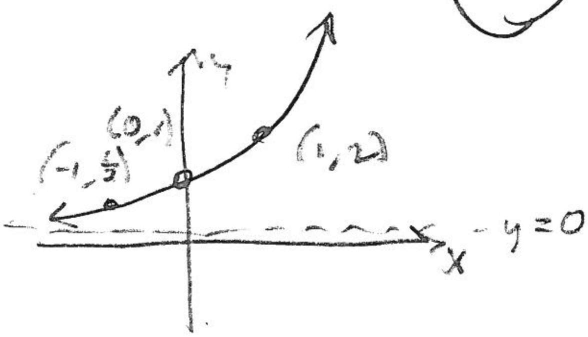
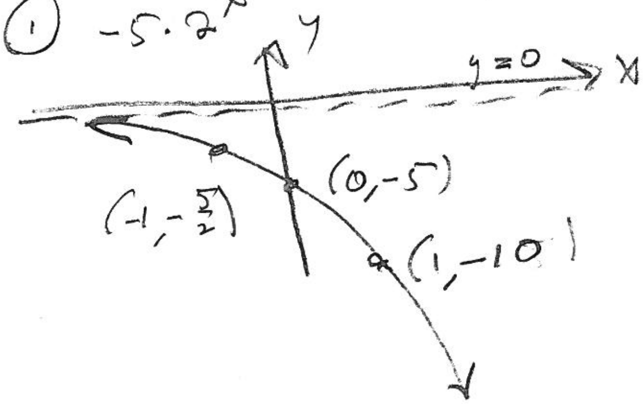
121 TEST 4 Spring, 2018 KEY

(1) 20pts

(0) $f(x)=2^x$

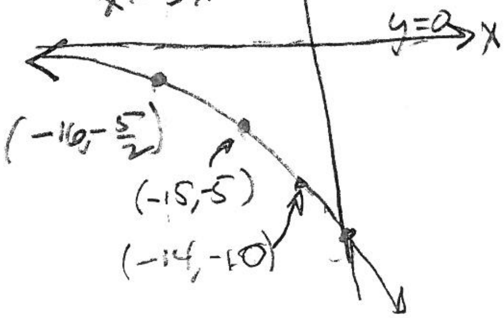



(1) $-5\cdot 2^x$

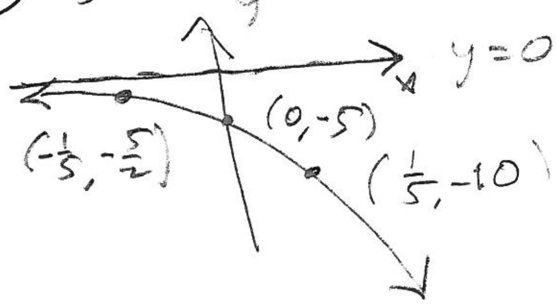



(2) (a) $-5\cdot 2^{x+15}$

$x \longmapsto x-15$



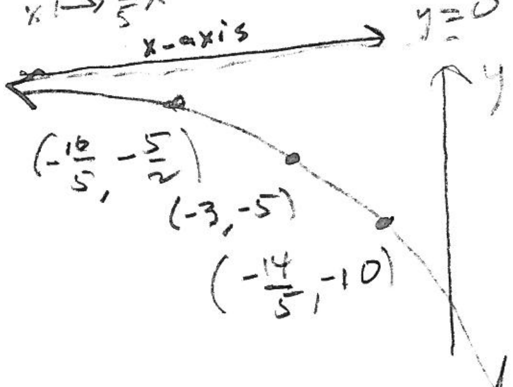

(2b) $-5\cdot 2^{5x}$ $x \longmapsto \frac{1}{5}x$




(3) $-5\cdot 2^{5x+15} = -5\cdot 2^{5(x+3)}$

$x \longmapsto \frac{1}{5}x$

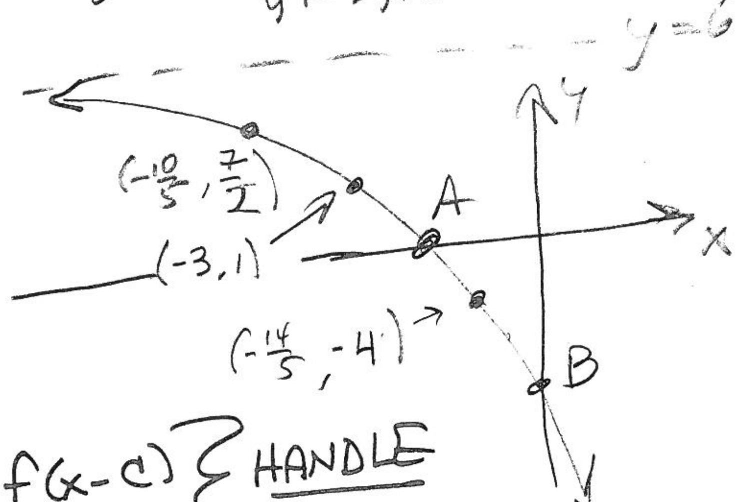
$x \longmapsto x-3$




$6-\frac{5}{2}=\frac{12-5}{2}$

$g(x)=-5\cdot 2^{5x+15}+6$

$y \longmapsto y+6$




$\left.\begin{array}{l} f(x-c) \\ f(bx) \end{array}\right\}$ HANDLE

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2 a x-int: $-5\cdot 2^{5x+15}+6=0$

$$-5\cdot 2^{5x+15}=-6$$

$$2^{5x+15}=\frac{6}{5}$$

$$5x+15=\log_2\left(\frac{6}{5}\right)$$

$$5x=\log_2\left(\frac{6}{5}\right)-15$$

$$x=\frac{\log_2\left(\frac{6}{5}\right)-15}{5}$$

$$\boxed{A=\left(\frac{\log_2\left(\frac{6}{5}\right)-15}{5},0\right)}\approx(-2.947393119,0)$$

5pts

b $g(0)=-5\cdot 2^{15}+6$

$$\boxed{B=(0,-5\cdot 2^{15}+6)}=(0,-163,834)$$

5pts

3 $-5\cdot 2^{5y+15}+6=x$

$$-5\cdot 2^{5y+15}=x-6$$

$$2^{5y+15}=\frac{x-6}{-5}$$

$$5y+15=\log_2\left(\frac{x-6}{-5}\right)$$

$$5y=\log_2\left(\frac{x-6}{-5}\right)-15$$

$$\boxed{y=\frac{1}{5}\left(\log_2\left(\frac{x-6}{-5}\right)-15\right)=g^{-1}(x)}$$

5pts

121 TEST 4

(4) $f(x) = \sqrt{x+16}$ , $g(x) = x^2 - 5x - 66$

(a) $\mathcal{D}(f)$: Need $x + 16 \geq 0$

$\longrightarrow x \geq -16$

$\longrightarrow \boxed{\mathcal{D}(f) = [-16, \infty)}$

5 pts

(b) $\mathcal{D}(g) = \mathbb{R}$ (Polynomial)

(c) $\left(\frac{f}{g}\right)(x) = \boxed{\frac{f(x)}{g(x)} = \frac{\sqrt{x+16}}{x^2-5x-66}}$

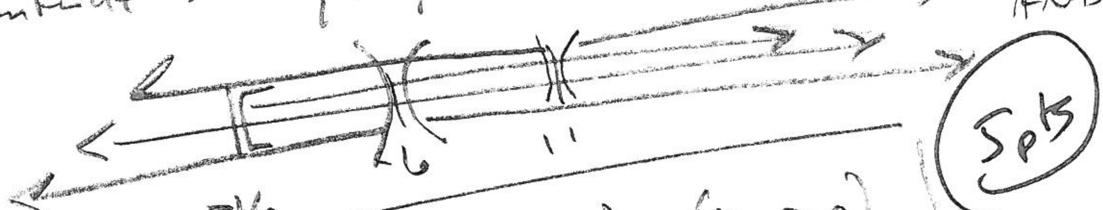
5 pts

(d) $\mathcal{D}\left(\frac{f}{g}\right) = \{x \mid x \in \mathcal{D}(f) \text{ and } x \in \mathcal{D}(g) \text{ and } g(x) \neq 0\}$

$= \{x \mid x \geq -16 \text{ and } x \in \mathbb{R} \text{ and } x^2 - 5x - 66 \neq 0\}$

Scratch: $x^2 - 5x - 66 = (x-11)(x+6) \overset{\text{SET}}{=} 0 \Longrightarrow x \in \{-6, 11\}$

Continue: $= \{x \mid x \geq -16 \text{ and } x \neq -6, 11\}$




$= [-16, -6) \cup (-6, 11) \cup (11, \infty)$

$\boxed{= [-16, -6) \cup (-6, 11) \cup (11, \infty)}$

5 pts

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4 e $(f \circ g)(x) = \boxed{f(g(x)) = \sqrt{x^2 - 5x - 66 + 16}}$

5pts

$= \sqrt{x^2 - 5x - 50}$

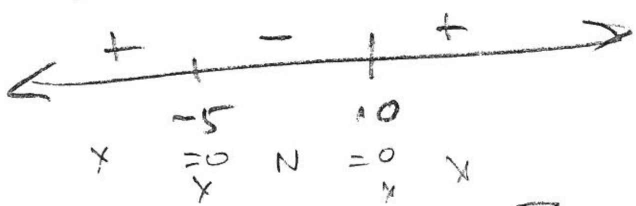
f $\mathcal{D}(f \circ g) = \{x \mid x \in \mathcal{D}(g) \text{ and } g(x) \in \mathcal{D}(f)\}$

$= \{x \mid x \in \mathbb{R} \text{ and } x^2 - 5x - 66 \geq -16\}$

Scratch: $x^2 - 5x - 66 \geq -16$

$x^2 - 5x - 50 \geq 0$

$(x - 10)(x + 5) \geq 0$




$= \{x \mid x \leq -5 \text{ OR } x \geq 10\}$

5pts

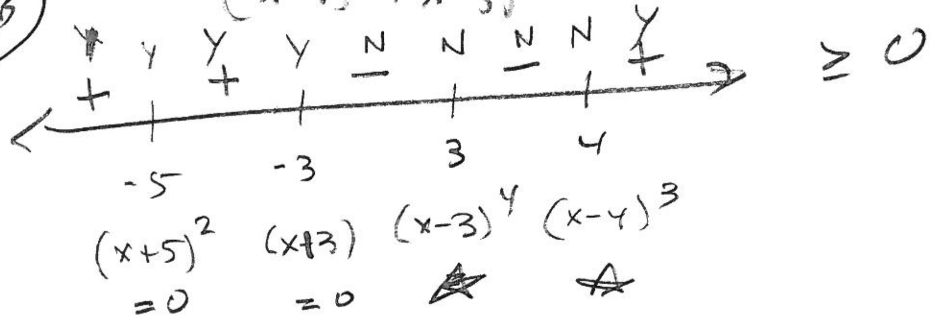
$= \boxed{(-\infty, -5] \cup [10, \infty) = \mathcal{D}(f \circ g)}$

