

NAME: _____ KEY _____

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MATH 126/126E FINAL EXAM SAMPLE

NOTE: The final exam will only have 14 questions. The different parts of each question (part A, B, etc.) are variations. Know how to do all the variations on this exam.

1A.) (6 pts) Solve for each equation for x .

i.) $\log_3(x-5) - \log_3(2x+3) = 0$

i. No solution

$$\log_3\left(\frac{x-5}{2x+3}\right) = 0$$

$$3^0 = \frac{x-5}{2x+3}$$

$$1 = \frac{x-5}{2x+3}$$

$$2x+3 = x-5 \quad \Rightarrow \quad x = -8 \quad \text{However, this is not in the domain, so no solution.}$$

ii.) $2^{4x-3} - 27 = 5$

ii. $x = 2$

$$2^{4x-3} = 32$$

$$2^{4x-3} = 2^5$$

$$4x-3 = 5$$

$$4x = 8 \Rightarrow x = 2$$

iii.) $10^{-x} = 1.6$

iii. -0.2041

$$\log 10^{-x} = \log 1.6$$

$$-x = \log 1.6$$

$$x = -\log 1.6 \approx -0.2041$$

1B.) (6 pts) Solve for each equation for x .

i.) $\log_2(x+5) + \log_2(2x-5) = 3$

i. 3

$$\log_2(x+5)(2x-5) = 3$$

$$2^3 = (x+5)(2x-5)$$

$$8 = 2x^2 + 5x - 25$$

$$2x^2 + 5x - 33 = 0$$

$$(2x+11)(x-3) = 0$$

$$x = -11/2 \quad \text{and} \quad x = 3$$

However, if you put $-11/2$ into the original equation, you will get a negative number inside the log. Therefore 3 is the only answer.

ii.) $3^{1-2x} - 21 = 6$

ii. $x = -1$

$$3^{1-2x} = 27$$

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

$$1 - 2x = 3$$

$$-2x = 2$$

$$x = -1$$

iii.) $e^x = 4.5$

iii. 1.5041

$$\ln e^x = \ln 4.5$$

$$x = \ln 4.5 \approx 1.5041$$

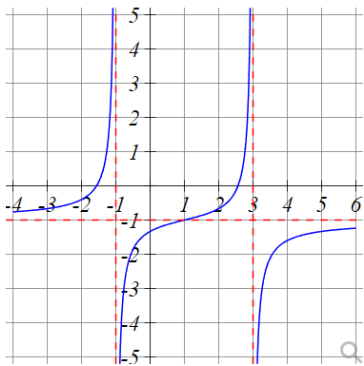
2A.) (3 pts) The graph of $f(x)$ has the below characteristics. Use this information to choose the correct graph of f below.

x-intercept: $(1, 0)$

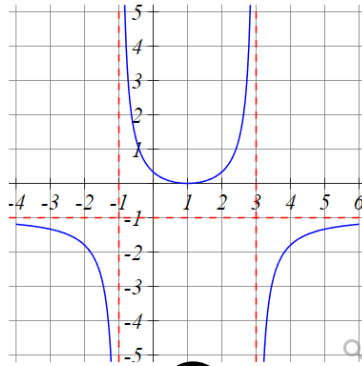
y-intercept: $\left(0, \frac{1}{3}\right)$

vertical asymptotes: $x = -1, x = 3$

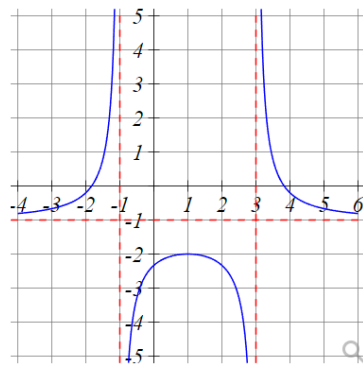
horizontal asymptote: $y = -1$



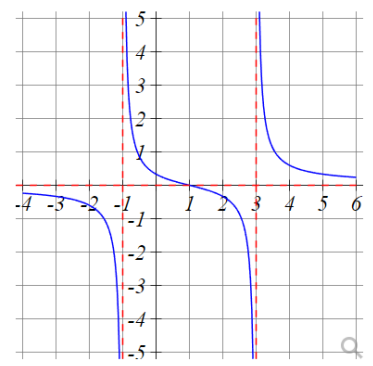
(a)



(b)



(c)



(d)

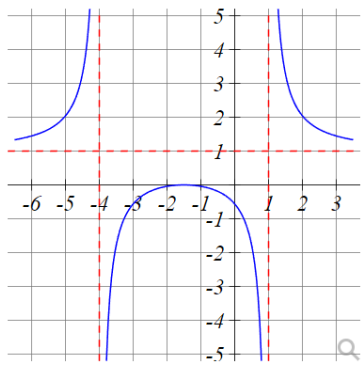
2B.) (3 pts) The graph of $f(x)$ has the below characteristics. Use this information to choose the correct graph of f below.

