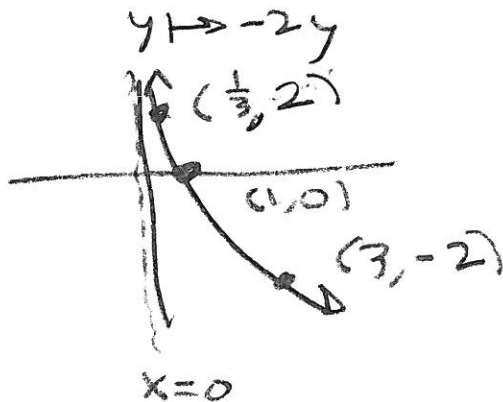
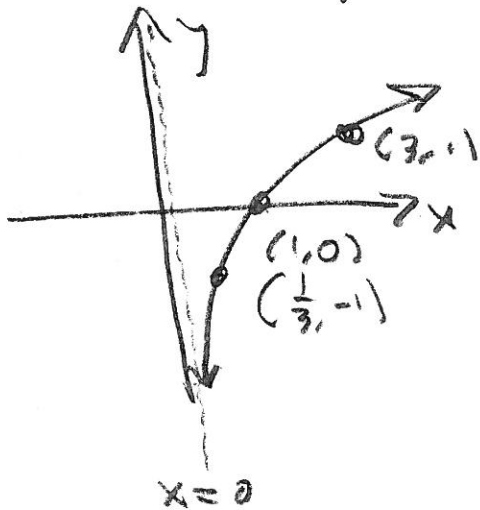


① $g(x) = -2 \log_3(-5x+20) + 7$

② $f(x) = \log_3(x)$

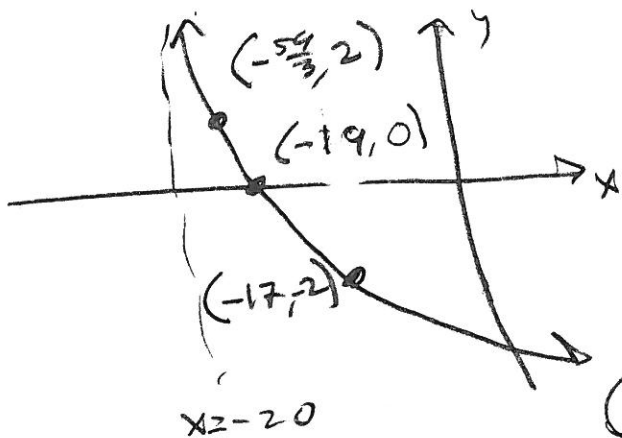
① $-2f(x) = -2 \log_3(x)$



$g(0) = -2 \log_3(20)$
 $+7 \approx -2(2.3) + 7$
 $> -2(3) + 7 > 0$

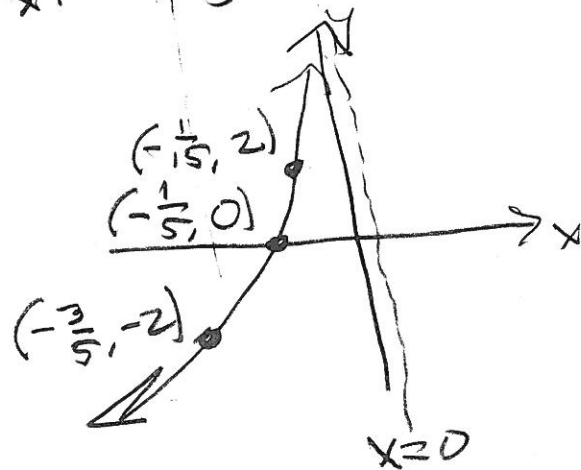
② M1

$-2f(x+20) = -2 \log_3(x+20)$
 $x \mapsto x-20$



$\frac{1}{3} - 20 = \frac{1}{3} - \frac{60}{3} = -\frac{59}{3}$
 $1 - 20 = -19$
 $3 - 20 = -17$

