

1. (4 pts.) Find the derivatives of the following functions:

(a)  $f(x) = \frac{x^2}{\sqrt{3}} = \frac{1}{\sqrt{3}} x^2$        $f'(x) = \frac{1}{\sqrt{3}} 2x = \boxed{\frac{2x}{\sqrt{3}}}$

(b)  $f(x) = 3x^4 - 2e^x$        $f'(x) = \boxed{12x^3 - 2e^x}$

2. (8 pts.) Find all  $x$  for which the tangent to the graph of  $f(x) = \frac{1}{4x^2} - x$  at  $(x, f(x))$  is horizontal.

$f(x) = \frac{1}{4} x^{-2} - x$

Need to solve  $f'(x) = 0$

$\frac{1}{4}(-2)x^{-2-1} - 1 = 0$

$-\frac{1}{2}x^{-3} - 1 = 0$

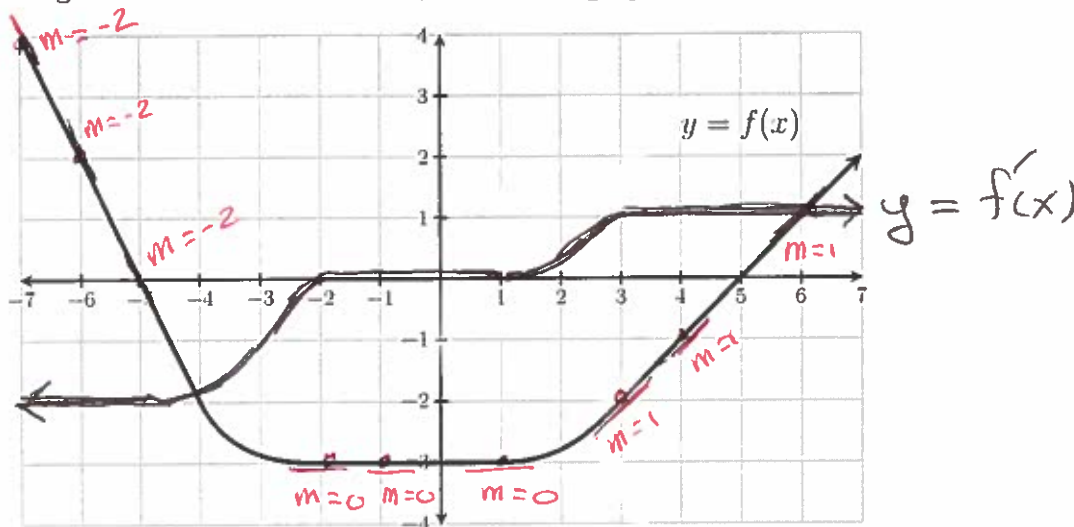
$-\frac{1}{2x^3} = 1$

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

$x = \sqrt[3]{-\frac{1}{2}}$

Ans  $\boxed{\text{Slope is 0 at } x = -\sqrt[3]{\frac{1}{2}}}$

3. (8 pts.) The graph of a function  $f(x)$  is shown below. Using the same coordinate axis, sketch the graph of its derivative  $f'(x)$



1. (4 pts.) Find the derivatives of the following functions:

(a)  $f(x) = 5e^x + 5x^3$

$$f'(x) = 5e^x + 15x^2$$

(b)  $f(x) = \frac{x}{1+\sqrt{2}} = \frac{1}{1+\sqrt{2}} x \Rightarrow$

$$f'(x) = \frac{1}{1+\sqrt{2}}$$

2. (8 pts.) Find all
- $x$
- for which the tangent to the graph of
- $f(x) = x^4 - 8x^2$
- at
- $(x, f(x))$
- is horizontal.