x-intercept: $\left(-\frac{3}{2}, 0\right)$

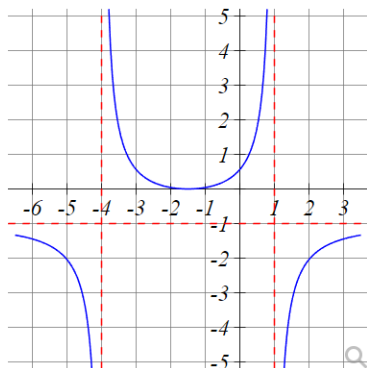
y-intercept: $\left(0, -\frac{3}{8}\right)$

vertical asymptotes: $x = -4, x = 1$

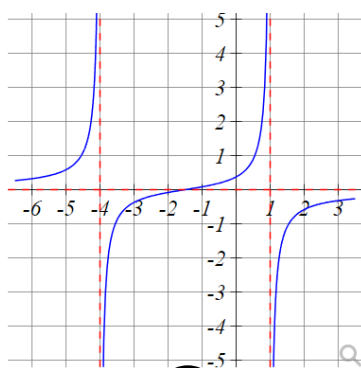
horizontal asymptote: $y = 0$



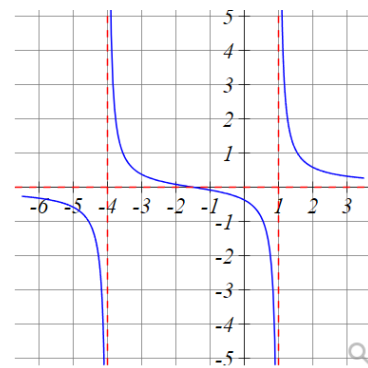
(a)



(b)



(c)

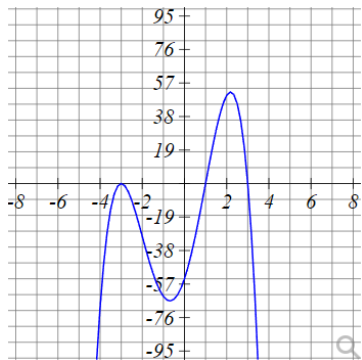


(d)

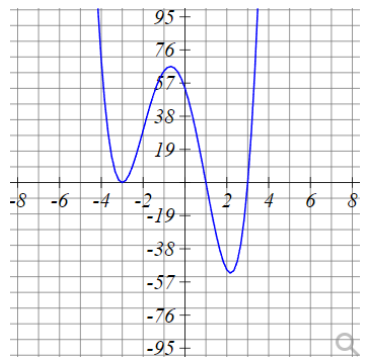
3A.) (3 pts) The graph of $f(x)$ has the below characteristics. Use this information to choose the correct graph of f below.

zeros: -3 (multiplicity 1), 1 (multiplicity 2), 3 (multiplicity 1)

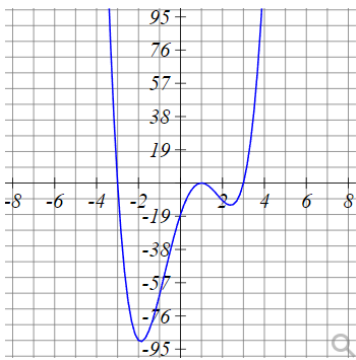
leading term (power function): $-2x^4$



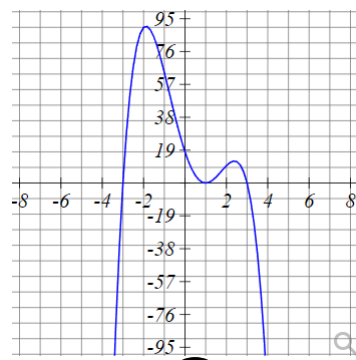
(a)



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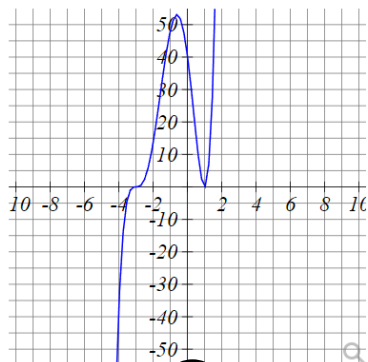


(d)

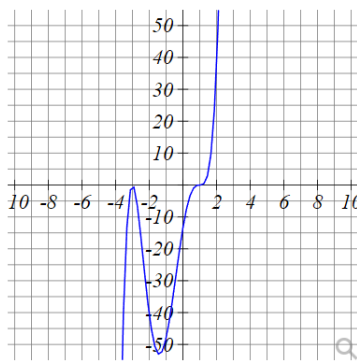
3B.) (3 pts) The graph of $f(x)$ has the below characteristics. Use this information to choose the correct graph of f below.