② M2 $-2f(-5x)$
 $x \mapsto -\frac{1}{5}x$



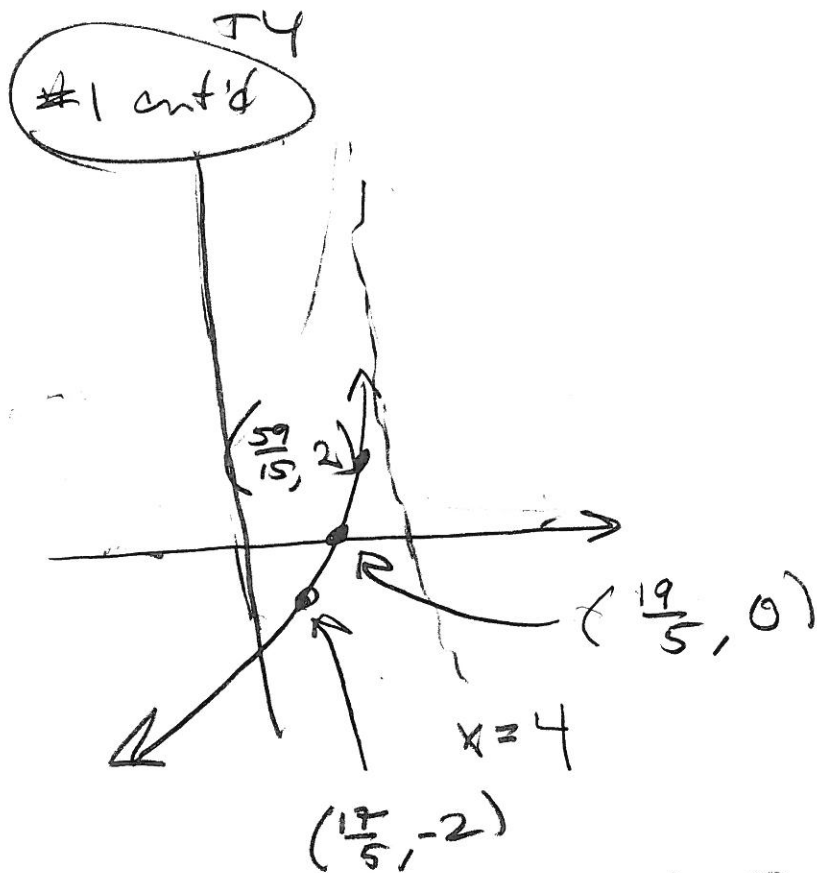
③ $-2f(-5x+20) = -2f(-5(x-4))$
 M1 $x \mapsto -\frac{1}{5}x$ M2 $x \mapsto x+4$

$(-\frac{59}{3})(-\frac{1}{5}) = \frac{59}{15}$ $-\frac{1}{15} + 4 = \frac{-1+60}{15} \checkmark$
 $(-19)(-\frac{1}{5}) = \frac{19}{5}$ $-\frac{1}{5} + 4 = \frac{-1+20}{5} \checkmark$
 $(-17)(-\frac{1}{5}) = \frac{17}{5}$ $-\frac{3}{5} + 4 = \frac{-3+20}{5} \checkmark$

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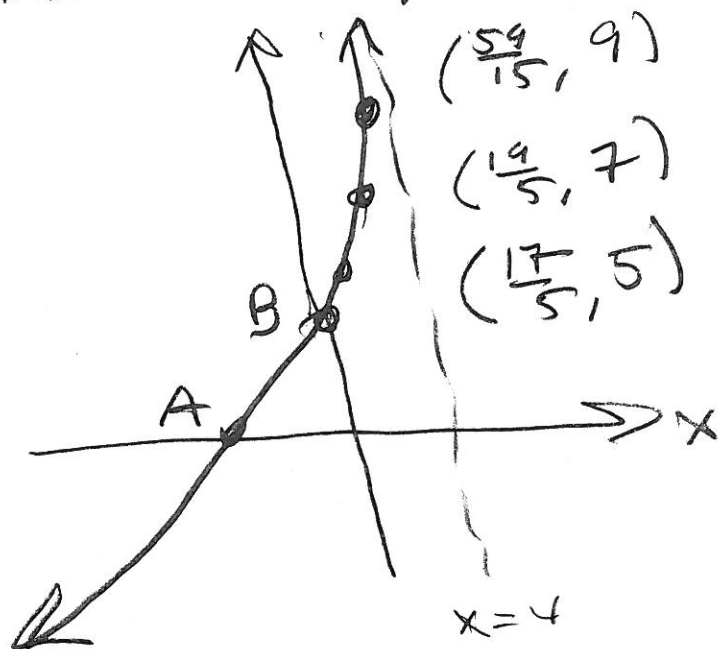
2

3



④ $g(x) = -2 \log_3(-5x+20) + 7$ M1 } up 7
 $= -2 \log_3(-5(x-4)) + 7$ M2 }

Final sketch: Note $g(0) > 0$ by Page 1.