Need to solve  $f'(x) = 0$ 

$$4x^3 - 16x = 0$$

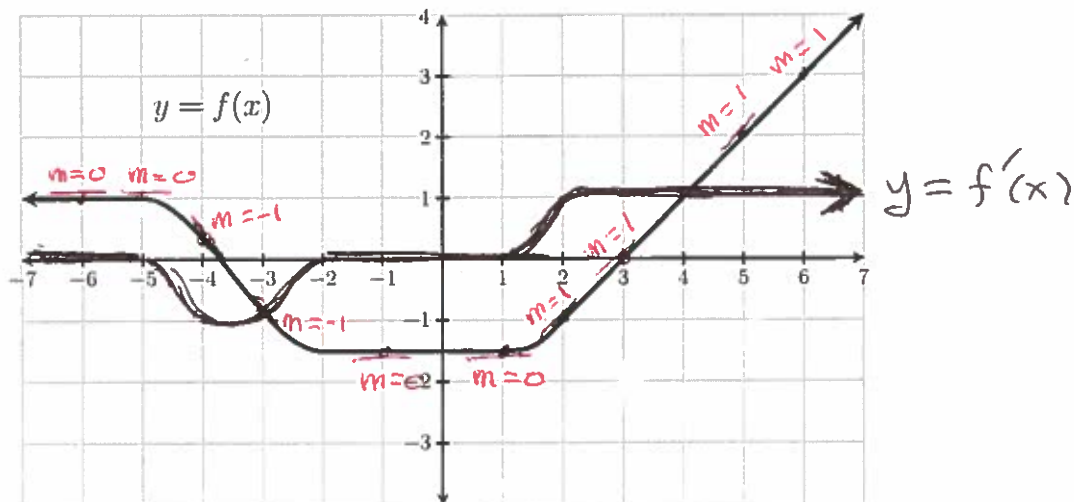
$$4x(x^2 - 4) = 0$$

$$4x(x-2)(x+2) = 0$$

$$\begin{array}{ccc}
 \downarrow & \downarrow & \downarrow \\
 x=0 & x=2 & x=-2
 \end{array}$$

AnswerSlope is zero at  $x=0$ ,  $x=2$  and  $x=-2$ 

3. (8 pts.) The graph of a function
- $f(x)$
- is shown below.

Using the same coordinate axis, sketch the graph of its derivative  $f'(x)$ .

1. (4 pts.) Find the derivatives of the following functions:

(a)  $f(x) = 3e^x + 4x^3$

$$f'(x) = 3e^x + 12x^2$$

(b)  $f(x) = \frac{x}{1+e} = \frac{1}{1+e} \cdot x$

$$f'(x) = \frac{1}{1+e} \cdot 1 = \boxed{\frac{1}{1+e}}$$

(constant multiple rule)

2. (8 pts.) Find all
- $x$
- for which the tangent to the graph of
- $f(x) = 3x - e^x$
- at
- $(x, f(x))$
- is horizontal.

Need to solve  $f'(x) = 0$

$$3 - e^x = 0$$

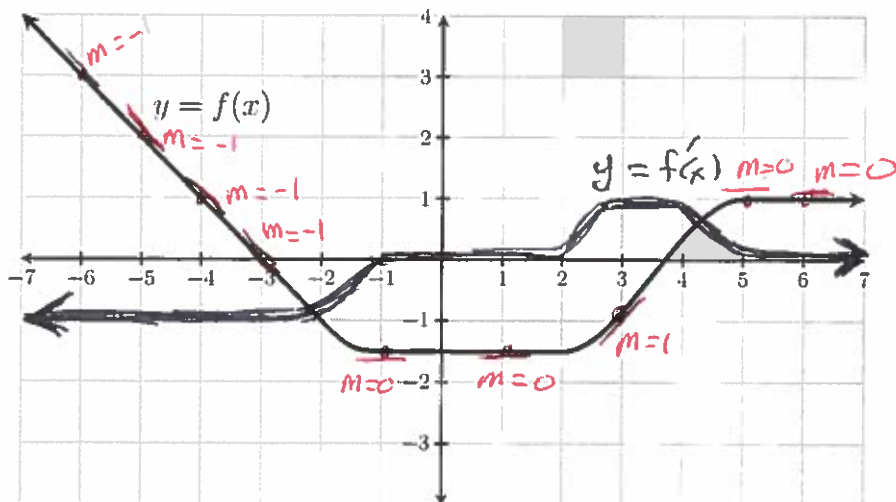
$$3 = e^x$$

$$\ln(3) = \ln(e^x)$$

$$\ln(3) = x$$

Answer: Tangent is horizontal at  $x = \ln(3)$

3. (8 pts.) The graph of a function
- $f(x)$
- is shown below.
- 
- Using the same coordinate axis, sketch the graph of its derivative
- $f'(x)$
- .



1. (4 pts.) Find the derivatives of the following functions:

(a)  $f(x) = \frac{e^3}{x} = e^3 x^{-1}$   $f'(x) = e^3 (-1) x^{-1-1} = \frac{-e^3}{x^2}$

↑ *constant!*

(b)  $f(x) = 3x^4 - 2e^x$   $f'(x) = 12x^3 - 2e^x$

2. (8 pts.) Find all  $x$  for which the tangent to the graph of  $f(x) = \frac{9}{x} + x$  at  $(x, f(x))$  is horizontal.

Solve  $f'(x) = 0$  ↑  $f(x) = 9x^{-1} + x$

$9(-1)x^{-1-1} + 1 = 0$

$-\frac{9}{x^2} + 1 = 0$

$-\frac{9}{x^2} = -1$

$9 = x^2$

$x = \pm\sqrt{9}$   
 $x = \pm 3$

Answer tangent line is horizontal at  $x=3$  and  $x=-3$

3. (8 pts.) The graph of a function  $f(x)$  is shown below. Using the same coordinate axis, sketch the graph of its derivative  $f'(x)$