zeros: -3 (multiplicity 3), 1 (multiplicity 2)

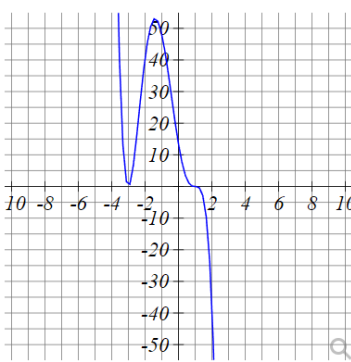
leading term (power function): $\frac{3}{2}x^5$



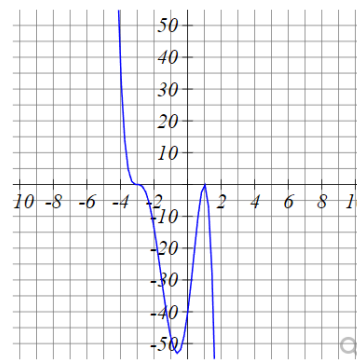
(a)



(b)



(c)



(d)

4A. (3 pts) For the functions $f(x) = \sqrt{6-3x}$ and $g(x) = 2x^2 - 3$, find $(f+g)(-1)$.

4A. 2

$$(f+g)(x) = \sqrt{6-3x} + 2x^2 - 3$$

$$(f+g)(-1) = \sqrt{6-3(-1)} + 2(-1)^2 - 3$$

$$(f+g)(-1) = \sqrt{9} + 2 - 3$$

$$(f+g)(-1) = 2$$

4B. (3 pts) For the functions $f(x) = \frac{30}{2+x^3}$ and $g(x) = 5-3x$, find $(f-g)(2)$.

4B. 4

$$(f-g)(x) = \frac{30}{2+x^3} - (5-3x)$$

$$(f-g)(2) = \frac{30}{2+2^3} - (5-3(2))$$

$$(f-g)(2) = \frac{30}{2+8} - (5-6)$$

$$(f-g)(2) = 3 - (-1) = 4$$

5A.) (3 pts) Let $f(x) = 3 - 2x^2$. Find the difference quotient.

5A. $-4x - 2h$

$$\text{Use } \frac{f(x+h) - f(x)}{h}.$$

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

$$f(x+h) = 3 - 2(x^2 + 2xh + h^2)$$

$$f(x+h) = 3 - 2x^2 - 4xh - 2h^2$$

$$\frac{3 - 2x^2 - 4xh - 2h^2 - (3 - 2x^2)}{h} = \frac{3 - 2x^2 - 4xh - 2h^2 - 3 + 2x^2}{h} = \frac{-4xh - 2h^2}{h} = \frac{h(-4x - 2h)}{h} = -4x - 2h$$

5B.) (3 pts) Let $f(x) = 3x^2 - \frac{x}{5}$. Find the difference quotient.

5B. $6x + 3h - \frac{1}{5}$

$$\text{Use } \frac{f(x+h) - f(x)}{h}.$$

$$f(x+h) = 3(x+h)^2 - \frac{x+h}{5}$$

$$f(x+h) = 3(x^2 + 2xh + h^2) - \frac{x+h}{5}$$

$$f(x+h) = 3x^2 + 6xh + 3h^2 - \frac{x}{5} - \frac{h}{5}$$

$$\frac{3x^2 + 6xh + 3h^2 - \frac{x}{5} - \frac{h}{5} - \left(3x^2 - \frac{x}{5}\right)}{h} = \frac{3x^2 + 6xh + 3h^2 - \frac{x}{5} - \frac{h}{5} - 3x^2 + \frac{x}{5}}{h} = \frac{6xh + 3h^2 - \frac{h}{5}}{h} = 6x + 3h - \frac{1}{5}$$

6A.) (3 pts) Given $f(x) = \begin{cases} x^2 & \text{if } x \leq 0 \\ -\sqrt{x} & \text{if } x > 0 \end{cases}$ find the following.

i.) $f(0) = 0^2 = 0$

We need to use the first equation since 0 is included here.

ii.) $f(9) = -\sqrt{9} = -3$

We are using the second equation since 9 is greater than 0.

iii.) $f(-4) = (-4)^2 = 16$

We are using the first equation since 16 is less than 0.

6B.) (3 pts) Given $f(x) = \begin{cases} |x| & \text{if } x < 0 \\ -4 & \text{if } 0 \leq x < 3 \\ -x-3 & \text{if } x \geq 3 \end{cases}$ find the following.

i.) $f(5) = -5 - 3 = -8$

We are using the third equation here since 5 is greater than 3.