121

TEST 4

(5) Need $\dfrac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4} \ge 0$

5pts

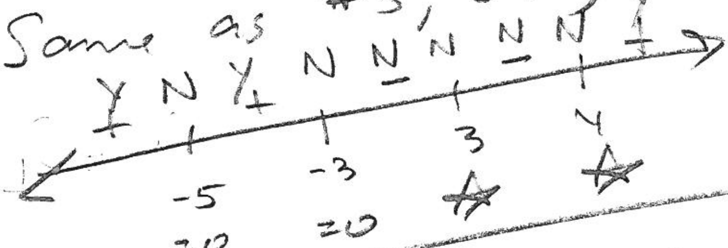



→ $D = (-\infty,-5] \cup [-5,-3] \cup (4,\infty)$

$= (-\infty,-3] \cup (4,\infty)$

5pts

(6) Same as #5, only "$>0$" →




5pts

→ $D = (-\infty,-5) \cup (-5,-3) \cup (4,\infty)$

M1 T4

7 $\ln(x-2) + \ln(x+5) = \ln(8)$

$\ln((x-2)(x+5)) = \ln(8)$

$x^2+3x-10 = 8$

$x^2+3x-18 = 0$

$(x+6)(x-3) = 0$

$x \in \{\cancel{-6}, 3\}$

$-6 \notin \mathcal{D}$. Check $x=3$:

$\ln(1)+\ln(8)=\ln(8)$ ✓

$\boxed{x \in \{3\}}$

10 pts

8 a) $\frac{1}{2}$-life is 4800 yrs

$\boxed{A(t) = A_0 e^{kt}}$

$A_0 e^{4800k} = \frac{1}{2} A_0$

$e^{4800k} = \frac{1}{2}$

$4800k = \ln(\frac{1}{2}) = -\ln(2)$

$\boxed{k = -\frac{\ln(2)}{4800}}$

10 pts

b) 10% remains

$A_0 e^{kt} = \frac{1}{10} A_0$

$e^{kt} = \frac{1}{10}$

$kt = \ln(\frac{1}{10}) = -\ln(10)$

$\boxed{t = \frac{-\ln(10)}{k}}$

$t = \frac{-\ln(10)}{-\frac{\ln(2)}{4800}}$

$= \frac{4800 \ln(10)}{\ln(2)}$

15945.25486

$\approx \boxed{15{,}945 \text{ yrs}}$

5 pts

121 T4

5pts each, except B1 which is 10pts

B1

$$|-5x+8|-11 > -2$$

$$|-5x+8| > 9$$

$$-5x+8 > 9 \quad \text{OR} \quad -5x+8 < -9$$

$$-5x > 1 \quad \text{OR} \quad -5x < -17$$

$$\left\{x \mid x < -\frac{1}{5} \quad \text{OR} \quad x > \frac{17}{5}\right\}$$

$$= \boxed{(-\infty, -\tfrac{1}{5}) \cup (\tfrac{17}{5}, \infty)}$$

Scratch

$$-57 - \frac{25}{28}$$

$$= \frac{-1596 - 25}{28} = \frac{-1621}{28}$$

B2

$$7x^2 - 5x - 57$$

$$= 7\left(x^2 - \frac{5}{7}x \qquad \right) - 57$$

$$= 7\left(x^2 - \frac{5}{7}x + \left(\frac{5}{14}\right)^2\right) - 57 - 7\left(\frac{25}{196}\right)$$

$$= \boxed{7\left(x - \frac{5}{14}\right)^2 - \frac{1621}{28}}$$

121 TY

B3 $4 \cdot 5^x = 6 \cdot 7^x$

$\ln 4 + \ln(5^x) = \ln 6 + \ln(7^x)$

$\ln 4 + (\ln 5)x = \ln 6 + (\ln 7)x$

$a + bx = c + dx$

$bx - cx = c - a$

$(b-d)x = c - a$

$x = \dfrac{c-a}{b-d} = \boxed{\dfrac{\ln 6 - \ln 4}{\ln 5 - \ln 7}} \approx -1.205047739$

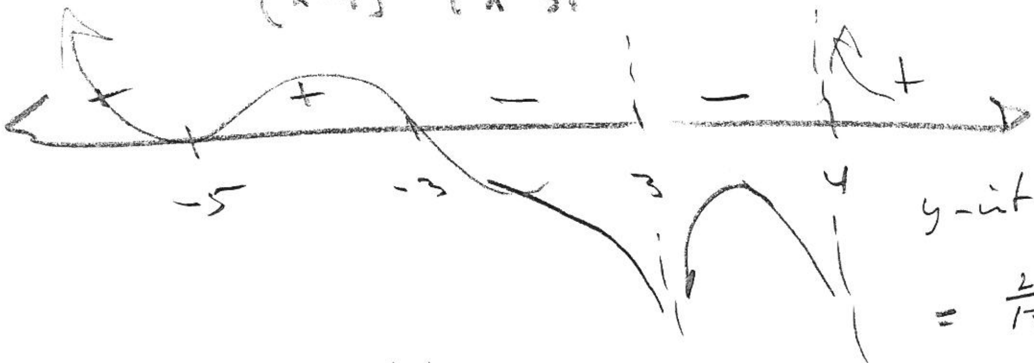
$\approx$ 4-place: $\boxed{-1.2050 \approx x}$ $\approx$ 7-place: $\boxed{\approx -1.2050477}$

121 T4

B3 $R(x) = \dfrac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}$

See #5

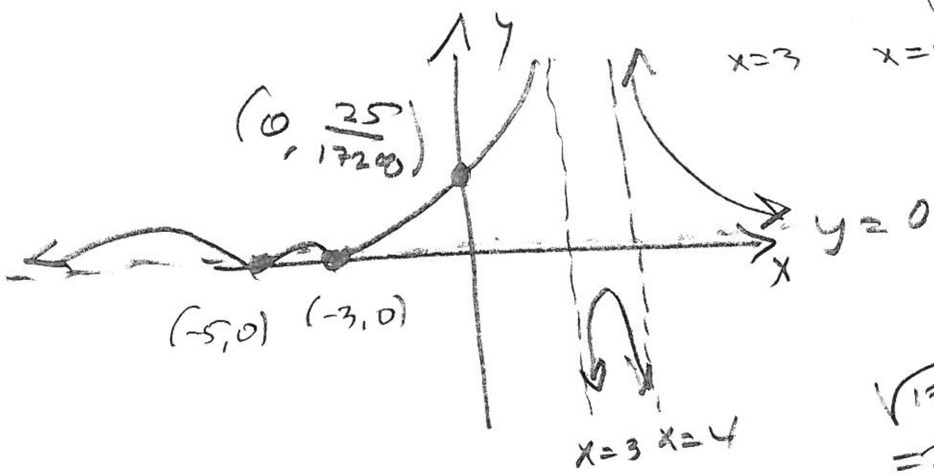
H.A. $y=0$ (Proper)




$y\text{-int} = \dfrac{5^2 \cdot 3}{-4^3 \cdot 3^4}$

$= \dfrac{25}{1728}$

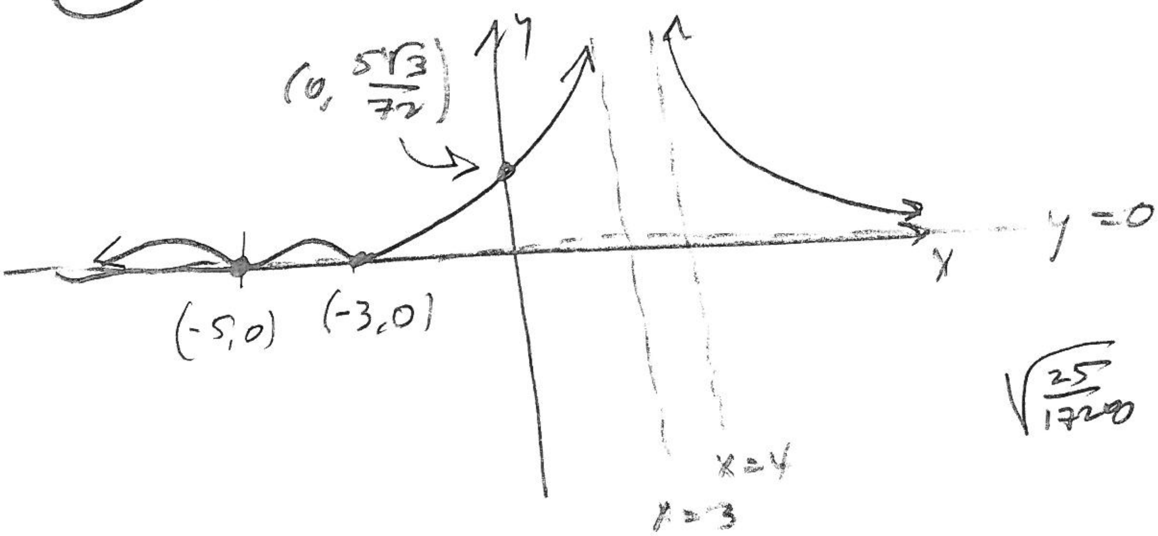
$x=3 \quad x=4 \quad \approx .01446\,75926$




$\sqrt{1728} = 24\sqrt{3}$

2 | 1728
2 | 864
2 | 432
2 | 216
2 | 108
2 | 54
3 | 27
3 | 9
3

B4 $\sqrt{R(x)} = Q(x)$




$\sqrt{\dfrac{25}{1728}} = \dfrac{5}{24\sqrt{3}} = \dfrac{5\sqrt{3}}{72}$

.121 T4

B6 $P_0 = 1000$, $K = .02$

START = 1992 (April 11th) $\Rightarrow \boxed{t_0 = 0}$

$t_1$ = Today 2018, 4/11

$t_1 = 2018 - 1992 = \boxed{26 = t_1}$

P = fish pop as function of t = time after 4/11/92

$P(t) = 1000e^{.02t}$

$P(26) = 1000e^{(.02)(26)} \approx 1682.02765$

$\approx \boxed{1682 \text{ fish}}$

B7 $1000e^{.02t} \overset{\text{SET}}{=} 10000$

$e^{.02t} = 10$

$.02t = \ln 10$

$t = \dfrac{\ln 10}{.02} \approx 115.1292546$ yrs,

corresponding to the year

$1992 + 115 = \boxed{2107}$, approximately

MAT 121-G11 Test 4 – Spring, 2018 Name Mattea Klein
100 Points Covers Chapter 4 NO GRAPHING CALCULATORS!!!

