

121 E4 I guess 3 Bonus shots?

$$\textcircled{1} 2 \cdot (1.3)^x = 5 \cdot (1.1)^x$$

$$\ln(2) + (\ln(1.3))x = \ln(5) + (\ln(1.1))x$$

$$2 + bx = c + dx$$

$$bx - dx = c - 2$$

$$(b-d)x = c-2$$

$$x = \frac{c-2}{b-d} = \frac{\ln 5 - \ln 2}{\ln 1.3 - \ln 1.1} \approx 5.484994478$$
$$\approx \boxed{5.4850}$$

$$\textcircled{2} |2x - 7| \geq 8$$

$$2x - 7 \geq 8 \text{ OR } 2x - 7 \leq -8$$

$$2x \geq 15 \text{ OR } 2x \leq -1$$

$$\left\{ x \mid x \geq \frac{15}{2} \text{ OR } x \leq -\frac{1}{2} \right\}$$



$$= \left[ (-\infty, -\frac{1}{2}] \cup [\frac{15}{2}, \infty) \right]$$

$$\textcircled{3} |2x - 7| \leq 8$$

$$2x - 7 \geq -8 \text{ OR } 2x - 7 \leq 8$$

$$2x \geq -1 \text{ OR } 2x \leq 15$$

$$\left\{ x \mid x \geq -\frac{1}{2} \text{ OR } x \leq \frac{15}{2} \right\}$$



$$= (-\infty, \infty)$$

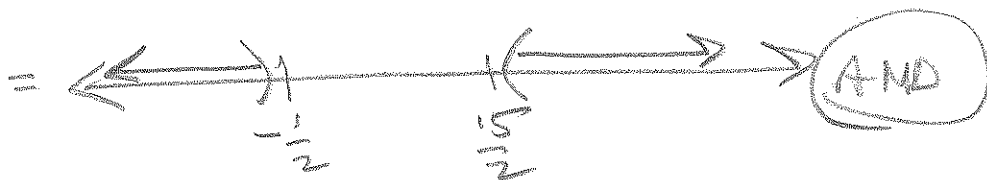
121 E4

(4)  $|2x-7| < -8$

$2x-7 < -8$  AND  $2x-7 > 8$

$2x < -1$  AND  $2x > 15$

$\left\{ x \mid x < -\frac{1}{2} \text{ AND } x > \frac{15}{2} \right\}$

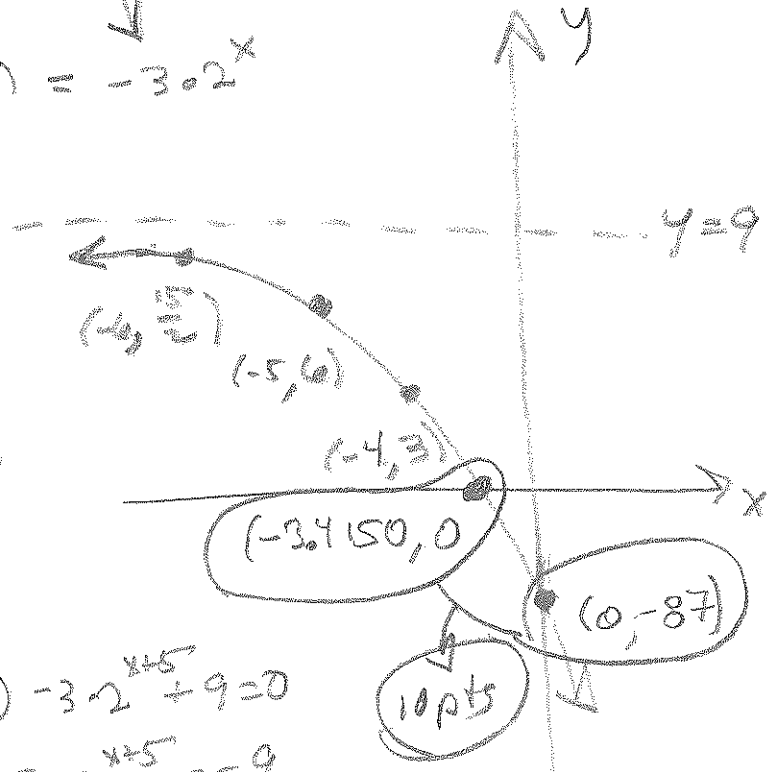
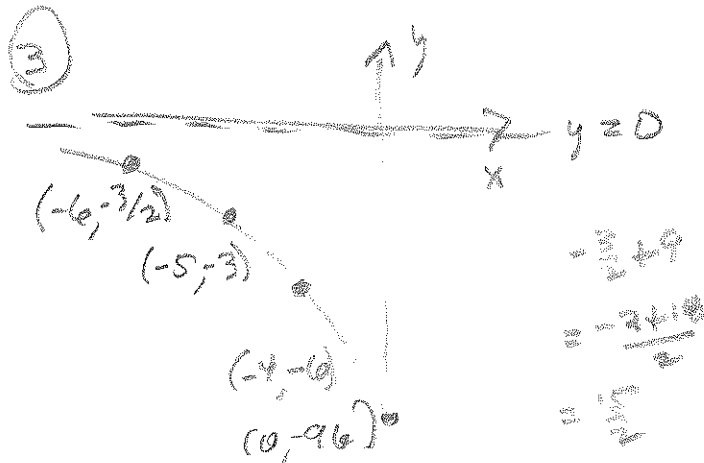