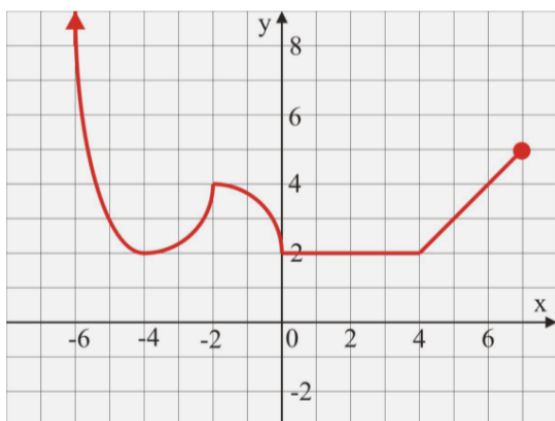
ii.) $f(0) = -4$

We are using the second equation here since 0 is included.

iii.) $f(-3) = |-3| = 3$

We are using the first equation here since -3 is less than 0.

7A.) (3 pts) Use the graph of $f(x)$ below to find the following.

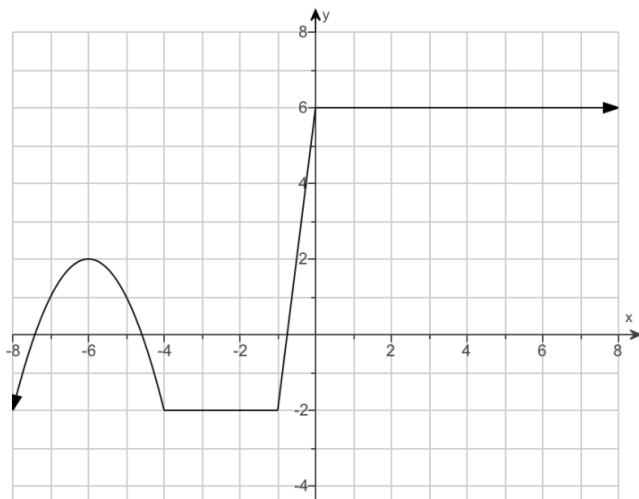


a.) interval(s) of increasing: $(-4, -2) \cup (4, 7)$

b.) interval(s) of decreasing: $(-\infty, -4) \cup (-2, 0)$

c.) interval(s) f is constant: $(0, 4)$

7B.) (3 pts) Use the graph of $f(x)$ below to find the following.



a.) interval(s) of increasing: $(-\infty, -6) \cup (-1, 0)$

b.) interval(s) of decreasing: $(-6, -4)$

c.) interval(s) f is constant: $(-4, -1) \cup (0, \infty)$

8A.) (3 pts) Graph $y = -2(x-1)^2(x+2)$ Find the following..

zero: **1** Multiplicity: **2** Crosses or touches? **Touches**

zero: **-2** Multiplicity: **1** Crosses or touches? **Crosses**

8B.) (3 pts) Graph $y = x^3(x-2)(x+2)$ Find the following..

zero: **0** Multiplicity: **3** Crosses or touches? **Crosses**

zero: **2** Multiplicity: **1** Crosses or touches? **Crosses**

zero: **-2** Multiplicity: **1** Crosses or touches? **Crosses**

9A.) (3 pts) The function $f(x) = 6x^3 - 5x^2 - 29x + 10$ has a zero at $x = -2$. Use synthetic division and factoring to find the other zeros.

$$\begin{array}{r|rrrr} -2 & 6 & -5 & -29 & 10 \\ & & -12 & 34 & -10 \\ \hline & 6 & -17 & 5 & 0 \end{array}$$

$$\begin{aligned} 6x^2 - 17x + 5 &= 0 \\ (2x - 5)(3x - 1) &= 0 \end{aligned}$$

$$x = \frac{5}{2}, \frac{1}{3}$$

9A. $x = \frac{5}{2}, \frac{1}{3}$

9B.) (3 pts) The function $f(x) = 27x^3 - 54x^2 + 27x - 4$ has a zero at $x = \frac{4}{3}$. Use synthetic division and factoring to find the other zeros.

$$\begin{array}{r|rrrr} \frac{4}{3} & 27 & -54 & 27 & -4 \\ & & 36 & -24 & 4 \\ \hline & 27 & -18 & 3 & 0 \end{array}$$

$$\begin{aligned} 27x^2 - 18x + 3 &= 0 \\ 3(9x^2 - 6x + 1) &= 0 \\ 3(3x - 1)(3x - 1) &= 0 \end{aligned}$$

$$x = \frac{1}{3}$$

9B. $x = \frac{1}{3}$

10A.) (3 pts) Solve the system: $\begin{matrix} 2x - 3y = -8 \\ 4x + 5y = 6 \end{matrix}$. Write your answer 10A. $(-1, 2)$
as coordinates.