Leave a margin at the top left corner (Write MAT 121 in big letters). Write DARK. 10% off for insufficient margin that puts work underneath the staple. Put all scratch work WITH the problem as you work it. Often there are partial credit points that you will NOT earn by writing your scratch on a separate page and stapling it to the back. To me, that's trash. That's why I give as much paper as needed or wanted!

1. (20 pts) Starting with $f(x)=2^x$, sketch the graph of $g(x)=-5\cdot 2^{5x+15}+6$ in 5 steps (counting $f(x)=2^x$ as the first step). Use $x=-1, x=0$, and $x=1$ to find 3 points in the first graph, and show how these 3 points are moved around by each step in the transformation to $g(x)$. $\frac{115}{100}$ Sick

2. (10 pts) Find the *exact* $x$- and $y$-intercepts for $g(x)$ from #1. That means no decimal approximations.

   a. $x$-intercept: $A =$

   b. $y$-intercept: $B =$

Label your final graph for #1 with the intercepts labeled with $A$ and $B$.

3. (5 pts) Find the inverse, $g^{-1}(x)$, for $g(x)$ in #1. The moves are very similar to what you did in #2a.

4. Let $f(x)=\sqrt{x+16}$ and $g(x)=x^2-5x-66$.

   a. (5 pts) What is the domain of $f$ ?

   b. (5 pts) What is the domain of $g$ ?

   c. (5 pts) Determine $\left(\frac{f}{g}\right)(x)$. (Sometimes this is just called $\frac{f}{g}$ in the text.)

   d. (5 pts) What is the domain of $\left(\frac{f}{g}\right)(x)$?

   e. (5 pts) Determine $(f\circ g)(x)$ (Again, sometimes just called $f\circ g$ ).

   f. (5 pts) What is the domain of $f\circ g$?

5. (5 pts) What is the domain of $\sqrt{\frac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}}$ ?

6. (5 pts) What is the domain of $\log_{11}\left(\frac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}\right)$?

7. (10 pts) Solve $\ln(x-2)+\ln(x+5)=\ln(8)$. Give an exact solution, then round to 3 decimal places.

8. Suppose the half-life of C-14 is 4800 years. (It isn't, quite, but just suppose…).

   a. (10 pts) Derive the exponential decay model, $A(t)=A_0e^{kt}$. The trick is to use the half-life to find the relative decay rate, $k$.

   b. (5 pts) How old is a sample of charcoal from a prehistoric fire pit, if 90% of the C-14 has decayed (i.e., 10% is left.) ? Round to the nearest year in your final answer. If it makes it easier for you, use an initial mass of 100 g of radioactive C-14 and a final mass of 10 g of the radioactive material. It's the same thing.

**Bonus** Answer up to three (3) 5-pointers. That's a total of 15 bonus points possible. Points to be had. Standards are high.

**B 1** (10 pts) Solve the absolute value inequality: $|-5x+8|-11>-2$. Yes, that's 10 points. Exception to the 5-point rule, if you can nail it, you can earn up to 20 bonus points.

**B 2** (5 pts) Re-write $f(x)=7x^2-5x-57$ in the form $a(x-h)^2+k$.

**B 3** (5 pts) Solve the exponential equation $4\cdot 5^x=6\cdot 7^x$. Give an exact answer and a decimal answer, rounded to 4 decimal places. Then rounded to 7 decimal places.

**B 4** (5 pts) Sketch the graph of $R(x)=\dfrac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}$.

**B 5** (5 pts) Sketch the graph of $Q(x)=\sqrt{\dfrac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}}$

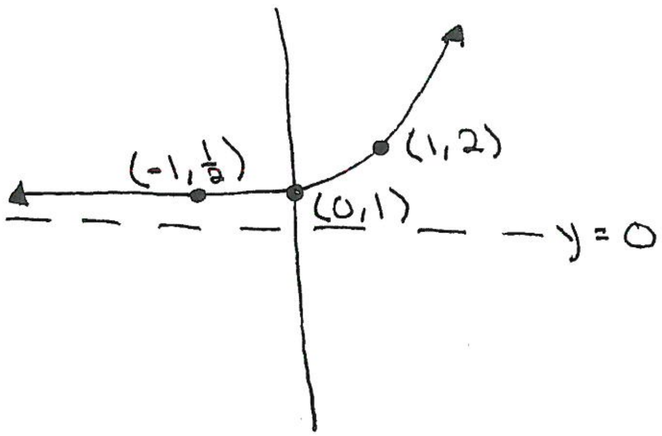
**B 6** (5 pts) The population of Kokanee salmon at Dworshak reservoir was 1,000 Kokanee, when they first introduced the species on this date 1992. It's quite a coincidence that you'd be taking your test on the anniversary Since then, the population has grown exponentially, with a relative growth rate of 2% every year. What is the Kokanee population in Dworshak Reservoir, today? Round your answer to the nearest fish.

**B 7** (5 pts) To the nearest year, when will (did) the population of Kokanee in the previous question reach 10,000?

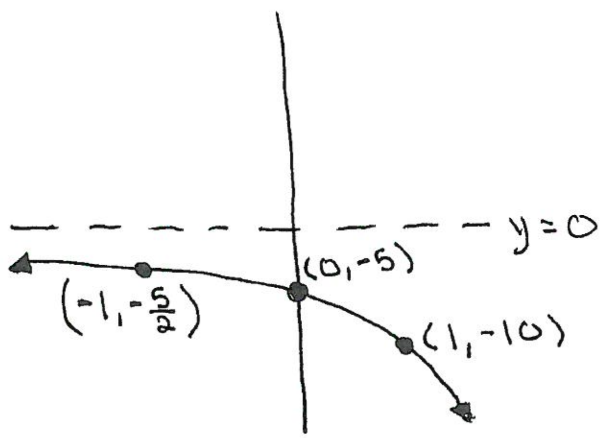
**B 8** (5 pts) Sketch the graph of $g(x)=-5\cdot\log_3(3x+9)+11$

Mat 121 Test 4 Spring, 2018

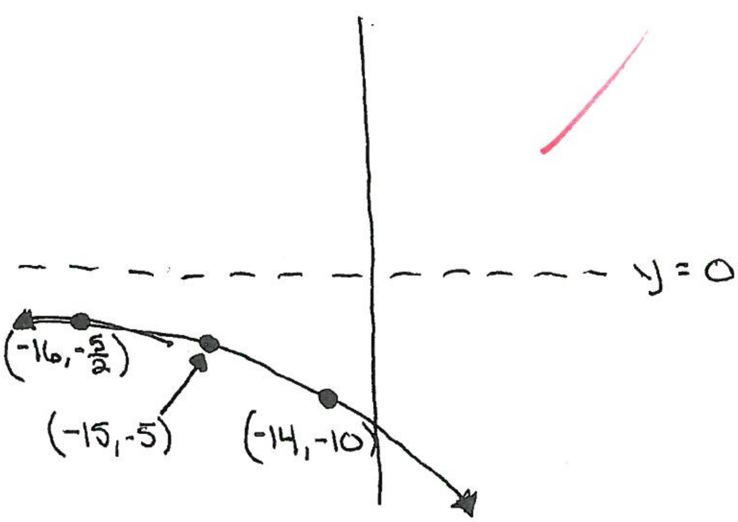
1) $f(x) = 2^x$




2) $f(x) = -5 \cdot 2^x$




3) $f(x) = -5 \cdot 2^{x+15}$

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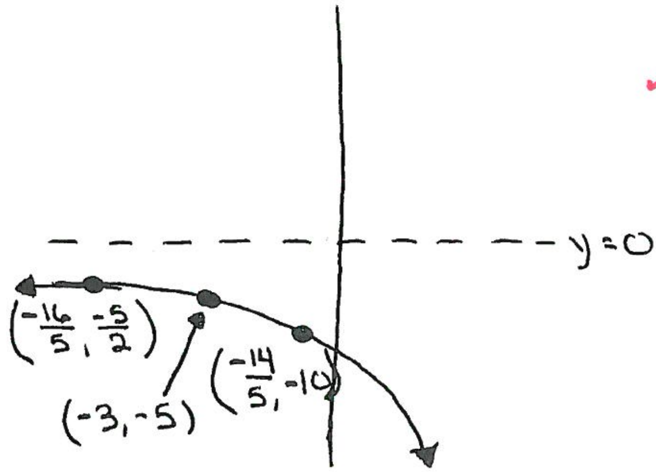
# Mat 121

4) $f(x) = -5 \cdot 2^{5x+15}$

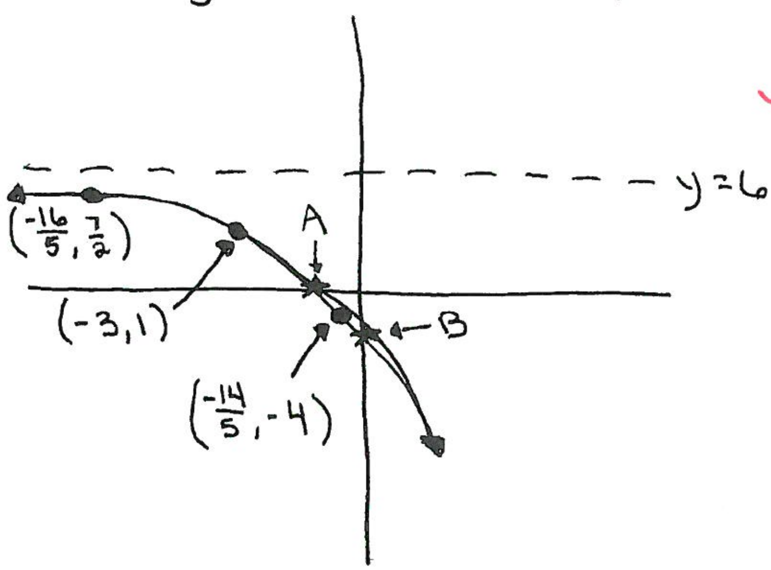
4




5) $g(x) = -5 \cdot 2^{5x+15} + 6$

$-\frac{5}{2} + \frac{12}{2} = \frac{7}{2}$

4




2 a) $g(x) = -5 \cdot 2^{5(x)+15} + 6$

$0 = -5 \cdot 2^{5x+15} + 6$

$-6 = -5 \cdot 2^{5x+15}$

$\frac{6}{5} = 2^{5x+15}$

5

$\log_2(\frac{6}{5}) = 5x+15$

$\boxed{\frac{\log_2(\frac{6}{5}) - 15}{5} = A}$ $\boxed{A = \left(\frac{\log_2(\frac{6}{5}) - 15}{5}, 0\right)}$