2

a

5pts

g(x) = 0:

-2 log3(-5x+20) + 7 = 0

-2 log3(-5x+20) = -7

log3(-5x+20) = -7/-2 = 7/2

-5x+20 = 3^(7/2)

-5x = 3^(7/2) - 20

x = (3^(7/2) - 20) / -5

A = ((3^(7/2) - 20) / -5, 0) ≈ (-5.353074363, 0)

b

g(0) = -2 log3(-5(0) + 20) + 7

= -2 log3(20) + 7

B = (0, -2 log3(20) + 7) ≈ (0, 1.54633916) ≈ B

3 (5pts) $g(x) = -2 \log_3(-5x+20) + 7$

$$-2 \log_3(-5y+20) + 7 = x$$

$$-2 \log_3(-5y+20) = x - 7$$

$$\log_3(-5y+20) = \frac{x-7}{-2}$$

$$-5y+20 = 3^{-\frac{x-7}{2}}$$

$$-5y = 3^{-\frac{x-7}{2}} - 20$$

$$y = \frac{3^{-\frac{x-7}{2}} - 20}{-5} = g^{-1}(x)$$

4 a (5pts) $f(x) = \sqrt{x-36} \rightarrow$ Need $x-36 \geq 0$
 $\rightarrow x \geq 36 \rightarrow D = [36, \infty)$

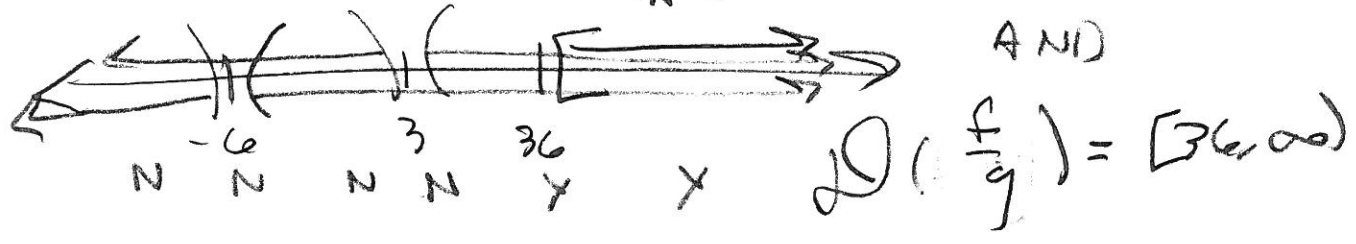
b (5pts) $g(x) = x^2 + 3x - 18$ is a polynomial
 $\rightarrow D(g) = \mathbb{R}$

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TY

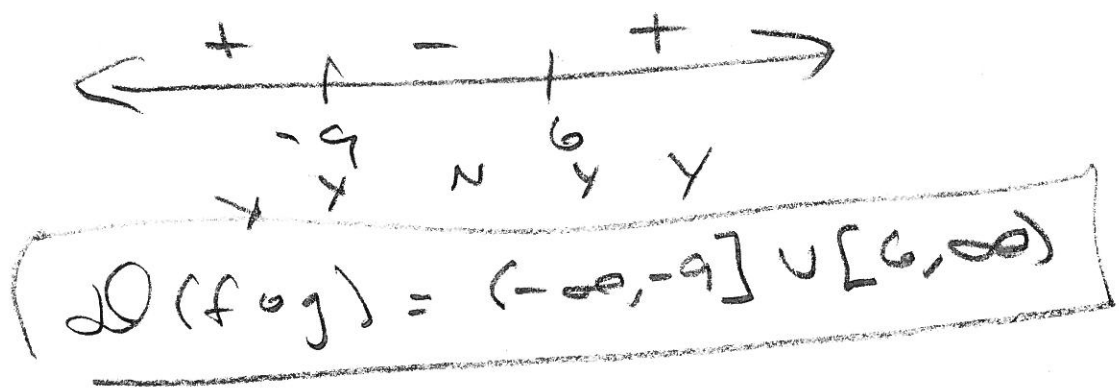
4c) 5pts $\left(\frac{f}{g}\right)(x) = \frac{\sqrt{x-36}}{x^2+3x-18}$