These kinds of problems can be solved using either the elimination or substitution method. Here, it will be easier to use the elimination method since we do not see a single x or y term. So we can choose to eliminate either the x or y. If we eliminate x, then we only need to multiply one equation, but if we choose to eliminate the y, then we need to multiply both equations. Therefore, we will choose to eliminate the x terms. To do this, we will multiply the first equation by -2 :

$$\begin{matrix} -2(2x - 3y = -8) & = & -4x + 6y = 16 \\ 4x + 5y = 6 & & 4x + 5y = 6 \end{matrix}$$

Now we will add the equations together.

$$\begin{matrix} 11y = 22 \\ y = 2 \end{matrix}$$

Now we will plug this into the first equation to solve for x.

$$\begin{matrix} 2x - 3(2) = -8 \\ 2x - 6 = -8 \\ 2x = -2 \\ x = -1 \end{matrix}$$

Our answer is the point $(-1, 2)$.

10B.) (3 pts) Solve the system: $\begin{matrix} 4x - 3y = 5 \\ 6x + 2y = 1 \end{matrix}$. Write your answer 10B. $\left(\frac{1}{2}, -1\right)$
as coordinates.

Here, it will be easier to use the elimination method since we do not see a single x or y term. So we can choose to eliminate either the x or y. If we eliminate x or y, then we need to multiply both equations. Therefore, it does not matter which variable we choose to eliminate. Let's eliminate the y. To do this, we will multiply the first equation by 2 and the second equation by 3:

$$\begin{matrix} 2(4x + 3y = 5) & = & 8x + 6y = 10 \\ 3(6x - 2y = 1) & = & 18x - 6y = 3 \end{matrix}$$

Now we will add the equations together.

$$\begin{matrix} 26x = 13 \\ x = \frac{1}{2} \end{matrix}$$

Now we will plug this into the first equation to solve for y.

$$\begin{matrix} 8\left(\frac{1}{2}\right) + 6y = 10 \\ 4 + 6y = 10 \\ 6y = -6 \\ y = -1 \end{matrix}$$

Our answer is the point $\left(\frac{1}{2}, -1\right)$.

11A.) (3 pts) Given $f(x) = \frac{2x-7}{x^3+16x}$ and $g(x) = \frac{\sqrt{3x-4}}{45}$, find the following:

i.) Domain of $f(x)$ in interval notation

i. $(-\infty, 0) \cup (0, \infty)$

$$f(x) = \frac{2x-7}{x(x^2+16)} \quad x(x^2+16) = 0 \Rightarrow x = 0 \text{ or } x^2+16 = 0.$$

Since x^2+16 can never be 0, the answer is all real numbers except 0.

ii.) Domain of $g(x)$ in interval notation

ii. $\left[\frac{4}{3}, \infty\right)$

$$3x - 4 \geq 0$$

$$3x \geq 4$$

$$x \geq \frac{4}{3}$$

$\left[\frac{4}{3}, \infty\right)$ We do include $\frac{4}{3}$ since it does not make the bottom zero.

11B.) (3 pts) Given $f(x) = \frac{x-4}{x^2-9}$ and $g(x) = \frac{8x-3}{\sqrt{11-5x}}$, find the following:

i.) Domain of $f(x)$ in interval notation

i. $(-\infty, -3) \cup (-3, 3) \cup (3, \infty)$

$$x^2 - 9 \neq 0 \Rightarrow x \neq 3 \text{ and } x \neq -3$$

The domain is all real numbers not including 3 and -3.

ii.) Domain of $g(x)$ in interval notation

ii. $\left(-\infty, \frac{11}{5}\right)$

$$11 - 5x > 0$$

$$-5x > -11$$

$$x < \frac{11}{5}$$

$\left(-\infty, \frac{11}{5}\right)$ We do not include $\frac{11}{5}$ since it makes the bottom zero.

12A. (4 pts) Use the function: $f(x) = \frac{1-x}{x^2-9}$

i.) Find the intercepts.

x-int: (1, 0)

x-int: top=0 y-int: $y=0$

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

y-int: $\left(0, -\frac{1}{9}\right)$

$$x=1$$

ii.) Find the asymptotes.

Vertical: $x=3, x=-3$

V.A.: Set bottom = 0

H.A. (Rules)

$$x^2 - 9 = 0$$

$$n < m \text{ so } y = 0$$

Horizontal: $y = 0$

$$x^2 = 9$$

$$x = \pm 3$$

iii.) Does f cross the horizontal asymptote? (Yes or No)

iii. Yes

iv.) Find the domain:

iv. $(-\infty, -3) \cup (-3, 3) \cup (3, \infty)$

v.) Find the range:

v. $(-\infty, \infty)$

12B. (4 pts) Use the function: $f(x) = \frac{x+1}{4-x}$

i.) Find the intercepts.

x-int: (-1, 0)

x-int: top=0 y-int: $y=0$

$$x+1=0 \quad y = \frac{0+1}{4-0} = \frac{1}{4}$$

y-int: $\left(0, \frac{1}{4}\right)$

$$x = -1$$

ii.) Find the asymptotes.