Mat 121

b) $y = -5 \cdot 2^{5(0)+15} + 6$

$y = -5 \cdot 2^{15} + 6$

$\boxed{B = (0, -5 \cdot 2^{15} + 6)}$

✓5

(3) $g(x) = -5 \cdot 2^{5x+15} + 6$

$x = -5 \cdot 2^{5y+15} + 6$

$x - 6 = -5 \cdot 2^{5y+15}$

$\frac{x-6}{-5} = 2^{5y+15}$

$\log_2\left(\frac{x-6}{-5}\right) = 5y + 15$

$\boxed{g^{-1}(x) = \frac{\log_2\left(\frac{x-6}{-5}\right) - 15}{5}}$

✓5

(4) $f(x) = \sqrt{x+16}$ $\quad g(x) = x^2 - 5x - 66$

a) $\sqrt{x+16} \geq 0$

$\boxed{D(f) = [-16, \infty)}$

✓5

b) $x^2 - 5x - 66$

$\boxed{D(g) = (-\infty, \infty)}$

✓5

c) $\boxed{\left(\frac{f}{g}\right)(x) = \frac{\sqrt{x+16}}{x^2 - 5x - 66}}$

✓5

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Mat 121

$x \geq -16$ and $x \neq -6$ and $x \neq 11$

d) $\dfrac{\sqrt{x+16}}{x^2-5y-66} \geq 0$ → No

$x^2 - 5x - 66 = (x-11)(x+6)$

$x \neq -6, 11$ Yes

3.5

$\boxed{D\left(\frac{f}{g}\right) = [-16,-6) \cup (11, \infty)}$ $\cup (-6, 11)$

5

e) $(f \circ g)(x) = \sqrt{g(x)+16}$

$(f \circ g)(x) = \sqrt{x^2-5x-66+16} = \boxed{\sqrt{x^2-5x-50}}$

f) $\sqrt{x^2-5x-50} \geq 0$ → Always true if $\sqrt{\ }$ exists. We're looking to find where $\sqrt{\ }$ exists.

4

$\sqrt{(x-10)(x+5)}$

$\cancel{x \neq} -5, 10$

Ambig.

$\boxed{D(f \circ g) = (-\infty, -5] \cup [10, \infty)}$

This requires $x^2 - 5x - 50 \geq 0$ which you didn't write ~~once~~. Duh. Just see here

⑤ $\sqrt{\dfrac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}}$

$\boxed{\dfrac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4} \geq 0}$ THIS. YES.

No — Doesn't change sign

$\boxed{D = [-5, -3] \cup (4, \infty)}$ OK

4

$(-\infty, -3]$

⑥ $\log_{11}\left(\dfrac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}\right)$ $\quad \dfrac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4} > 0$

No double jeopardy

5

$\boxed{D = (-5, -3) \cup (4, \infty)}$

Mat 121

7) $\ln(x-2)+\ln(x+5)=\ln(8)$

$\ln[(x-2)(x+5)] = \ln 8$

$(x-2)(x+5)=8$

$x^2+3x-10=8$

$x^2+3x-18=0$

$(x-3)(x+6)=0$

$x=\cancel{-6},3$

$\boxed{x=3}$

10

8) a) $A(t)=A_0e^{kt}$ $\frac{1}{2}$ life $=4800$

$\frac{1}{2}=e^{4800k}$

$\ln(\frac{1}{2})=4800k$ $\ln(\frac{1}{2}) = -\ln(2)$

$\boxed{\frac{-\ln(2)}{4800}=k}$ $\boxed{k=-0.000144406}$

10

b) $0.10=e^{(\frac{-\ln(2)}{4800})t}$

$\ln(0.10)=(\frac{-\ln(2)}{4800})t$

$\frac{\ln(0.10)}{(\frac{-\ln(2)}{4800})}=t$

$\boxed{t=15{,}945 \text{ years}}$

5

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# Mat 121

$$7x^2-5x-57$$
$$=7\left(x^2-\tfrac{5}{7}x+\left(\tfrac{5}{14}\right)^2\right)-57-7\left(\tfrac{25}{196}\right)$$
$$=7\left(x-\tfrac{5}{14}\right)^2-\tfrac{1621}{28}$$

$\frac{196}{7}=28$

**B1** $|-5x+8|-11>-2$

$|-5x+8|>9$

$-5x+8>9$ or $-5x+8<-9$

$-5x>1$ ✓ or $-5x<-17$ GOOD

$x<\frac{-1}{5}$ or $x>\frac{17}{5}$

10

$-\frac{1}{5}$ $\frac{17}{5}$

$$\boxed{(-\infty,-\tfrac{1}{5})\cup(\tfrac{17}{5},\infty)}$$

**B2** $f(x)=7x^2-5x-57$

$7x^2-5x-57=0$

$x^2-\frac{5}{7}x-\frac{57}{7}=0$

$\frac{57}{7}\cdot\frac{28}{28}+\frac{25}{196}=\frac{1596+25}{196}$

$=\frac{1621}{196}$

yes Lost

$x^2-\frac{5}{7}x+\left(-\frac{5}{14}\right)^2=\frac{57}{7}+\left(-\frac{5}{14}\right)^2=\frac{57}{7}+\frac{25}{196}=\frac{1596+25}{196}=\frac{399+25}{49}=\frac{57}{7}$

* ~~$7(x+\frac{5}{14})^2+1596$~~ $\boxed{7\left(x+\tfrac{5}{14}\right)^2+\tfrac{57}{7}}$ 3 New p

**B3** $\cancel{4}\cdot5^x=6\cdot7^x$

$\log(4)+x\log(5)=\log(6)+x\log(7)$

$A+B=C+D$

$A-C=D-B$

$\frac{A-C}{D-B}=0=\frac{\log(4)-\log(6)}{x\log(7)-x\log(5)}=\frac{\log(\frac{2}{3})}{x\log(\frac{7}{5})}$

$\left(x-\frac{5}{14}\right)^2=\frac{1621}{196}$

$\left(x-\frac{5}{14}\right)^2-\frac{1621}{196}=0$

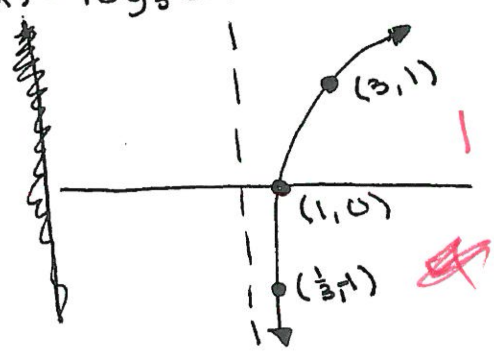
Retro-fit =

$7\left(x-\frac{5}{14}\right)^2-7\left(\frac{1621}{196}\right)$

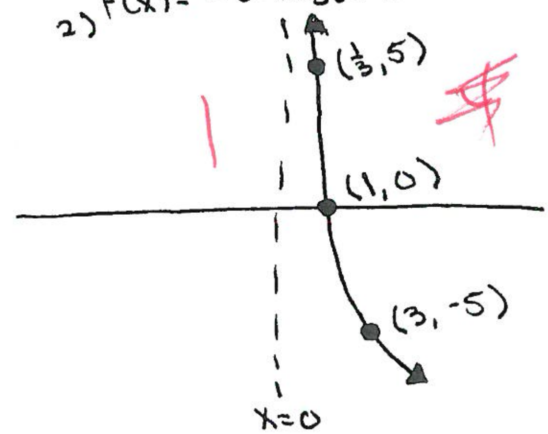
$=7\left(x-\frac{5}{14}\right)^2-\frac{1621}{28}$

Mat 121

**B8** 1) $f(x) = \log_3(x)$

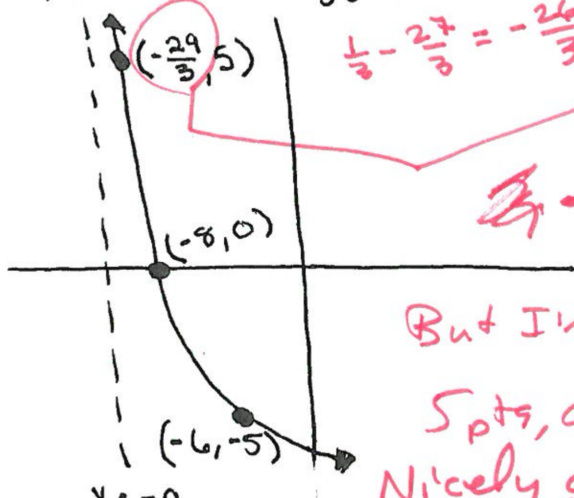



2) $f(x) = -5\cdot\log_3(x)$




3) $f(x) = -5\cdot\log_3(x+9)$

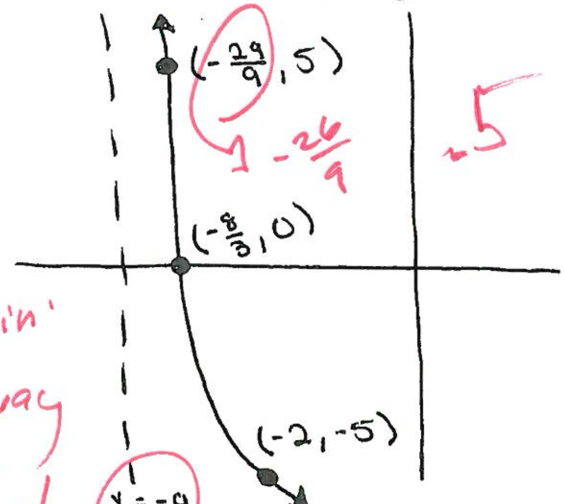
$\frac{1}{3}-9 = \frac{1}{3}-\frac{27}{3} = -\frac{26}{3}$




$\frac{1}{3}-\frac{27}{3} = -\frac{26}{3}$

.5

4) $f(x) = -5\cdot\log_3(3x+9)$



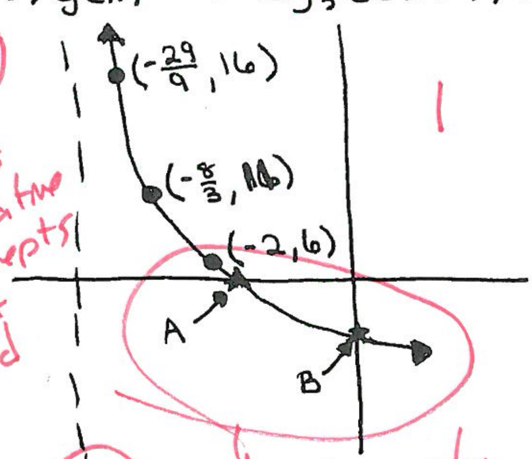

$-\frac{26}{9}$

.5

But I'm givin' 5 pts, anyway. Nicely done, and well played.