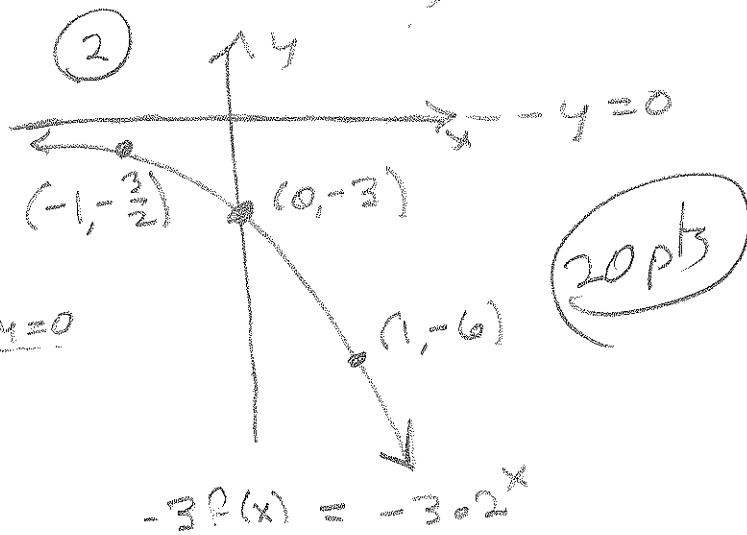
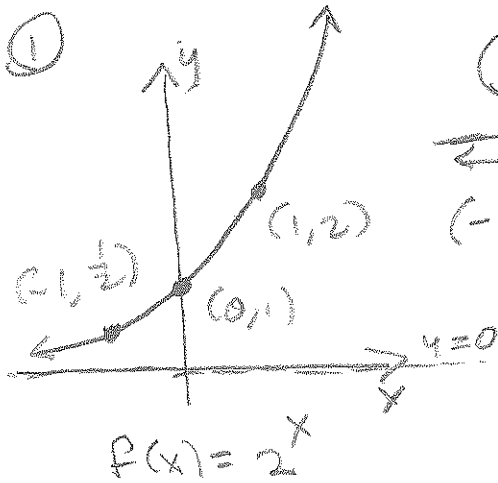


=  $\emptyset$

=  $\{ \}$

No Overlap in an AND situation!

①  $g(x) = -3 \cdot 2^{x+5} + 9$



$$\begin{aligned} -3f(x+5) &= -3 \cdot 2^{x+5} \end{aligned}$$

$$\begin{aligned} -3(2^5) &= -3(32) \\ &= -96 \end{aligned}$$

x-Int

$$\begin{aligned} -3 \cdot 2^{x+5} + 9 &= 0 \\ -3 \cdot 2^{x+5} &= -9 \\ 2^{x+5} &= \frac{-9}{-3} = 3 \end{aligned}$$

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

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

$$\begin{aligned} &= \frac{\ln(3)}{\ln(2)} - 5 \approx -3.415037499 \\ &\approx -3.4150 \end{aligned}$$

(2) Work on previous page

$$(0, -87) = (0, g(0))$$

$$\frac{1}{8} f(x) = 0 \Rightarrow x \approx 3.4150 \rightarrow (3.4150, 0)$$

(3)  $f(x) = \sqrt{3x-6}$ ,  $g(x) = \frac{x+10}{x+4}$

(a) (5pts)  $\mathcal{D}(f) = \{x \mid 3x-6 \geq 0\} = \{x \mid x \geq 2\}$

$$3x-6=0 \quad = [2, \infty)$$

$$3x=6$$

$$x=2$$

(b) (5pts)  $\mathcal{D}(g) = \{x \mid x+4 \neq 0\} = \{x \mid x \neq -4\}$

(c)  $\left(\frac{f}{g}\right)(x) = \frac{\sqrt{3x-6}}{\frac{x+10}{x+4}}$  (5pts)