Vertical: $x = 4$

V.A.: Set bottom = 0

H.A. (Rules)

$$4-x=0$$

$$n = m \text{ so } y = \frac{a_n}{b_m} = \frac{1}{-1} = -1$$

Horizontal: $y = -1$

$$x = 4$$

iii.) Does f cross the horizontal asymptote? (Yes or No)

iii. No

iv.) Find the domain:

iv. $(-\infty, 4) \cup (4, \infty)$

v.) Find the range:

v. $(-\infty, -1) \cup (-1, \infty)$

Since the graph does not cross the horizontal asymptote, it never uses the y -value of -1 . Therefore, it is not included in the range.

13A.) (4 pts) For the polynomial $y = -5(x-5)^2(x+2)^3(x+1)$:

i.) Find the leading term (a power function): $y = -5x^6$

ii.) Find the degree: 6

iii.) Choose the correct statement below:

A. As $x \rightarrow -\infty$, $y \rightarrow \infty$. As $x \rightarrow \infty$, $y \rightarrow \infty$.

B. As $x \rightarrow -\infty$, $y \rightarrow -\infty$. As $x \rightarrow \infty$, $y \rightarrow -\infty$.

C. As $x \rightarrow -\infty$, $y \rightarrow \infty$. As $x \rightarrow \infty$, $y \rightarrow -\infty$.

D. As $x \rightarrow -\infty$, $y \rightarrow -\infty$. As $x \rightarrow \infty$, $y \rightarrow \infty$.

iv.) Find the y -intercept of the graph of f (as an ordered pair): $(0, -1000)$

y -int: $x = 0$

$$y = -5(0-5)^2(0+2)^3(0+1)$$

$$y = -5(-5)^2(2)^3(1)$$

$$y = -5(25)(8)(1)$$

$$y = -1000$$

13B.) (4 pts) For the polynomial $y = 4x(x-5)^6$:

i.) Find the leading term (a power function): $y = 4x^7$

ii.) Find the degree: 7

iii.) Choose the correct statement below:

A. As $x \rightarrow -\infty$, $y \rightarrow \infty$. As $x \rightarrow \infty$, $y \rightarrow \infty$.

B. As $x \rightarrow -\infty$, $y \rightarrow -\infty$. As $x \rightarrow \infty$, $y \rightarrow -\infty$.

C. As $x \rightarrow -\infty$, $y \rightarrow \infty$. As $x \rightarrow \infty$, $y \rightarrow -\infty$.

D. As $x \rightarrow -\infty$, $y \rightarrow -\infty$. As $x \rightarrow \infty$, $y \rightarrow \infty$.

iv.) Find the y-intercept of the graph of f (as an ordered pair): $(0, 0)$

$$y\text{-int: } x = 0$$

$$y = 4(0)(0-5)^6$$

$$y = 0$$

14A.) (3 pts) Find the equation of a line (in slope-intercept form) that passes

14A. $y = \frac{2}{3}x - 5$

through $\left(\frac{3}{2}, -4\right)$ and $(-3, -7)$.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-7 - (-4)}{-3 - \frac{3}{2}} = \frac{-3}{-\frac{9}{2}} = 3 \cdot \frac{2}{9} = \frac{2}{3}$$

$$y - y_1 = m(x - x_1) \Rightarrow y - (-7) = \frac{2}{3}(x - (-3)) \Rightarrow y + 7 = \frac{2}{3}(x + 3) \Rightarrow y + 7 = \frac{2}{3}x + 2 \Rightarrow y = \frac{2}{3}x - 5$$

14B.) (3 pts) Find the equation of a line (in slope-intercept form) that is

14B. $y = -\frac{3}{2}x + 2$

perpendicular to $2x - 3y = 4$ and passes through $(-2, 5)$.