$x = -3$

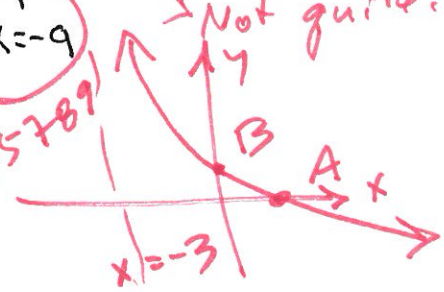
5) $g(x) = -5\cdot\log_3(3x+9)+11$




Positioning of x- & y-axes is off, relative to intercepts. You'd see it if you did calculations.

Not quite.

$\frac{3^{11/5}-9}{2}$




$\approx 1.105789$

a) $0 = -5\cdot\log_3(3x+9)+11$

$-11 = -5\cdot\log_3(3x+9)$

$\frac{11}{5} = \log_3(3x+9)$

$3^{\frac{11}{5}} = 3x+9$

$\frac{3^{\frac{11}{5}}-9}{3} = x = \boxed{\left(\frac{3^{\frac{11}{5}}-9}{3}, 0\right)}$ A

b) $g(x) = -5\cdot\log_3(3(0)+9)+11$

$y = -5\cdot\log_3(9)+11$

$\boxed{y = (0, -5\cdot\log_3(9)+11)}$

B $= (0, -5(2)+11)$

$= (0, 1)$ !

5

MAT 121-G11 Test 4 – Spring, 2018 Name Madison LaBorde

100 Points Covers Chapter 4 NO GRAPHING CALCULATORS!!!

Leave a margin at the top left corner (Write MAT 121 in big letters). Write DARK. 10% off for insufficient margin that puts work underneath the staple. Put all scratch work WITH the problem as you work it. Often there are partial credit points that you will NOT earn by writing your scratch on a separate page and stapling it to the back. To me, that's trash. That's why I give as much paper as needed or wanted!

1. (20 pts) Starting with $f(x)=2^x$, sketch the graph of $g(x)=-5\cdot 2^{5x+15}+6$ in 5 steps (counting $f(x)=2^x$ as the first step). Use $x=-1, x=0$, and $x=1$ to find 3 points in the first graph, and show how these 3 points are moved around by each step in the transformation to $g(x)$.

$\frac{58}{100}$

2. (10 pts) Find the *exact* $x$- and $y$-intercepts for $g(x)$ from #1. That means no decimal approximations.

   a. $x$-intercept: $A=$

   b. $y$-intercept: $B=$

Label your final graph for #1 with the intercepts labeled with $A$ and $B$.

3. (5 pts) Find the inverse, $g^{-1}(x)$, for $g(x)$ in #1. The moves are very similar to what you did in #2a.

4. Let $f(x)=\sqrt{x+16}$ and $g(x)=x^2-5x-66$.

   a. (5 pts) What is the domain of $f$ ?

   b. (5 pts) What is the domain of $g$ ?

   c. (5 pts) Determine $\left(\frac{f}{g}\right)(x)$. (Sometimes this is just called $\frac{f}{g}$ in the text.)

   d. (5 pts) What is the domain of $\left(\frac{f}{g}\right)(x)$?

   e. (5 pts) Determine $(f\circ g)(x)$ (Again, sometimes just called $f\circ g$ ).

   f. (5 pts) What is the domain of $f\circ g$?

5. (5 pts) What is the domain of $\sqrt{\frac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}}$ ?

6. (5 pts) What is the domain of $\log_{11}\left(\frac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}\right)$?

7. (10 pts) Solve $\ln(x-2)+\ln(x+5)=\ln(8)$. Give an exact solution, then round to 3 decimal places.

8. Suppose the half-life of C-14 is 4800 years. (It isn't, quite, but just suppose…).

   a. (10 pts) Derive the exponential decay model, $A(t)=A_0e^{kt}$. The trick is to use the half-life to find the relative decay rate, *k*.

   b. (5 pts) How old is a sample of charcoal from a prehistoric fire pit, if 90% of the C-14 has decayed (i.e., 10% is left.) ? Round to the nearest year in your final answer. If it makes it easier for you, use an initial mass of 100 g of radioactive C-14 and a final mass of 10 g of the radioactive material. It's the same thing.

**Bonus** Answer up to three (3) 5-pointers. That's a total of 15 bonus points possible. Points to be had. Standards are high.

**B 1** (10 pts) Solve the absolute value inequality: $|-5x+8|-11>-2$. Yes, that's 10 points. Exception to the 5-point rule, if you can nail it, you can earn up to 20 bonus points.

**B 2** (5 pts) Re-write $f(x)=7x^2-5x-57$ in the form $a(x-h)^2+k$.

**B 3** (5 pts) Solve the exponential equation $4\cdot 5^x=6\cdot 7^x$. Give an exact answer and a decimal answer, rounded to 4 decimal places. Then rounded to 7 decimal places.

**B 4** (5 pts) Sketch the graph of $R(x)=\dfrac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}$.

**B 5** (5 pts) Sketch the graph of $Q(x)=\sqrt{\dfrac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}}$

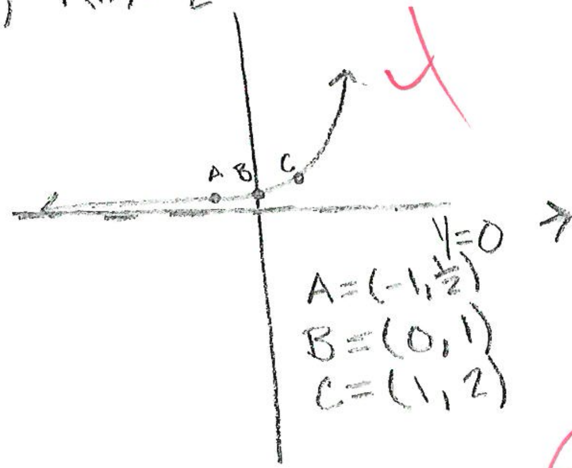
**B 6** (5 pts) The population of Kokanee salmon at Dworshak reservoir was 1,000 Kokanee, when they first introduced the species on this date 1992. It's quite a coincidence that you'd be taking your test on the anniversary Since then, the population has grown exponentially, with a relative growth rate of 2% every year. What is the Kokanee population in Dworshak Reservoir, today? Round your answer to the nearest fish.

