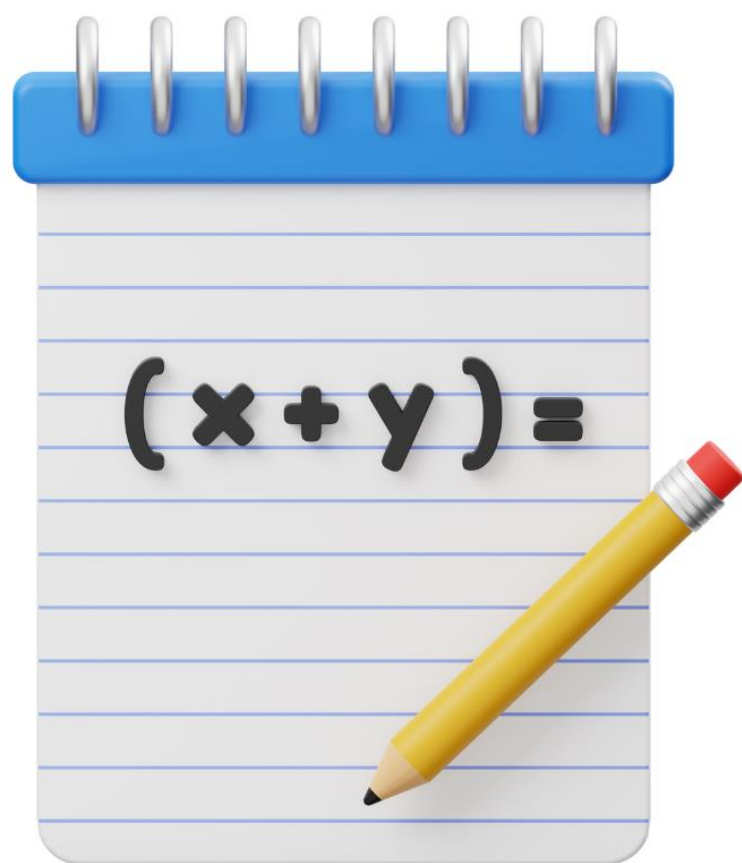


MATHATHON 2024

Problems Worksheet



Algebra I



Problem 1

Solve for x :

$$8 - 5x = x + 15$$

Your answer:

Your solution process (optional):



Problem 2

Solve for x :

$$0.5(5 - 7x) = 8 - (4x + 6)$$

Your answer:

Your solution process (optional):



Problem 3

Solve for y :

$$py + 7 = 6y + q$$

Your answer:

Your solution process (optional):



Problem 4

Solve for x :

$$|2x - 1| = 5$$

Your answer:

Your solution process (optional):



Problem 5

Are the functions $h(x) = 2x - 3$ and $g(x) = -3x + 7$ parallel, perpendicular, or neither?

Your answer:

Your solution process (optional):



Problem 6

Solve for x :

$$|3x + 2| = |x - 1|$$

Your answer:

Your solution process (optional):



Problem 7

Solve for x :

$$a(5 - x) = bx - 8$$

Your answer:

Your solution process (optional):



Problem 8

Elle paints walls for a living. She paints at a constant speed, and then she takes a constant amount of time to clean up. The table compares the total area Elle paints (in square meters) and the time it takes Elle to finish painting and cleaning up (in hours).

Area (m^2)	time (hours)
30	2
45	2,75
60	3,5

How long does it take Elle to paint 1 square meter?

Your answer:

Your solution process (optional):



Problem 9

How many solutions does the following equation have?

$$3z + 9 + 14z = 4z + 5$$

- a) no solutions
- b) exactly one solution
- c) infinitely many solutions

Your answer:

Your solution process (optional):



Problem 10

Simplify, assuming z is positive.

$$5\sqrt{(14z^2)} \cdot 4\sqrt{(21z^3)}$$

Your answer:

Your solution process (optional):



Problem 11

In which step was a mistake made?

$$\begin{array}{l} 2(x-3)^2 + 4 = 102 \\ 2(x-3)^2 = 106 \quad \text{Step 1} \\ (x-3)^2 = 53 \quad \text{Step 2} \\ x-3 = \pm \sqrt{53} \quad \text{Step 3} \\ x = \pm \sqrt{53} + 3 \quad \text{Step 4} \end{array}$$