$$2x - 3y = 4$$

$$-3y = -2x + 4$$

$$y = \frac{2}{3}x - \frac{4}{3}$$

Slope perpendicular is $-\frac{3}{2}$

$$y - y_1 = m(x - x_1)$$

$$y - 5 = -\frac{3}{2}(x + 2)$$

$$y - 5 = -\frac{3}{2}x - 3$$

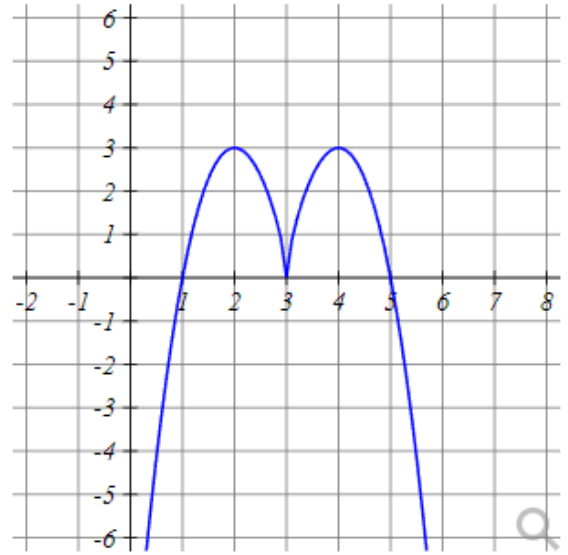
$$y = -\frac{3}{2}x + 2$$

15A.) (3 pts) Given the graph of f (to the right), find the following:

i.) $f(4) = 2$

ii.) the solution(s) to $f(x) = 0$: $x = 1, 3, 5$

iii.) the coordinate(s) of the relative maximum: $(2, 3), (4, 3)$

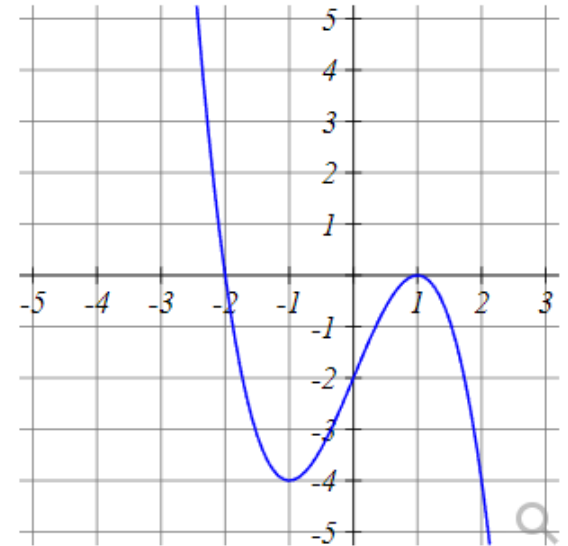


15B.) (3 pts) Given the graph of f (to the right), find the following:

i.) $f(2) = -4$

ii.) the solution(s) to $f(x) = 0$: $x = -2, 1$

iii.) the coordinate(s) of the relative minimum: $(-1, -4)$



More on next page...

16A.) (4 pts) Use the graph to answer the following.

i.) The graph has: (choose) **max**

Find the max (y-value): 4

ii.) x-intercept(s): $(-2,0), (6,0)$

iii.) y-intercept: $(0,3)$

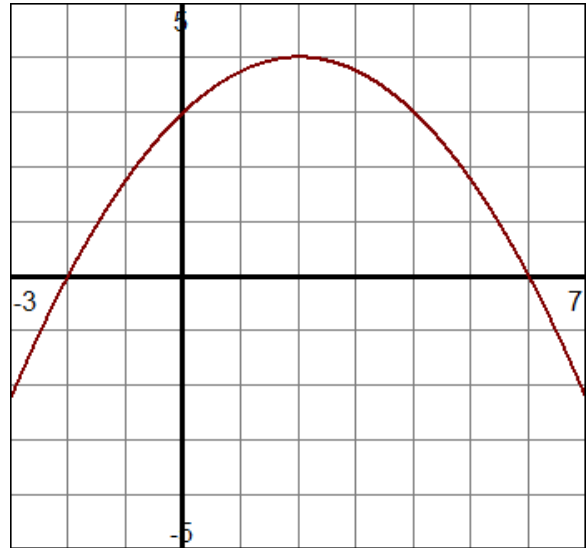
iv.) vertex: $(2,4)$

v.) axis of symmetry: $x = 2$

vi.) domain: $(-\infty, \infty)$

vii.) range: $(-\infty, 4]$

viii.) Write the function's equation in the form $f(x) = a(x-h)^2 + k$



We found the vertex, which means $h = 2$ and $k = 4$. We can plug this into the given formula:

$y = a(x-2)^2 + 4$. Now we need to find the a value. We need to plug in a point on the curve and solve for a . We can use the y-intercept, $(0, 3)$. Put in a 0 for x and a 3 for y :

$$3 = a(0-2)^2 + 4$$

$$3 = 4a + 4$$

$$-1 = 4a$$

$$a = -\frac{1}{4}. \text{ Therefore, our equation is } f(x) = -\frac{1}{4}(x-2)^2 + 4$$

16B.) (4pts) Use the graph to answer the following.

i.) The graph has: (choose) **min**.

