

Write your questions
and thoughts here!**Recall:**Explicit equationImplicit equation**Chain Rule and Implicit Differentiation**

In terms of x	In terms of y
$\frac{d}{dx}x =$	$\frac{d}{dx}y =$
$\frac{d}{dx}x^2 =$	$\frac{d}{dx}y^2 =$
$\frac{d}{dx}e^{5x} =$	$\frac{d}{dx}e^{5y} =$

Implicit Differentiation Example: Find $\frac{dy}{dx}$ for $y^2 - 5x^3 = 3y$ Step 1: Take the derivative. Each time the derivative of “ y ” is involved, include a $\frac{dy}{dx}$.Step 2: Gather all terms with $\frac{dy}{dx}$ on the left side, everything else on the right.Step 3: Factor out the $\frac{dy}{dx}$ if necessary, to create only one $\frac{dy}{dx}$ term.Step 4. Solve for $\frac{dy}{dx}$.

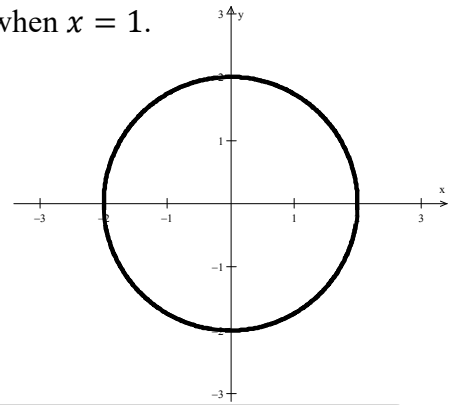
1. $y^3 - 2x = x^4 + 2y$

2. $\sin(xy) = 10x$

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Derivative at a point – implicit differentiation.

3. Find the equation of all tangent lines for $x^2 + y^2 = 4$ when $x = 1$.



Horizontal and Vertical Tangent Lines

Horizontal tangent lines exist when the slope, $\frac{dy}{dx} =$

Vertical tangent lines exist when the slope, $\frac{dy}{dx}$ is

4. Find all **horizontal** tangent lines of the graph $3x^2 + 2y^2 = 16$.

5. Find all **vertical** tangent lines of the graph $3x^2 + 2y^2 = 16$.

3.2 Implicit Differentiation

Calculus

Practice

Find $\frac{dy}{dx}$.

1. $5x^2 + 2y^3 = 4$

2. $5y^2 + 3 = x^2$

3. $\sin(x + y) = 2x$

$$4. 4x + 1 = \cos y^2$$

$$5. 5x^2 - e^{4y^2} = -6$$

$$6. \ln(y^3) = 5x + 3$$

$$7. x^2 = 4y^3 + 5y^2$$

$$8. 5x^3 - 2y = 5y^3$$

$$9. \ln y^2 + \cos^2 x = 1 - y$$

$$10. \sin\left(\frac{y}{2}\right) + e^y = 4x$$

$$11. x^3 + y^3 = 6xy$$

$$12. \frac{x}{\sin y} = 5$$

$$13. \ln x e^{3y} = 2y^2$$

Find the slope of the tangent line at the given point. Show work.

14. $2 = 3x^4 + xy^4$ at $(-1, 1)$

15. $x \ln y = 4 - 2x$ at $(2, 1)$

Find the equation of the tangent line at the given point.

16. $x^2 + y^2 + 19 = 2x + 12y$ at $(4, 3)$

17. $x \sin 2y = y \cos 2x$ at $\left(\frac{\pi}{4}, \frac{\pi}{2}\right)$

Find the equations of all horizontal and vertical tangent lines. Calculator allowed. Round to three decimals.

18. $x^2 + x + 2y^2 = 8$

19. $x + y = y^2$

Horizontal: _____

Horizontal: _____

Vertical: _____

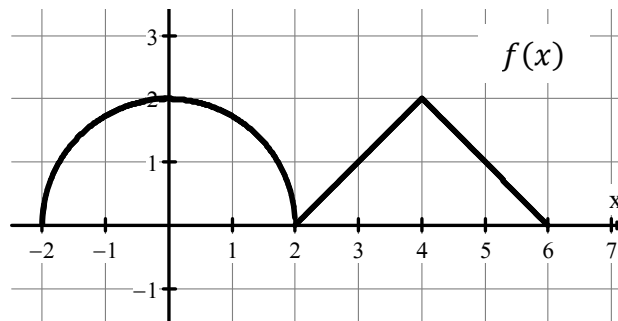
Vertical: _____

3.2 Implicit Differentiation

20. Find the slope of the normal line to $y = x + \cos(xy)$ at $(0,1)$.

- (A) 1 (B) -1 (C) 0 (D) 2 (E) Undefined

21. The graph of $f(x)$, shown below, consists of a semicircle and two-line segments. $f'(1) =$



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

22. Find the value(s) of $\frac{dy}{dx}$ of $x^2y + y^2 = 5$ at $y = 1$.

- (A) $-\frac{3}{2}$ only (B) $-\frac{2}{3}$ only (C) $\frac{2}{3}$ only (D) $\pm\frac{2}{3}$ (E) $\pm\frac{3}{2}$