$$x \neq -10$$

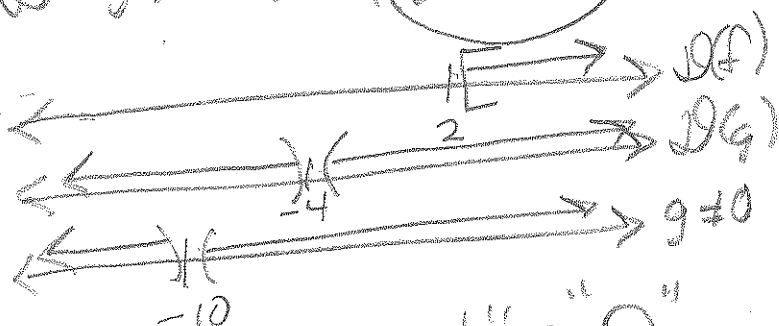
(d)  $\mathcal{D}\left(\frac{f}{g}\right) = \mathcal{D}(f) \cap \mathcal{D}(g) \cap \{x \mid g(x) \neq 0\}$

$$g(x) = \frac{x+10}{x+4} = 0 \Rightarrow$$

$$x+10=0 \Rightarrow$$

$$x=-10$$

(5pts)



'AND' = "Intersect" = " $\cap$ "

$$\mathcal{D}\left(\frac{f}{g}\right) = [2, \infty) = \{x \mid x \geq 2\}$$

=

3) (e) (5pts)  $(f \circ g)(x) = f(g(x))$

$$= \sqrt{3g(x) - 6} = \sqrt{3\left(\frac{x+10}{x+4}\right) - 6}$$

(f) (5pts)  $D(f \circ g) = \left\{ x \mid x \in D(g) \text{ and } g(x) \in D(f) \right\}$

$$= \left\{ x \mid x \neq -4 \text{ and } \frac{x+10}{x+4} \geq 2 \right\}$$

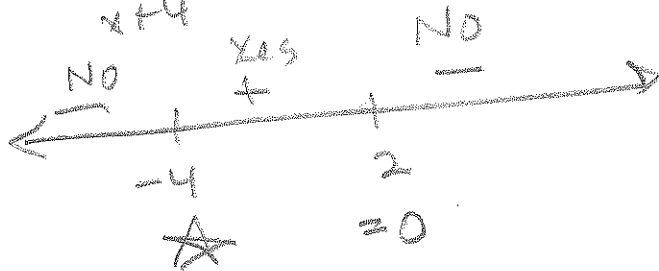
$$\frac{x+10}{x+4} \geq 2$$

$$\frac{x+10}{x+4} - 2 \geq 0$$

$$\frac{x+10-2(x+4)}{x+4} \geq 0$$

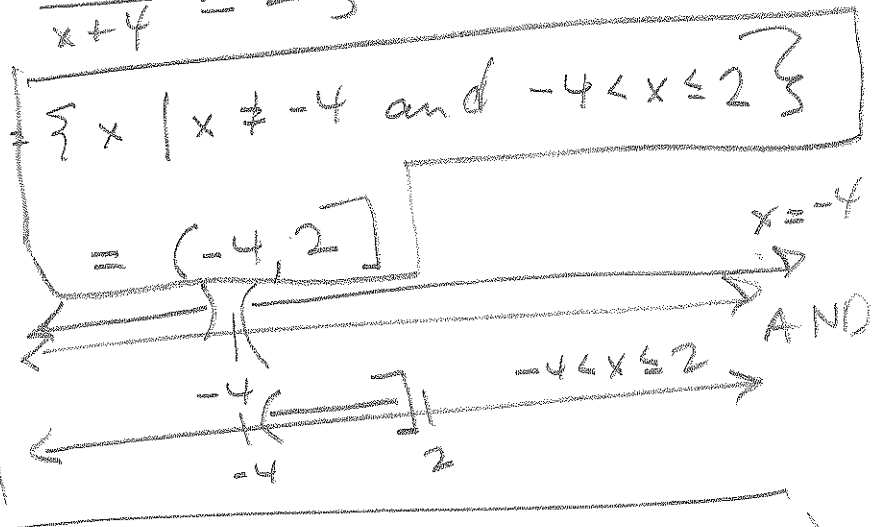
$$\frac{x+10-2x-8}{x+4} \geq 0$$

$$\frac{-x+2}{x+4} \geq 0$$



(H.o.A.  $y = -1$  gives "-" outside)  
OR  $\frac{0+2}{0+4} = \frac{1}{2}$  gives "+" in middle)