4d) 5pts Need $x \geq 36$ and $x^2+3x-18 \neq 0$
 $(x+6)(x-3) \neq 0$
 $x \neq -6, 3$



4e) 5pts $(f \circ g)(x) = \sqrt{x^2+3x-18-36}$

4f) 5pts Need $x^2+3x-54 \geq 0$
 $(x+9)(x-6) \geq 0$



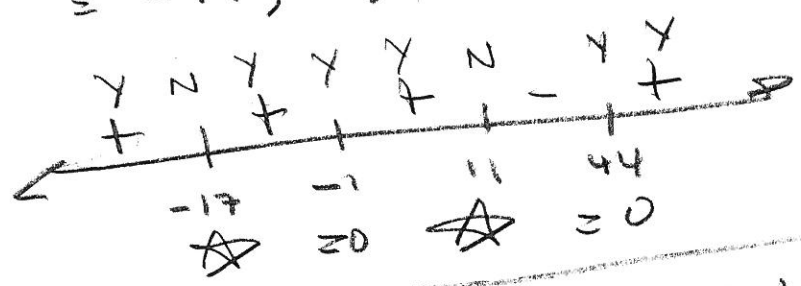
5 a
5pts

$$\sqrt{\frac{(x-44)^5(x+1)^{32}}{(x-11)^3(x+17)^{34}}} = h(x) = \sqrt{\text{stuff}}$$

Need stuff ≥ 0 & Denom $\neq 0$
(Throw out \star)

$$x = 44, -1, 11, -17$$

$$= -17, -1, 11, 44$$

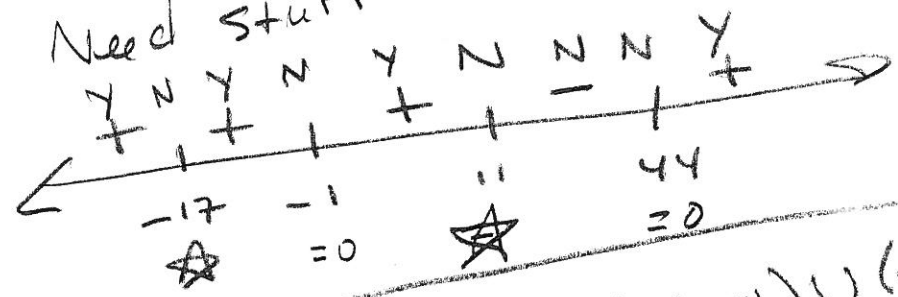


$$\mathcal{D} = (-\infty, -17) \cup (-17, 11) \cup [44, \infty)$$

5b
5pts

$$k(x) = \log_3 \left(\frac{(x-44)^5(x+1)^{32}}{(x-11)^3(x+17)^{34}} \right) = \log_3(\text{stuff})$$

Need stuff > 0 & denom $\neq 0$



$$\mathcal{D} = (-\infty, -17) \cup (-17, -1) \cup (-1, 11) \cup (44, \infty)$$

(6) 10pts $\log_6(x+6) + \log_6(x-3) = 2$

$$\log_6((x+6)(x-3)) = 2$$

$$x^2 + 3x - 18 = 6^2 = 36$$

$$x^2 + 3x - 54 = 0$$

$$(x+9)(x-6) = 0$$

$$x = \cancel{-9}, 6$$

$$\rightarrow x \in \{6\}$$

(7) The $\frac{1}{2}$ life of $C-14$ is 10,000 yrs.

(a) Let $t =$ time in years.
 $A(t) =$ Amount of $C-14$ present,
 in grams

Then $A(t) = A_0 e^{kt}$ & $A(10000) = \frac{1}{2} A_0$

So, $A_0 e^{10000k} = \frac{1}{2} A_0 \Rightarrow$
 $e^{10000k} = \frac{1}{2} \Rightarrow$

$$10,000k = \ln\left(\frac{1}{2}\right) = -\ln(2)$$

$$k = \frac{-\ln 2}{10,000} \approx 6.93471806 \times 10^{-5}$$

$$= 0.00006931471806$$

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8

(b) 5 pts

How old if 17% C-14 remains?