Your answer:

Your solution process (optional):



Problem 12

Solve the system of equations:

$$\begin{cases} 2x + y = 8 \end{cases}$$

$$\begin{cases} 3x - 2y = 5 \end{cases}$$

Your answer:

Your solution process (optional):



Problem 13

Solve for x :

$$\frac{x}{2} + 3 = 7 \left[\frac{4(2+5)}{7} - 3 \right]$$

Your answer:

Your solution process (optional):



Problem 14

Solve using the quadratic formula:

$$3x^2 - 7x + 2 = 0$$

Your answer:

Your solution process (optional):



Problem 15

Factor $x^2 - 5x + 6$.

Your answer:

Your solution process (optional):



Problem 16

Solve the system of equations:

$$\{x^2 + y = 10$$

$$\{xy = 24$$

Your answer:

Your solution process (optional):



Problem 17

Solve the system of equations:

$$\{2x^2 + y = 2$$

$$\{y = 2x + 2$$

Your answer:

Your solution process (optional):



Problem 18

Simplify:

$$7x - 4(2x + 6) + 12 \left[\frac{1}{2} + \frac{7(2+3)}{14} \right] + x$$

Your answer:

Your solution process (optional):



Problem 19

Solve for y :

$$32x + 5 > 6(4x + y) + 3$$

Your answer:

Your solution process (optional):



Problem 20

Solve the system of equations:

$$7x + 2(2 + 4) + \frac{x+4}{2} = -2y \qquad x - 4 = y + 7$$

Your answer:

Your solution process (optional):



Geometry & Trigonometry



Problem 1

How far am I from ice cream? Let's say I am at (3, 4) and the ice cream is at (6, 12). Use the distance formula.

Your answer:

Your solution process (optional):



Problem 2

Evaluate $\tan(\pi/3)$.

Your answer:

Your solution process (optional):



Problem 3

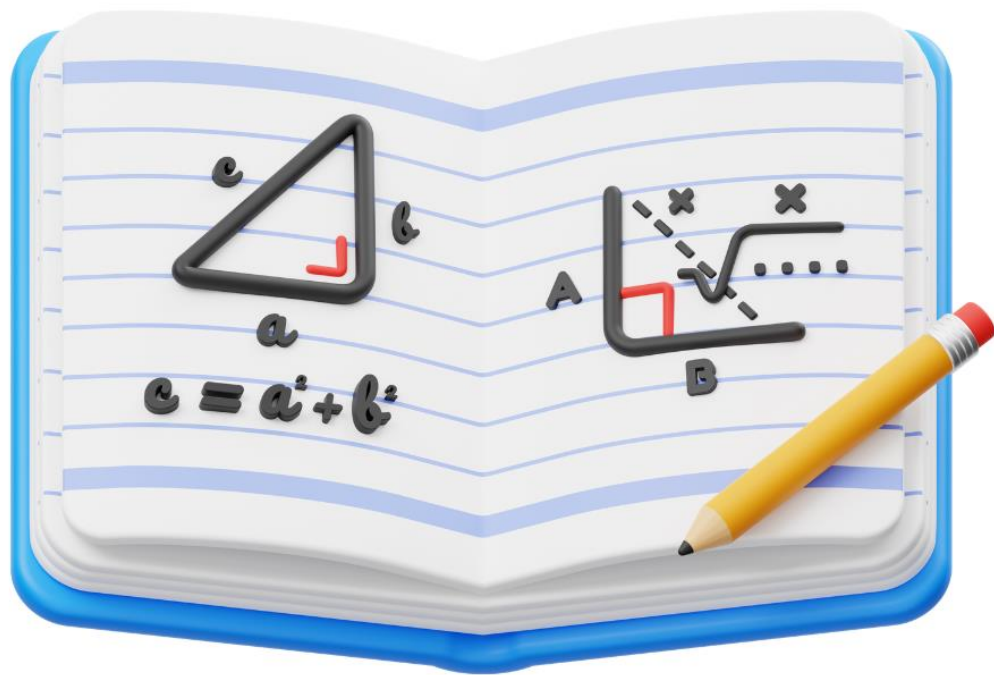
Evaluate $\tan(390^\circ)$.