Find the min (y-value): -3

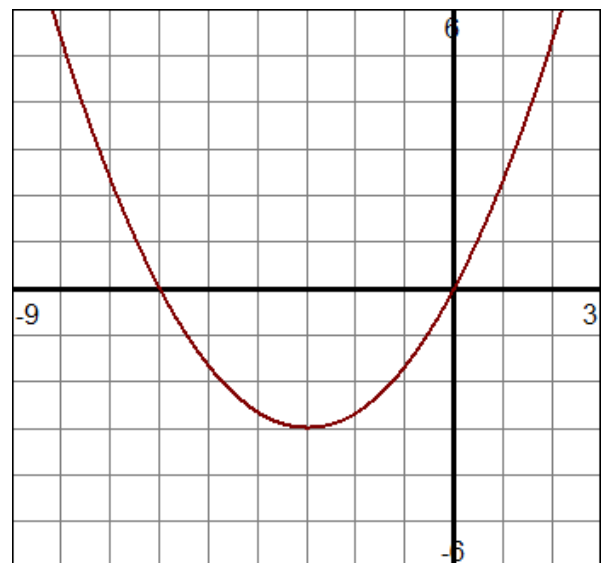
ii.) x-intercept(s): $(-6,0), (0,0)$

iii.) y-intercept: $(0,0)$

iv.) vertex: $(-3,-3)$

v.) axis of symmetry: $x = -3$

vi.) domain: $(-\infty, \infty)$



vii.) range: $[-3, \infty)$

viii.) Write the function's equation in the form $f(x) = a(x-h)^2 + k$

We found the vertex, which means $h = -3$ and $k = -3$. We can plug this into the given formula: $y = a(x+3)^2 - 3$. Now we need to find the a value. We need to plug in a point on the curve and solve for a . We can use the y-intercept, $(0, 0)$. Put in a 0 for x and a 0 for y :

$$0 = a(0+3)^2 - 3$$

$$0 = 9a - 3$$

$$3 = 9a$$

$$a = \frac{1}{3}. \text{ Therefore, our equation is } f(x) = \frac{1}{3}(x+3)^2 - 3$$

17A.) (2 pts) Given $h(x) = \frac{2}{(7-9x)^3}$, find two functions $f(x)$ and $g(x)$

$$f(x) = \frac{2}{x^3}$$

such that $h(x) = f(g(x))$. NOTE: $g(x)$ cannot equal just x .

$$g(x) = 7 - 9x$$

To do this one, first find the inside function, which is always the g . The g is always the expression that is inside something else. It could be inside parenthesis, or inside a root. In this problem, $g(x) = 7 - 9x$. Now take the original equation and take out the $7 - 9x$ and replace it with x . You will get $f(x) = \frac{2}{x^3}$.

17B.) (2 pts) Given $h(x) = 9\sqrt{2-3x}$, find two functions $f(x)$ and $g(x)$

$$f(x) = 9\sqrt{x}$$

such that $h(x) = f(g(x))$. NOTE: $g(x)$ cannot equal just x .

$$g(x) = 2 - 3x$$

To do this one, first find the inside function, which is always the g . The g is always the expression that is inside something else. It could be inside parenthesis, or inside a root. In this problem, $g(x) = 2 - 3x$. Now take the original equation and take out the $2 - 3x$ and replace it with x . You will get $f(x) = 9\sqrt{x}$.

18A.) (1 pt) Use a calculator to evaluate each expression. Round your answers to four decimal places where appropriate. (No partial credit on this one.)

i.) $3^{1.2} \approx 3.7372$

ii.) $\ln\left(\frac{10}{3.5}\right) \approx 1.0498$

18B.) (1 pts) Use a calculator to evaluate each expression. Round your answers to four decimal places where appropriate. (No partial credit on this one.)

i.) $e^{0.03} \approx 1.0305$

ii.) $\log\left(\frac{3}{11}\right) \approx -0.5643$

19A.) (2 pts) Convert each to an exponential equation. (Do not solve for any unknowns.)

i.) $\ln(5x - 6) = 3$

This equation can be rewritten as $\log_e(5x - 6) = 3$.

i. $e^3 = 5x - 6$

ii.) $\ln(5x) = 4$

This equation can be rewritten as $\log_e(5x) = 4$

ii. $e^4 = 5x$

19B.) (2 pts) Convert each to an exponential equation. (Do not solve for any unknowns.)

i.) $\log(2 - 7x) = 6$

Remember a log with no base written is automatically base 10.

i. $10^6 = 2 - 7x$

ii.) $\log_{13}(60) = x$

ii. $13^x = 60$

20A.) (1 pt) Convert the equation $2^{-5} = \frac{1}{32}$ into a logarithmic equation.

20A. $\log_2\left(\frac{1}{32}\right) = -5$

20B.) (1 pt) Convert the equation $\left(\frac{1}{3}\right)^3 = \frac{1}{27}$ into a logarithmic equation.

20B. $\log_{\frac{1}{3}}\left(\frac{1}{27}\right) = 3$