$$A_0 e^{kt} = .17 A_0$$

$$e^{kt} = .17$$

$$kt = \ln(.17)$$

$$t = \frac{\ln(.17)}{k} = \frac{\ln(.17)}{-\frac{\ln 2}{1000}}$$

$$= \frac{-1000 \ln(.17)}{\ln(2)} \approx 25,569.93349$$

$t \approx 25,569$ yrs old

(B) 10 pts

$$|4 - 8x| + 2 \leq 10$$

$$|8x - 4| + 2 \leq 10$$

$$|8x - 4| \leq 8$$

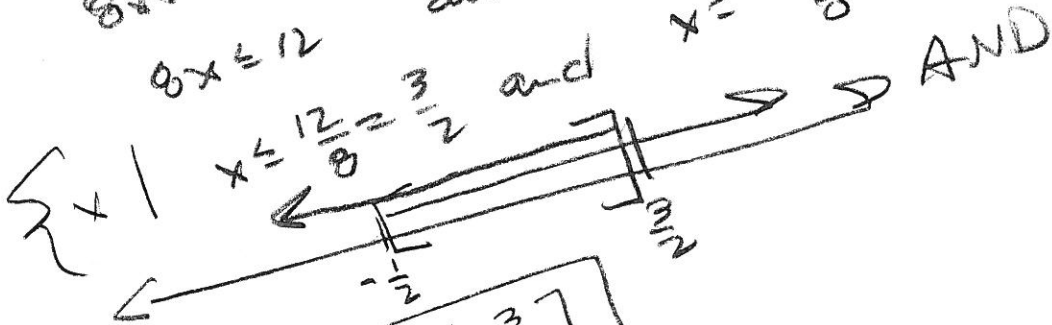
$$8x - 4 \leq 8 \text{ and } 8x - 4 \geq -8$$

$$8x \leq 12$$

$$8x \geq -4$$

$$x \geq -\frac{4}{8} = -\frac{1}{2}$$

$$x \leq \frac{12}{8} = \frac{3}{2} \text{ and } x \geq -\frac{1}{2}$$



$$= \left[-\frac{1}{2}, \frac{3}{2} \right]$$

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(9)

(B2) (5 pts) $f(x) = 6x^2 - 5x - 12$

$$= 6\left(x^2 - \frac{5}{6}x + \left(\frac{5}{12}\right)^2\right) - 12 - 6\left(\frac{5}{2 \cdot 6}\right)^2 =$$

$$= 6\left(x - \frac{5}{12}\right)^2 - \frac{313}{24}$$

Scratch

$$-12 - \left(\frac{5^2}{2 \cdot 6}\right) = -12 - \frac{25}{24}$$

$$\begin{array}{r} 24 \\ 12 \\ + 9 \\ \hline 240 \\ \hline 288 \end{array}$$

$$= \frac{-288 - 25}{24} = \frac{-313}{24}$$

(B3) (5 pts) $2 \cdot \pi^{x-3} = 3 \left(\frac{3}{2}\right)^x$

$$\ln 2 + (x-3) \ln \pi = \ln 3 + \ln\left(\frac{3}{2}\right)^x$$

$$a + b(x-3) = c + dx, \text{ where}$$

$$a = \ln 2, b = \ln \pi, c = \ln 3, d = \ln\left(\frac{3}{2}\right)$$

$$\Rightarrow a + bx - 3b = c + dx$$

$$bx - dx = c + 3b - a$$

$$(b-d)x = c + 3b - a$$

$$x = \frac{c + 3b - a}{b-d} = \frac{\ln 3 + 3 \ln \pi - \ln 2}{\ln \pi - \ln\left(\frac{3}{2}\right)}$$

OR $\frac{\ln\left(\frac{3\pi^3}{2}\right)}{\ln\left(\frac{2\pi}{3}\right)} \approx 5.193883005 \approx x$