**B 7** (5 pts) To the nearest year, when will (did) the population of Kokanee in the previous question reach 10,000?

**B 8** (5 pts) Sketch the graph of $g(x)=-5\cdot\log_3(3x+9)+11$

① $g(x) = -5 \cdot 2^{5x+15} + 6$

1) $f(x) = 2^x$




$A = (-1, \frac{1}{2})$
$B = (0, 1)$
$C = (1, 2)$

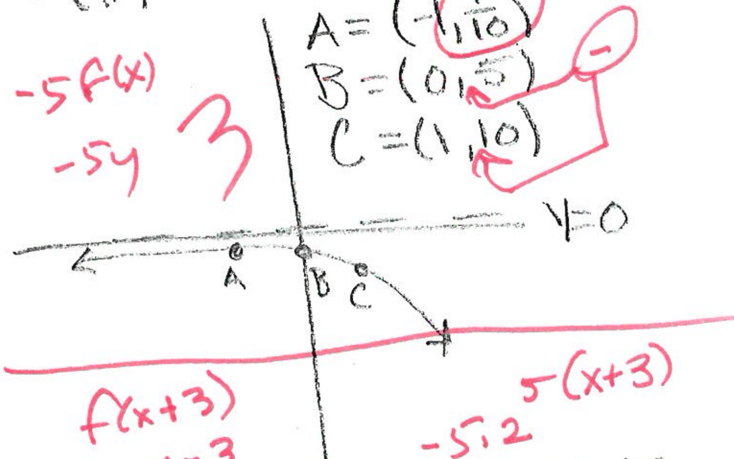
4

2) $-5 f(x) = -5 \cdot 2^x$

$-5f(x)$
$-5y$

3

$A = (-1, \frac{1}{10})$ $\frac{5}{2}$
$B = (0, 5)$ −
$C = (1, 10)$




$f(x+3)$
$x-3$

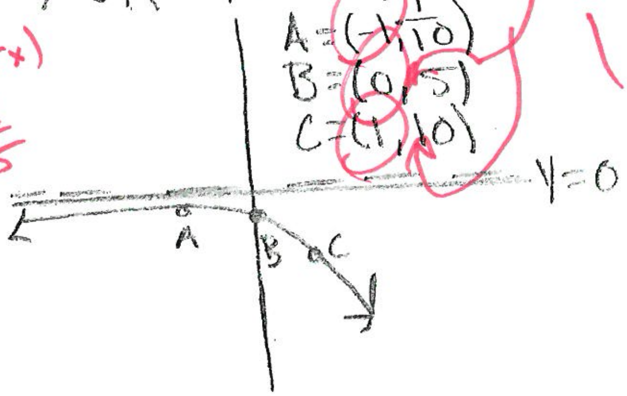
$-5 \cdot 2^{5(x+3)}$

3) $-5 \cdot f(5x) = -5 \cdot 2^{5x}$ −

$f(5x)$
$\frac{x}{5}$

$A = (-1, \frac{1}{10})$
$B = (0, 5)$
$C = (1, 10)$

1

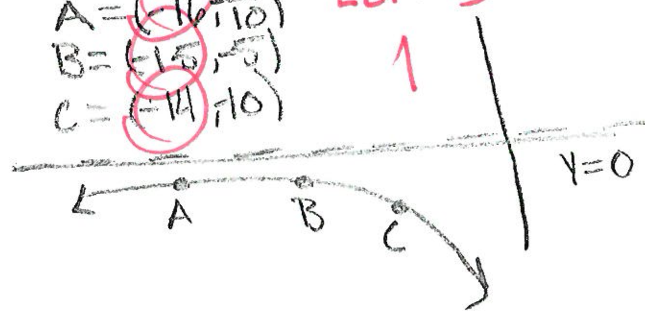



4) $-5 \cdot f(5x+15) = -5 \cdot 2^{5x+15}$

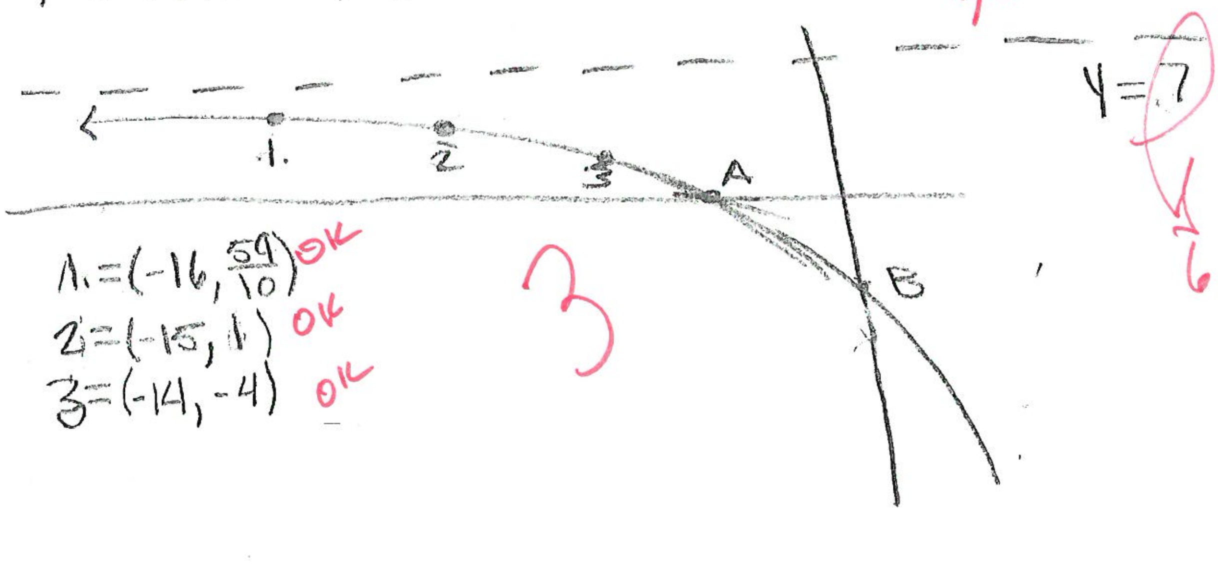
$A = (-16, \frac{1}{10})$
$B = (-15, 5)$
$C = (-14, 10)$

LEFT 3

1




5) $-5 \cdot f(5x+15) + 6 = -5 \cdot 2^{5x+15} + 6$ $f(x)+6$
$y+6$




$1. = (-16, \frac{59}{10})$ OK
$2 = (-15, 1)$ OK
$3 = (-14, -4)$ OK

3

Mat 121



2 x- and y- intercepts

a. $G(x) = -5 \cdot 2^{5x+15} + 6$

$-5 \cdot 2^{5x+15} + 6 = 0$

$-5 \cdot 2^{5x+15} = -6$

$2^{5x+15} = \frac{6}{5}$

GOOD START

2

B. y-intercept

$\boxed{(0, -5 \cdot 2^{15} + 6)}$

5

7

Mat 121

(4) $f(x)=\sqrt{x+16}$, $g(x)=x^2-5x-66$

a) $D = f(x)=\sqrt{x+16}$

$x \geq -16$ $\geq$

$\boxed{D: [-16,\infty)}$

4.7

$x+16 \geq 0$

$x \geq -16$

b) $D = g(x) = x^2-5x-66$

$(x-11)(x+6)$

$\boxed{D: \mathbb{R} = (-\infty,\infty)}$

Show logical sequence of moves for others to see.

c) $\left(\frac{f}{g}\right)(x)$

$$\boxed{\frac{\sqrt{x+16}}{x^2-5x+66}}$$

d) domain of $\left(\frac{f}{g}\right)(x)$

$$\frac{\sqrt{x+16}}{x^2-5x+66}$$

use this

Need $x \geq -16$ $\mathcal{D}(f)$

$x \in \mathbb{R}$ $\mathcal{D}(g)$

$g(x) \neq 0$ Division by zero

1

$\boxed{(-\infty,-16] \cup [-16,6) \cup (11,\infty) : D}$

$[-16,-6) \cup (-6,11) \cup (11,\infty)$

$\geq -16$ & $\neq -6, 11$

4

E) $(f \circ g)(x)$

$\sqrt{g(x)+16} \rightarrow \sqrt{x^2-5x-66+16} \rightarrow$ =

$\boxed{\sqrt{x^2-5x-50}}$

20

MAT 121

f) domain $f \circ g$

$\sqrt{x^2-5x-50}$

$\Downarrow$

$(x-10)(x+5)$

$\boxed{[5, \infty) : D}$

$\checkmark$

Need $x^2-5x-50 \geq 0$

$\Rightarrow (x-10)(x+5) \geq 0$

$+ \quad | \quad - \quad | \quad +$

$-5 \qquad 10$ $\quad \geq 0$

Y $\quad =0 \quad$ N $\quad =0 \quad$ Y

$-5 \qquad 10$

Y $\qquad$ Y

$(-\infty, -5] \cup [10, \infty)$

⑤ domain of $\sqrt{\dfrac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}}$ $\geq 0$

$+ \quad | \quad - \quad | \quad - \quad | \quad - \quad | \quad +$

Y $\quad -5 \quad$ Y $\quad -3 \quad$ N $\quad 3 \quad$ N $\quad 4 \quad$ Y

$\star$ $\quad =0 \quad =0 \quad \star$

$\boxed{(-\infty, -3) \cup \{3\} \cup [4, \infty) : D}$

No. Need ~~that~~ the radicand $\geq 0$, not the whole $\sqrt{\phantom{xx}} \geq 0$, which you get automatically if it's defined. The issue is where is it defined?

By your pattern:

$+ \quad | \quad - \quad | \quad - \quad | \quad - \quad | \quad +$ $\quad \geq 0$

$-5 \qquad -3 \qquad 3 \qquad 4$

$(-\infty, -5] \cup \{-3\} \cup \{3\} \cup [4, \infty)$

Mat 121

(6) domain of $\log_{11}\left(\dfrac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}\right)$.

2

Need $>0$

$+ \quad - \quad - \quad - \quad +$

N $\quad -5$ (Y) $\quad$ N $\quad -3$ (Y) $\quad$ N $\quad 3$ (N) $\quad$ N $\quad 4$ (Y) $\quad$ Y

$\boxed{\{-5\} \cup \{-3\} \cup [4,\infty)}$

Your Y's & N's appear random as do the +'s & -'s

(7) Solve $\ln(x-2)+\ln(x+5)=\ln(8)$

$\ln(x-2)(x+5)=\ln(8)$

$\ln(x^2+3x-10)=\ln(8)$

$\dfrac{\ln(x^2+3x-10)}{\ln(8)}=0 \rightarrow 1$

3

$A=B \Rightarrow$

$\dfrac{A}{B}=1$, not

$\dfrac{A}{B}=0$

$\dfrac{x^2+3x-10}{8}=0$

$\dfrac{(x+5)(x-2)}{8}=0$

$\boxed{x=-5,\ 2}$

5

Mat 121

8 $\frac{1}{2}$ life C-14, 4800 years

a) $A_0 e^{K(4800)} = A(t)$

$A_0 e^{Kt} = A(t)$

$\cancel{A_0 e^{Kt} =}$

$A_0 e^{4800K} = \frac{1}{2} A_0$

$e^{K(4800)} = A_0 0$

$\ln(K)(4800) = A_0 0$

$\ln K = \ln(4800)$

$\boxed{K \approx 8.476371197 \approx \boxed{8.476}}$

10.6136098 4

3

b) $A(t) = A_0 e^{(8.476)(4800)}$

$A(t) = \ln((8.476)(4800))$

$A(t) \approx 10.6136098 4$

$\approx \boxed{10.614 \text{ years old}}$

(

MAT 121

B6 $1{,}000 = P \quad R = 2\% \quad T = 26$

2

$1{,}000^{(1.02)(26)} = \boxed{3.630780548 \times 10^{79} \text{ fish}}$

B7 $1{,}000^{(1.02)t} = 10{,}000$

$\log_{1.02}(1{,}000) = 8.6$

$\approx \boxed{9 \text{ years}}$

$P(t) = P_0 e^{kt}$

$= 1000 e^{.02t}$

$P_0 e^{kt}$, not $P_0 e^{(k+1)t}$

B1 $|-5x+8| - 11 > -2$

$+11 \quad +11$

$|-5x+8| > 9$

$-5x + 8 > 9$

$-5x > 1$

$x < -\frac{1}{5}$

$x < -\frac{1}{5}$

good

$-5x + 8 < 9$

$-5x < 1$

$x > \frac{1}{5}$

$-5x+8 < -9$

3

$\boxed{[-\frac{1}{5}, \frac{1}{5}]}$

MAT 121-G11 Test 4 – Spring, 2018 ✓ Name Suraine Griffin
100 Points Covers Chapter 4 NO GRAPHING CALCULATORS!!!

Leave a margin at the top left corner (Write MAT 121 in big letters). Write DARK. 10% off for insufficient margin that puts work underneath the staple. Put all scratch work WITH the problem as you work it. Often there are partial credit points that you will NOT earn by writing your scratch on a separate page and stapling it to the back. To me, that's trash. That's why I give as much paper as needed or wanted!

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2. (10 pts) Find the *exact* $x$- and $y$-intercepts for $g(x)$ from #1. That means no decimal approximations.

   a. $x$-intercept: $A =$

   b. $y$-intercept: $B =$

Label your final graph for #1 with the intercepts labeled with $A$ and $B$.

3. (5 pts) Find the inverse, $g^{-1}(x)$, for $g(x)$ in #1. The moves are very similar to what you did in #2a.

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   f. (5 pts) What is the domain of $f\circ g$ ?

5. (5 pts) What is the domain of $\sqrt{\frac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}}$ ?

6. (5 pts) What is the domain of $\log_{11}\left(\frac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}\right)$?