Your answer:

Your solution process (optional):



Algebra II



Problem 1

What is the degree of the following polynomial?

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

Your answer:

Your solution process (optional):



Problem 2

Solve for x in the following equation.

$$\frac{2x-4}{5x+2} = 2$$

Your answer:

Your solution process (optional):



Problem 3

Rewrite $4^3 = 64$ in logarithmic form.

Your answer:

Your solution process (optional):



Problem 4

Convert 270° to radians.

Your answer:

Your solution process (optional):



Problem 5

Let $f(x) = x^x + x$. Find $f(3)$.

Your answer:

Your solution process (optional):



Problem 6

Let $f(x) = x^x + x$. Find $f(-2)$.

Your answer:

Your solution process (optional):



Problem 7

What does x equal in the following equation?

$$x = \log_2(8)$$

Your answer:

Your solution process (optional):



Problem 8

Let $f(x) = x^3 - 2x$. Let $g(x)$ be $f(x)$ translated 2 units up and 3 units right. Find $g(x)$.

Your answer:

Your solution process (optional):



Problem 9

Find the solution(s) to the following system of equations.

$$\begin{cases} y = 2x^2 - 5x + 4 \\ y = 3x - 4 \end{cases}$$

Your answer:

Your solution process (optional):



Problem 10

Let $f(x) = 2x$. What is the average value of the function on the interval $[0, 5]$?

Your answer:

Your solution process (optional):



Problem 11

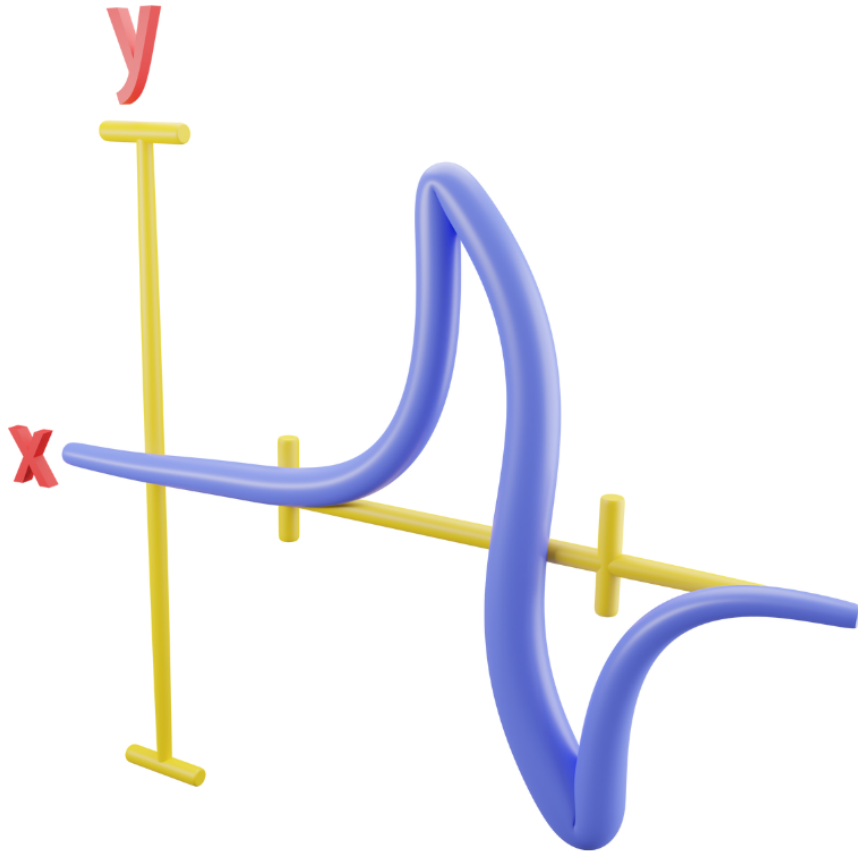
Prove that $\sin^2(\theta) + \cos^2(\theta) = 1$.