So  $(-4, 2]$  is  
all good

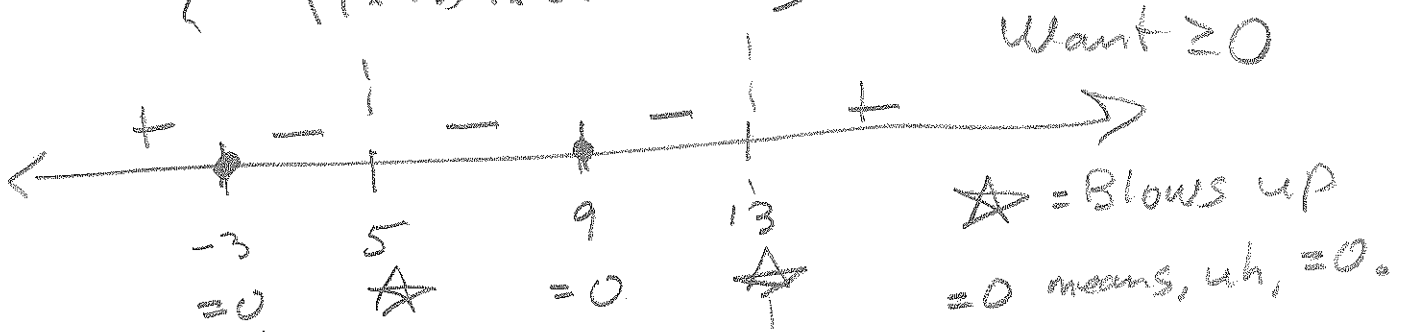


121 54

(4) (0) (5pts)

$$f(x) = \sqrt{\frac{(x+3)(x-9)^2}{(x-13)^3(x-5)^2}} \rightarrow$$

$$D(f) = \left\{ x \mid \frac{(x+3)(x-9)^2}{(x-13)^3(x-5)^2} \geq 0 \right\}$$



$$(-\infty, -3] \cup \{9\} \cup (13, \infty)$$

(b) (5pts)

Similar question but in side the log, we need " $> 0$ " and not just " $\geq 0$ ".  
Same Sign Pattern, but " $= 0$ " is now bad.

$$(-\infty, -3) \cup (13, \infty)$$

5 (10pts)

$$\log_7(2x+3) + \log_7(x-3) = \log_7(4x+6)$$

$$\log_7((2x+3)(x-3)) = \log_7(4x+6) \quad \log(a) + \log(b) = \log(ab)$$

$$(2x+3)(x-3) = 4x+6 \quad (\log \text{ is } 1-1-1)$$

$$2x^2 - 3x - 9 = 4x + 6$$

$$2x^2 - 7x - 15 = 0 \quad \text{Solve by any legit method.}$$

$$(2x+3)(x-5) = 0$$

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

Check against domain of original

$$2x+3 > 0$$

$$x-3 > 0$$

$$4x+6 > 0$$

$$D = (3, \infty)$$

$$x > -\frac{3}{2}$$

$$x > 3$$

$$4x > -6$$

$$x > -\frac{3}{2}$$

$x = -\frac{3}{2}$  is extraneous

$x = 5$  is unique solution

or  $x \in \{5\}$  to show some class

121 E4

6 10 pts

$$3^{x^2-12} \cdot 3^{-2x} = 27$$

$$\Rightarrow 3^{x^2-2x-12} = 3^3$$

$$\Rightarrow x^2-2x-12 = 3$$

$$\Rightarrow x^2-2x-15 = 0$$

$$\Rightarrow (x-5)(x+3) = 0$$

$$\Rightarrow x \in \{-3, 5\}$$

7 10 pts

half-life is 950 yrs.

82% of isotope is gone.

How old is manuscript?

Answer to nearest year.

1/2-life is 950 yrs

Find k:

$$A_0 e^{950k} = \frac{1}{2} A_0$$

$$e^{950k} = \frac{1}{2}$$

$$950k = \ln\left(\frac{1}{2}\right) = -\ln(2)$$

$$k = -\frac{\ln(2)}{950} \approx -7.296286111 \times 10^{-4}$$

$$= -0.0007296286111$$

82% is gone  
18% remains

$$A_0 e^{kt} = .18 A_0$$

$$e^{kt} = .18$$

$$kt = \ln(.18)$$

$$t = \frac{\ln(.18)}{k}$$

$$t = \frac{\ln(.18)}{-\frac{\ln(2)}{950}} = \frac{950 \ln(.18)}{-\ln(2)}$$

$$\approx 2350.234629 \text{ yrs}$$

$$\approx \boxed{2380 \text{ yrs old}}$$