AIMS Testing Center
StartTime 9:43
EndTime
Station # P7
TimeLimit 120 mins

MA T121

1.) $g(x) = -5 \cdot 2^{5x+15} + 6$

$x = -1 \quad x = 0 \quad x = 1$

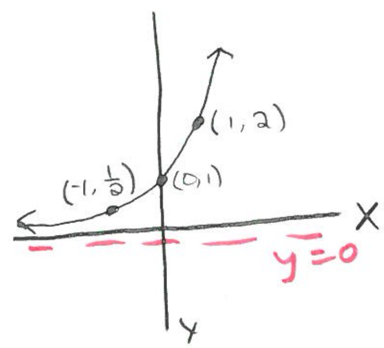
$f(-1) = 2^{-1} = 0.5 = \frac{1}{2}$

$f(0) = 2^0 = 1$

$f(1) = 2$

Coordinates: $(-1, \frac{1}{2})$ $(0,1)$ $(1,2)$

$\boxed{0}$ $f(x) = 2^x$




3

Asymptote?

$-5f(x)$

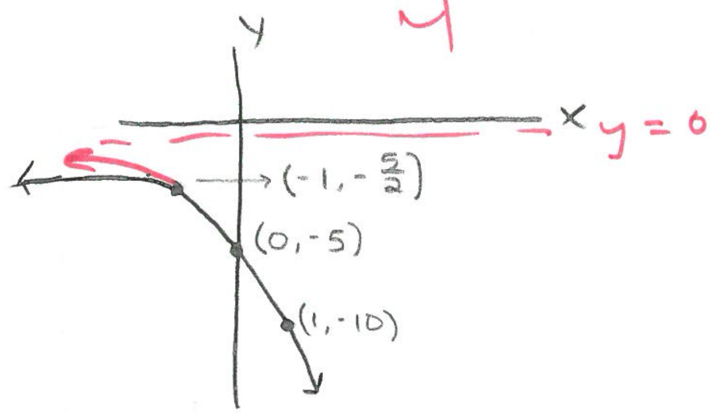
graph flipped

$\boxed{1}$ $f(x) = -5 \cdot 2^x$

$-5 \cdot \frac{1}{2} = -\frac{5}{2} \rightarrow (-1, -\frac{5}{2})$

$-5 \cdot 1 = -5 \rightarrow (0, -5)$

$-5 \cdot 2 = -10 \rightarrow (1, -10)$




4

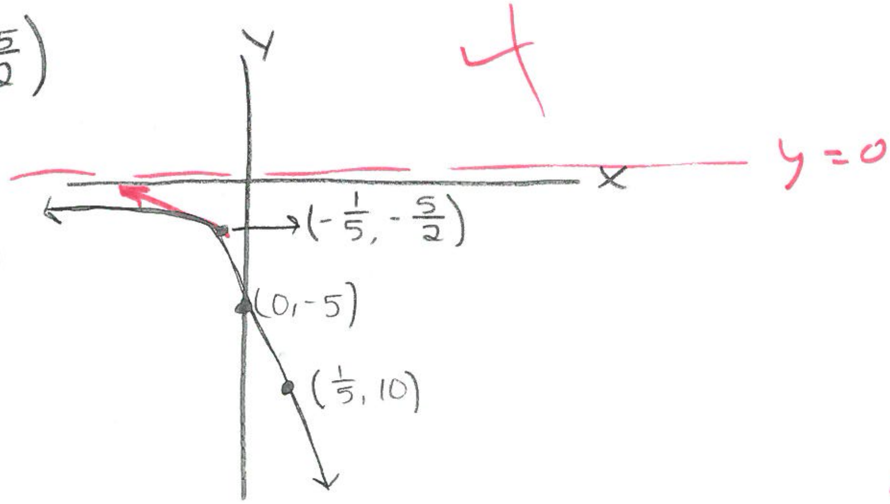
$-5f(5x)$

$\boxed{2}$ $f(x) = -5 \cdot 2^{5x}$

$-\frac{1}{5} = -\frac{1}{5} \rightarrow (-\frac{1}{5}, -\frac{5}{2})$

$\frac{0}{5} = 0 \rightarrow (0, -5)$

$\frac{1}{5} = \frac{1}{5} \rightarrow (\frac{1}{5}, -10)$




4

11

MAT121

cont'd

1.) $g(x) = -5 \cdot 2^{5x+15} + 6$

yes

No. Now you're doing $-5f(5x+15)$, which should be viewed as $-5f(5(x+3))$ when you do the "5x" before you do the "+15"

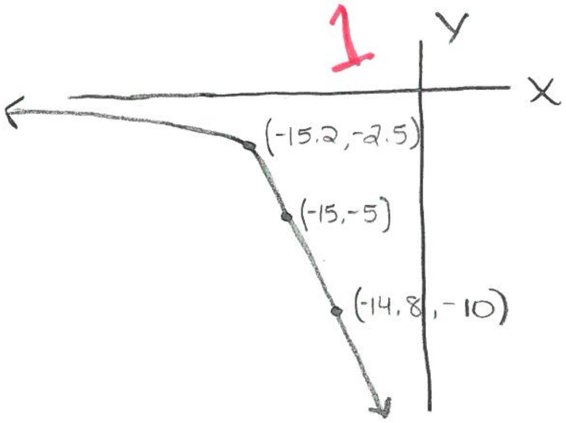
$\boxed{3}$ $g(x) = -5 \cdot 2^{5x+15}$

$-\frac{1}{5} - 15 = -15.2 \rightarrow (-15.2, -2.5)$

$0 - 15 = -15 \longrightarrow (-15, -5)$

$\frac{1}{5} - 15 = -14.8 \rightarrow (-14.8, -10)$

1




No. Passing from $-5f(5x)$ to $-5f(5x+15)$ is achieved by replacing $x$ by $x+3$:

$5x+15 = 5(x+3)$

So, left 3 units

$\boxed{4.}$ $g(x) = -5 \cdot 2^{5x+15} + 6$

$-2.5 + 6 = 3.5 \longrightarrow (-15.2, 3.5)$

$-5 + 6 = 1 \longrightarrow (-15, 1)$

$-10 + 6 = -4 \longrightarrow (-14.8, -4)$

$-5f(x) \rightarrow -5f(5x)$

$x \mapsto \frac{1}{5}x$

$-5f(x) \rightarrow -5f(x+15)$

$x \mapsto x - 15$

But $-5f(5x) \rightarrow -5f(5(x+3))$

$-5f(5x+15)$

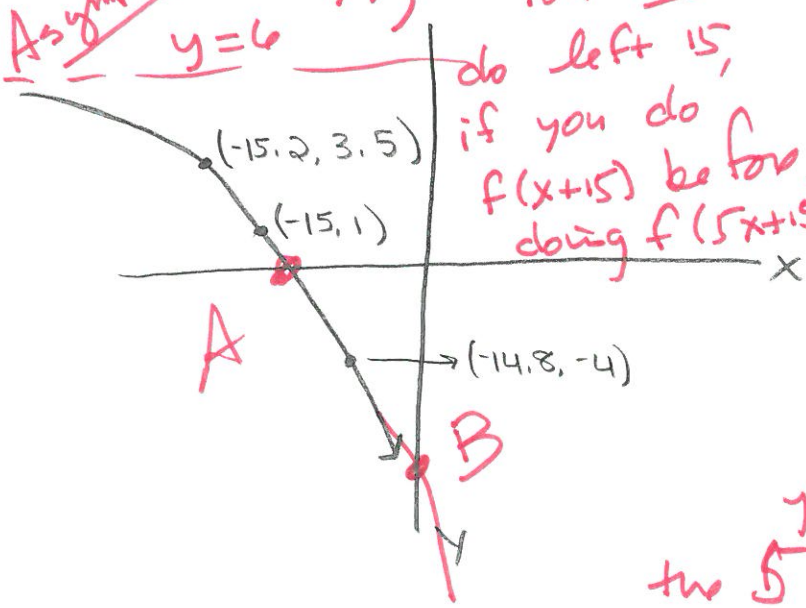
$x \mapsto x - 3$

3

Asymptote

$y = 6$

You CAN do left 15, if you do $f(x+15)$ before doing $f(5x+15)$




When you do $f(5x)$ before the $5x+15$, you need to factor out the 5 to make it a "replace x by" move.

4

MAT121

2.) a. x-intercept:

$$-5 \cdot 2^{5x+15} + 6 = 0$$
$$\quad -6 \quad -6$$

$$\frac{-5 \cdot 2^{5x+15}}{-5} = \frac{-6}{-5}$$

$$2^{5x+15} = \frac{6}{5}$$

$$\log_{(2)}(5x+15) = \log_{(2)}\left(\frac{6}{5}\right)$$

$$5x+15 = \log_{(2)}\left(\frac{6}{5}\right)$$
$$-15 \quad -15$$

$$\frac{5x = \log_{(2)}\left(\frac{6}{5}\right)-15}{5}$$

$$x = \frac{\log_{(2)}\left(\frac{6}{5}\right)-15}{5}$$

A = $\boxed{\left(\frac{\log_{(2)}\left(\frac{6}{5}\right)-15}{5}, 0\right) \text{ or } (3.031672498, 0)}$ 4.9

≈

b. y-intercept

$$g(0) = -5 \cdot 2^{5(0)+15} + 6$$

$$g(0) = -5 \cdot 2^{15} + 6$$

$$g(0) = -163834 \ (?)$$

B = $\boxed{(0, -163834)}$ ? !

5

Deduct 1pt for not showing A & B on graph

9

MAT121

3.) $g^{-1}(x)$

$f(x) = -5 \cdot 2^{5x+15} + 6$

$y = -5 \cdot 2^{5x+15} + 6$

$x = -5 \cdot 2^{5y+15} + 6$

$-6 \qquad -6$

$-5 \cdot 2^{5y+15} + 6 = x$

$-5 \cdot 2^{5y+15} = x - 6$, etc.

$\dfrac{-5 \cdot 2^{5y+15}}{-5} = \dfrac{-6}{-5}$

Where'd 'x' go?

$2^{5y+15} = \dfrac{6}{5}$

$\log(2) \quad \log(2)$

$5y + 15 = \log_{(2)}\left(\frac{6}{5}\right)$

$-15 \qquad -15$

3

$\dfrac{5y}{5} = \dfrac{\log_{(2)}\left(\frac{6}{5}\right) - 15}{5}$

$y = \dfrac{\log_{(2)}\left(\frac{6}{5}\right) - 15}{5}$

$\frac{6-x}{5}$ or $\frac{x-6}{-5}$

$\boxed{\cancel{\left(0, \dfrac{\log_{(2)}\left(\frac{6}{5}\right) - 15}{5}\right)}}$

We're not looking for x- or y-intercept.