Your answer:

Your solution process (optional):



Precalculus (and Some Calculus)



Problem 1

Convert the following coordinate pairs to polar form:

I. $(1, 2)$

II. $(2, 4)$

III. $(3, 6)$

Your answer:

Your solution process (optional):



Problem 2

Convert the following coordinate pairs to rectangular form:

I. $(1, \pi/2)$

II. $(8, 2\pi/3)$

III. $(4, \pi)$

Your answer:

Your solution process (optional):



Problem 3

Convert the following equations to polar form:

I. $2x^2 + 2y^2 = 1$

II. $y = \sqrt{x}$

Your answer:

Your solution process (optional):



Problem 4

Convert the following equations to rectangular form:

I. $r = \sin(2\theta)$

II. $r = 2 - 2\sin(\theta)$

Your answer:

Your solution process (optional):



Problem 5

List the end behaviors as $x \rightarrow \infty$ for the functions $a(x)$ through $c(x)$.

$$a(x) = \frac{2x^2 + \sqrt{x}}{x\sqrt{x}}$$

$$b(x) = \frac{8x^2 - 8}{(\frac{1}{2}x - 1)(x + 2)}$$

$$c(x) = \frac{x^5 + 3x^4 - x^3 + x^2}{x^4 - 3x^3 + 9x^2 - x^2}$$

Your answer:

Your solution process (optional):



Problem 6

Which of the following statements is true about $f(x)$?

- I. It has no vertical asymptotes.
- II. It has no horizontal asymptotes.
- III. It has a removable discontinuity at $x = -1$.

$$f(x) = \frac{x^4 + 10x^3 + 35x^2 + 50x + 24}{x^3 - x^2 - 2x}$$

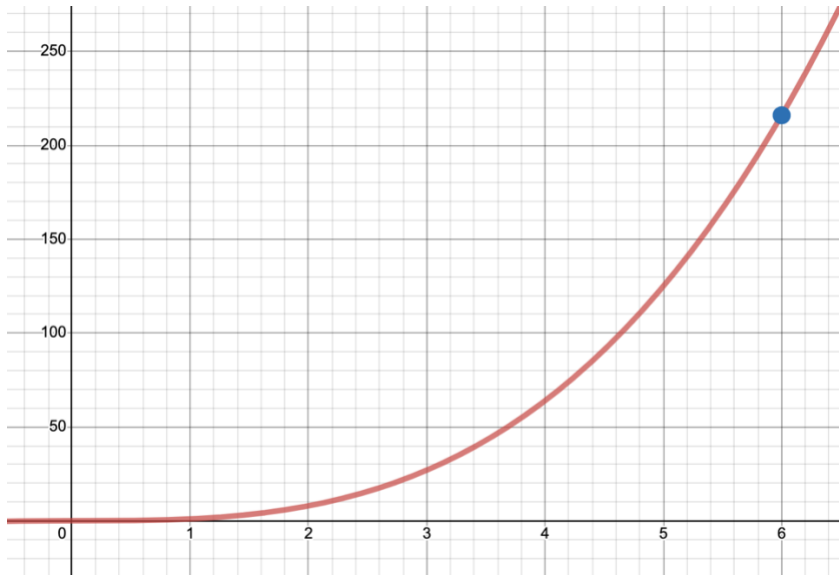
Your answer:

Your solution process (optional):



Problem 7

Find the equation of the tangent line at $x = 6$ for $f(x) = x^3$.



Your answer:

Your solution process (optional):



Problem 8

The equation of the tangent line to $f(x) = \sqrt{x}$ at $x = 4$ is $y = x/4 + 1$. Identify $f'(4)$ and then write the equation of the normal line to $f(x)$ at $x = 4$.

Your answer:

Your solution process (optional):



Problem 9

Find the indefinite integral of the following functions:

I. $f(x) = 2x^2$

II. $g(x) = \sqrt{x} + 1/x^2$

Your answer:

Your solution process (optional):



Problem 10

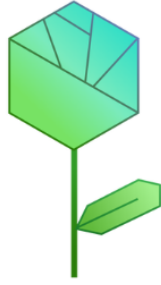
Find the integral of the following functions on the given intervals:

- I. $f(x) = 2x^2$ on $[-1, 1]$
- II. $g(x) = \sqrt{x} + 1/x^2$ on $[2, 3]$

Your answer:

Your solution process (optional):





**You're
Done :)**

**Thank you for
participating in this
year's Mathathon!**

**Remember to upload this
to the Google Form to
win your prize(s)!**