BY

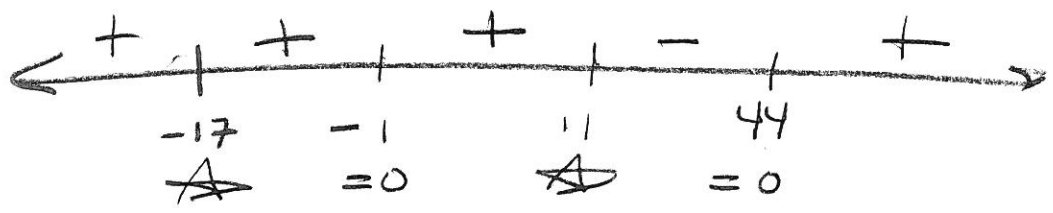
Spt3

$$R(x) = \frac{(x-44)^5 (x+1)^{32}}{(x-11)^3 (x+17)^{34}}$$

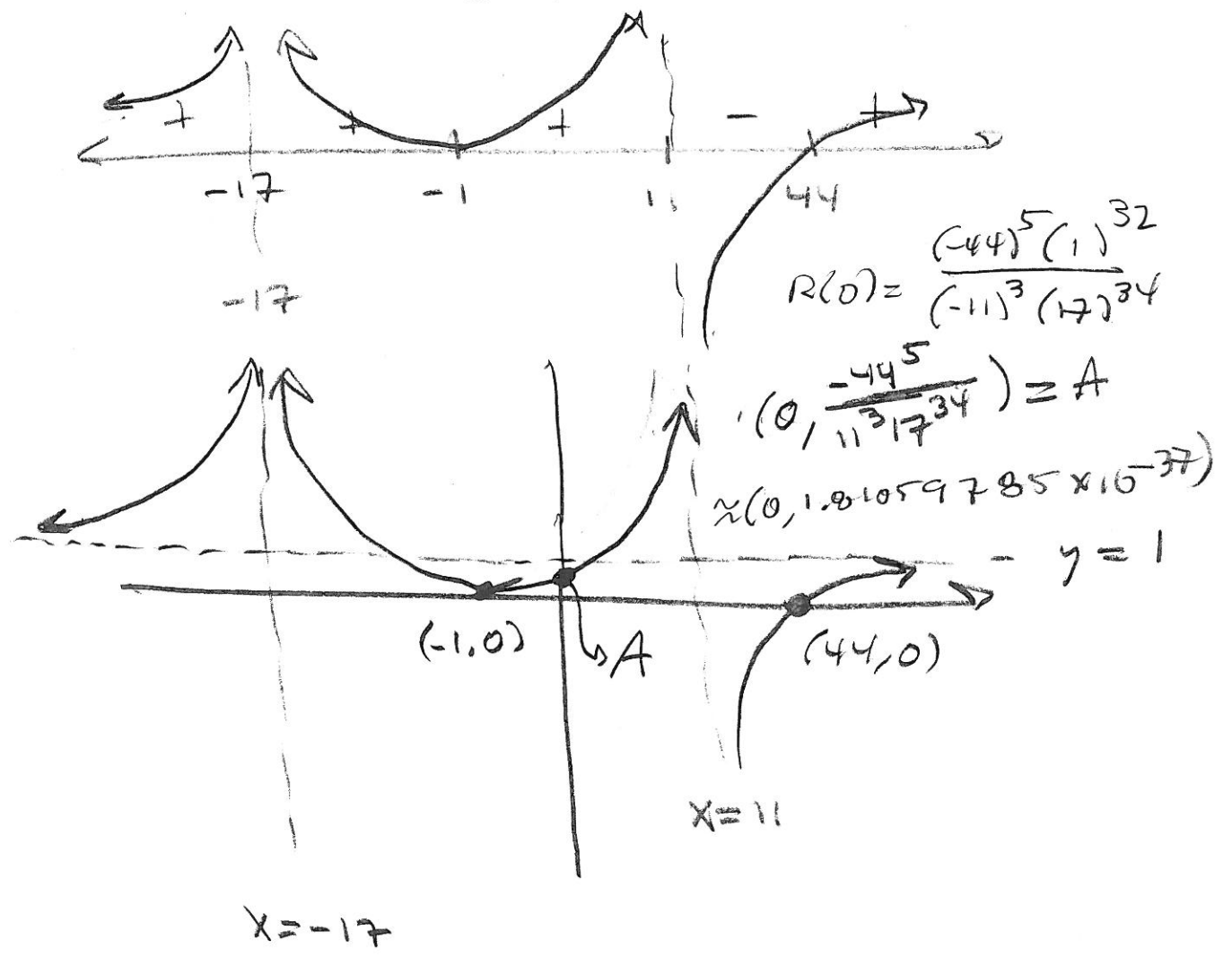
$$\mathcal{D} = \mathbb{R} \setminus \{-17, 11\}$$

$$x\text{-int} = (44, 0), (-1, 0)$$

$$\text{V.A.: } x = -17, x = 11$$



H.A.: $\frac{x^{32}}{x^{32}} = 1 = y$ + to far right ϕ far left from this.