You started out, fine $g(y) = x$

You solved $g(y) = 0$

Then you interpreted your work

Then you interpreted your work as a y-intercept because you ended with a "y ="

3

MAT121

4.) $F(x)=\sqrt{x+16}$ $g(x)=x^2-5x-66$

a. $DF(x)=$

Need $x+16\geq 0$ Yes

$-16\ -16$

$D=\{x \mid x\geq -16\}=\boxed{[-16,\infty)}$

5

b. all real #s : no radicals or negs in denom.

$\boxed{(-\infty,\infty)}$

5

c. $\left(\frac{F}{g}\right)(x)$

$\boxed{\dfrac{\sqrt{x+16}}{x^2-5x-66}}$

5

d. $D\left(\frac{F}{g}\right)(x)$

$x^2-5x-66=0$

$(x-11)(x+6)=0$

$x-11=0$ $\quad$ $x+6=0$

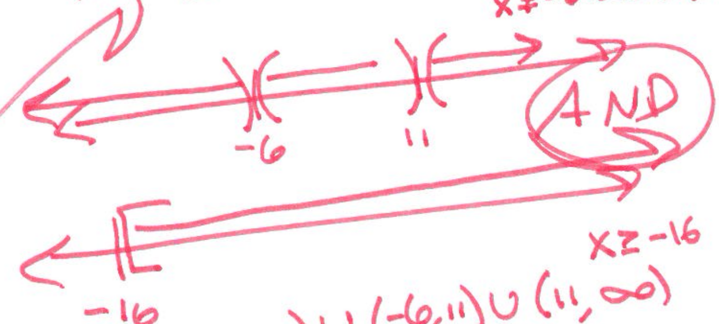
$+11\ +11$ $\quad$ $-6\ -6$

$x=11$ $\quad$ $x=-6$

$\boxed{(-\infty,-6)\cup(11,\infty)}$

$[-16,-6)\cup(-6,11)\cup(11,\infty)$

$x\neq -6$ and $x\neq 11$




3

$(-16,-6)\cup(-6,11)\cup(11,\infty)$

$[-16,-6)$

You're throwing out all of $(-6,11)$, which interval ALSO satisfies $x\neq -6, 11$

And you forgot the f(x) part still needs $x\geq -16$

18

MAT121

4.) e. $F \circ g(x) \rightarrow F(g(x))$

$\sqrt{x^2 - 5x - 66 + 16}$

$\boxed{\sqrt{x^2 - 5x - 50}}$

5

F. $D(F \circ g)(x)$

need $x^2 - 5x - 50 \geq 0$ Yes.

$(x - 10)(x + 5) \geq 0$

$\boxed{x - 10 \geq 0 \quad x + 5 \geq 0}$ No!

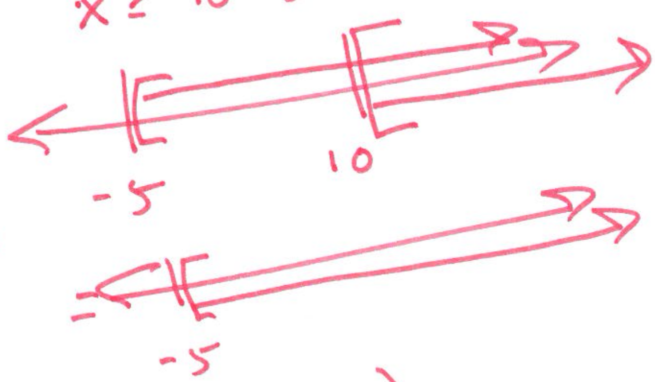
$+10 \; +10 \qquad -5 \; -5$

$\boxed{x \geq 10}$ $\boxed{x \geq -5}$ → No!

3

$\boxed{(-\infty, -5] \cup [10, \infty)}$

$x \geq 10$ OR $x \geq -5$



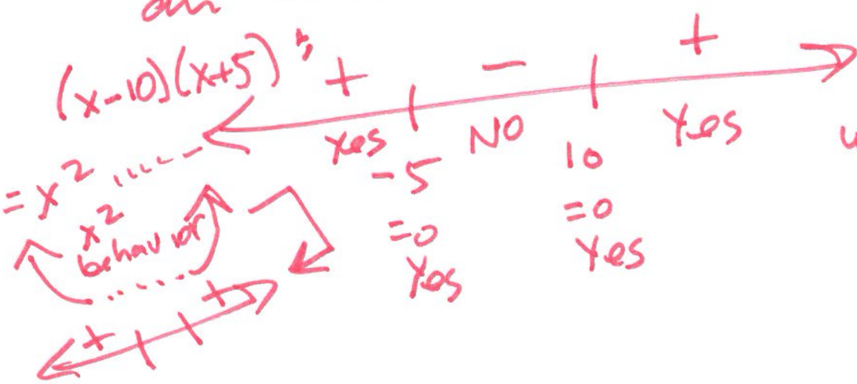
You need to reason from a $\boxed{\text{sign pattern}}$ that uses the interplay of all (both) factors.

It's <u>not</u> enough to say $x \geq 10$ or $x \geq -5$ separately

$= [-5, \infty)$

$x \geq 10$ and $x \geq -5$ is even worse. Instead

on $(x-10)(x+5)$:



and <u>THIS</u> is where $(-\infty, -5] \cup [10, \infty)$ comes from.

8

MAT121

5.) $D \sqrt{\dfrac{(x+5)^2(x+3)}{(x-4)^3(x-3)^4}}$

For THIS, by this point, You should tell by inspection that $x = -5, -3, 3, 4$ are the ~~impor~~ important x-values

$(x+5)^2 = 0$   $\sqrt{\ }$   $\sqrt{\ }$

$x+5=0$
$-5 \quad -5$
$x=-5$

$x+3=0$
$-3 \quad -3$
$x=-3$

$m=2$ is even $(x+5)^2$ No sign change at $x=-5$

$m=1$ is odd $(x+3)^1$ sign changes

$(x-4)^3$ sign changes

$m=3$ is odd

$(x-4)^3=0$   $\sqrt[3]{\ }$   $\sqrt[3]{\ }$

$x-4=0$
$+4 \quad +4$
$x=4$

$(x-3)^4=0$   $\sqrt[4]{\ }$   $\sqrt[4]{\ }$

$x-3=0$
$+3 \quad +3$
$x=3$

Don't confuse test values of intervals with the endpoints end behavior

In fact, use end test value OR At most ONE test value to get started, and THEN analyze whether the sign changes at the next endpoint

$(x-3)^4$ sign doesn't change $m=4$ is even

| − | 0 | 0 | 0 | − | + | ? | + | + |
|---|---|---|---|---|---|---|---|---|
| | −5 | −4 | −3 | 0 | 3 | | 4 | |
| | =0 | =0 | =0 | | ☆ | | ☆ | |
| | y | y | y | n | n | | n | y |

No! 2

x is big: All are positive.

| | −5 | −3 | 3 | 4 | + |
|---|---|---|---|---|---|
| | =0 | =0 | ☆ | ☆ | |

$\boxed{(-\infty, -5] \cup [-3, 3) \cup (4, \infty)}$ ?

I think you're bogged down in recipes & details, when a few ideas let you fly.

| + | + | − | − | + |
|---|---|---|---|---|
| | −5 | −3 | 3 | 4 |

$(x+5)^2$ even No change

$(x+3)^1$ odd ~~ch~~ changes

$(x-3)^4$ even no change

$(x-4)^3$ ODD No chang

2

MAT121

7.) $\ln(x-2) + \ln(x+5) = \ln(8)$

$\ln(x-2)+(x+5) = \ln(8)$

$\ln\left((x-2)(x+5)\right) = \ln(8$ Still struggling w/ ln

$\ln(A) + \ln(B)$ 0

$= \ln(AB)$

$3^x \cdot 3^y = 3^{x+y}$

Logs ARE the exponents.

0

MAT121

8.) C-14 hL is 4800 yrs

just guessing here...

a. $A(t) = A_0 e^{kt}$

$\dfrac{A(4800) = 100e^{kt}}{100}$ ?

$\frac{1}{2}$-life is 4800 yrs, so

$A_0 e^{4800k} = \frac{1}{2} A_0$

THE half-life equation

$A(48) = e^{kt}$ $= \dfrac{\log_e A48 = kt}{t} = \boxed{\dfrac{\log_e A48}{t} = k}$ ?

$\log_e$ $\log_e$

b. 90% C-14 decayed

2

$10(4800) = 100 \cdot e^{kt}$

$\dfrac{48000}{100} = \dfrac{100e^{kt}}{100}$

$480 = e^{kt}$

$\log_e$ $\log_e$

$\dfrac{\log_e 480}{k} = \dfrac{kt}{k}$

$\boxed{\dfrac{\log_e 480}{k} = t}$ ?

b. $A_0 e^{kt} = .1 A_0$ solve for t. after k is known part a.

$k = \dfrac{\ln(\frac{1}{2})}{4800}$

CHEATER (Legit by me.) I'd prefer you mastered the manipulations, but this is OK.

cheat

B2. $7x^2 - 5x - 57$

vertex $(h, k)$

$h = -\dfrac{b}{2a}$ $k = F(h)$

$h = -\dfrac{(-5)}{2(7)} = \dfrac{5}{14}$

GOOD

$\boxed{y = 7\left(x - \frac{5}{14}\right)^2 - \frac{1621}{28}}$

$k = 7\left(\frac{5}{14}\right)^2 - 5\left(\frac{5}{14}\right) - 57$

$\dfrac{25}{28} - \dfrac{25}{14} - 57 = -\dfrac{1621}{28}$

7

MAT121

B6. $A(t) = 1000e^{0.02(26)}$ yup.

$A(t) = 1000e^{0.52}$

$A(t) = 1682.02765$

$A(t) = 1682$

$\boxed{\text{1,682 fish today?}}$ Yup.

5

B7. $10,000 \div 1682$

5.945

5.946

$26 \cdot 5.946 = 154.596$

$2018 + 154.596 = 2172.596$

$\boxed{\text{year 2173}}$ ?

1

SET $A(t) = 10000$

$1000e^{.02t} = 10000$

$e^{.02t} = 10$

$\cancel{.02t = \ln(10)}$

$.02t = \ln(10)$

$t = \frac{\ln(10)}{.02}$

SOLVE EXPONENTIAL EQUATION.

6