$$R(0) = \frac{(-44)^5 (1)^{32}}{(-11)^3 (17)^{34}}$$

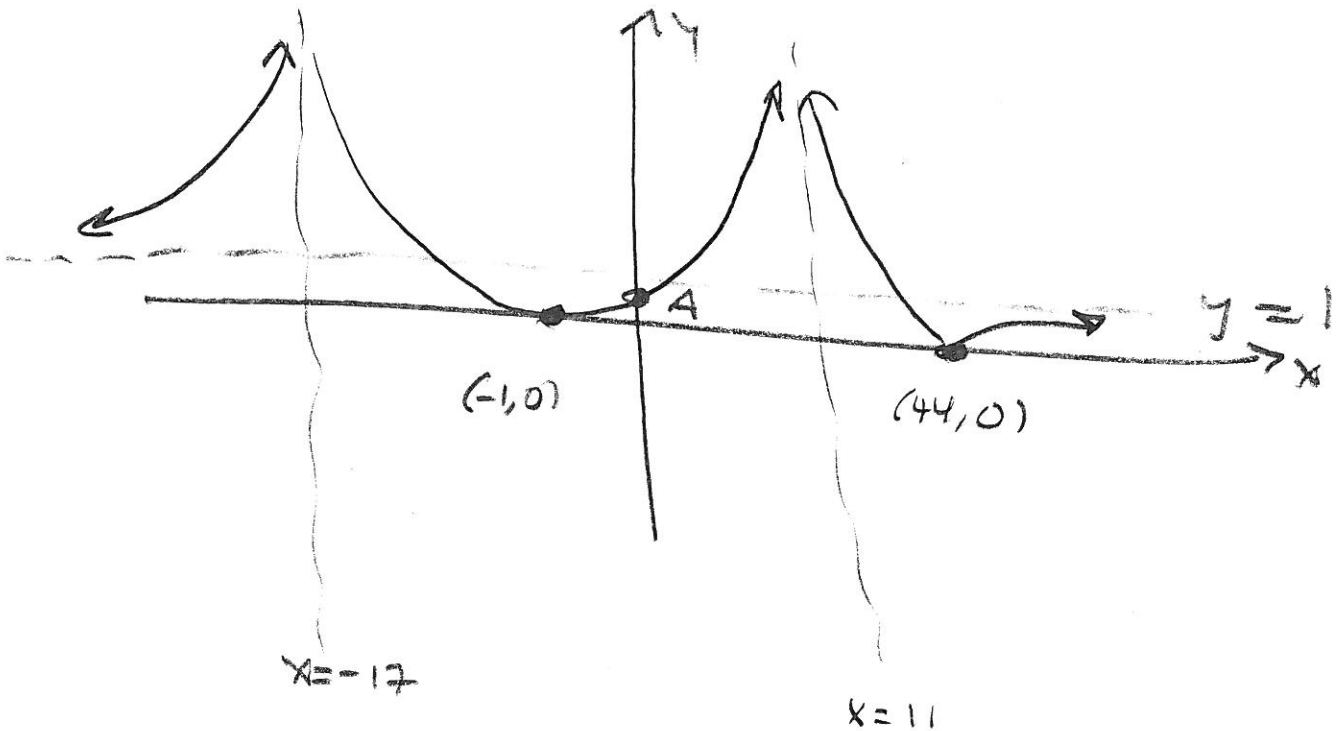
$$(0, \frac{-44^5}{11^3 17^{34}}) = A$$

$$\approx (0, 1.81059785 \times 10^{-37})$$

B5

SpB

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



B6

SpB

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

$t = \text{time in years}$

since 1992

$$A_0 = 200,$$

$$k = .05 \text{ Want } A(2019 - 1992) = A(27)$$

$$A_0 e^{kt} = 200 e^{.05t} = A(t) \Rightarrow$$

$$A(27) = 200 e^{.05(27)} \approx 771.4851061$$

STUDENT MAY work

it THIS way:

5% compounded annually =

$$200(1 + .05)^{27} \approx 746.6912645$$

≈ 771 KOKanee

(B7) (5pts)

$$\text{SET } 200e^{-.05t} = 100,000$$

$$\Rightarrow e^{.05t} = \frac{100,000}{200} = \frac{1000}{2} = 500$$

$$\Rightarrow .05t = \ln(500)$$

$$200(1+.05)^t = 100,000$$

$$1.05^t = 500$$

$$t = \log_{1.05}(500) = \frac{\ln 500}{\ln 1.05}$$

$$\Rightarrow t = \frac{\ln(500)}{.05} \approx 124.242162 \approx 127.341994$$

$$\approx 124 \rightarrow$$

$$\approx 127 \text{ yrs} \rightarrow$$

1992 + 124 = 2116 A.D. is the
year they hit 100,000

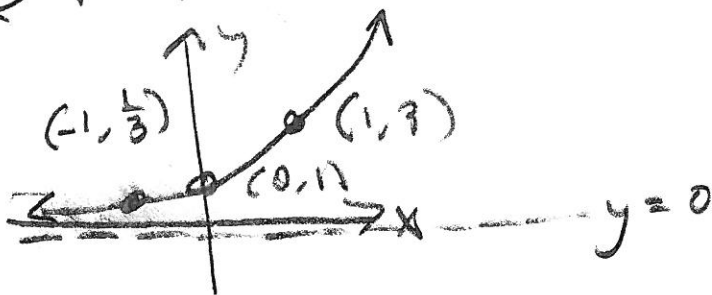
$$\frac{1992+127}{\boxed{2119 \text{ A.D.}}}$$

(assuming growth rate remains
constant 5% per annum.)

(B8)

$$g(x) = -5 \cdot 3^{3x+9} + 11$$

$$f(x) = 3^x$$



12)

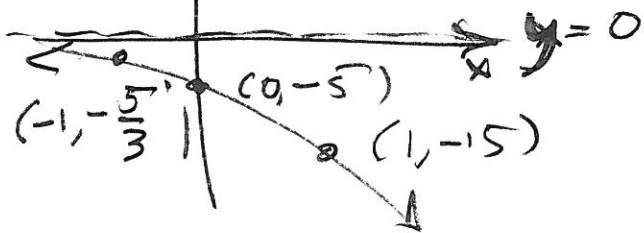
Ty

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B8 artikel

① $-5 \cdot 3^x$

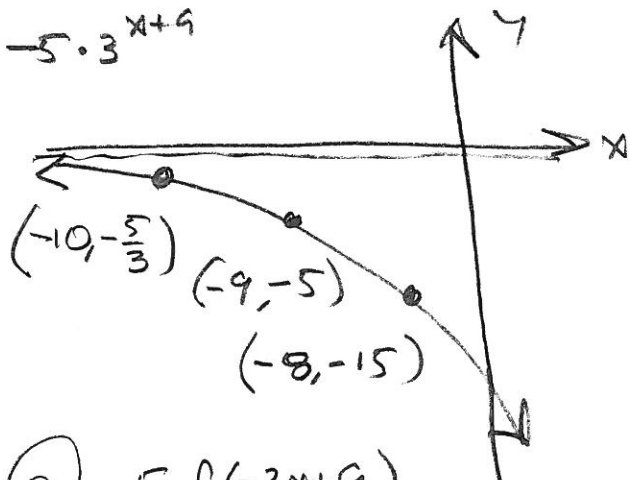
$y \mapsto -5y$



② $-3x + 9 = -3(x - 3)$

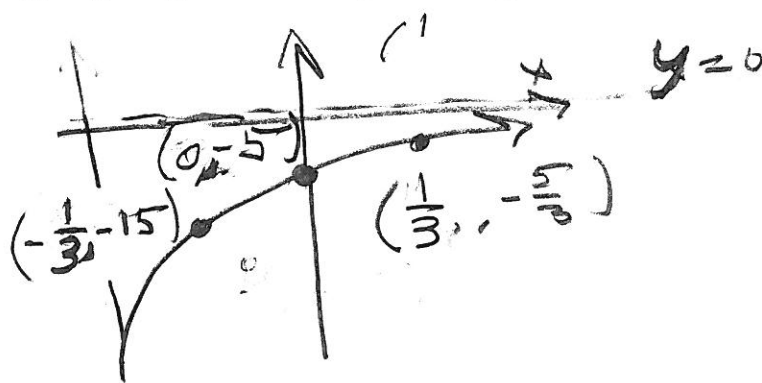
m1 $-5f(x+9)$ left +9

$-5 \cdot 3^{x+9}$



m2 $-5f(-3x)$

$= -5 \cdot 3^{-3x}$ $x \mapsto -\frac{1}{3}x$



③ $-5f(-3x+9)$

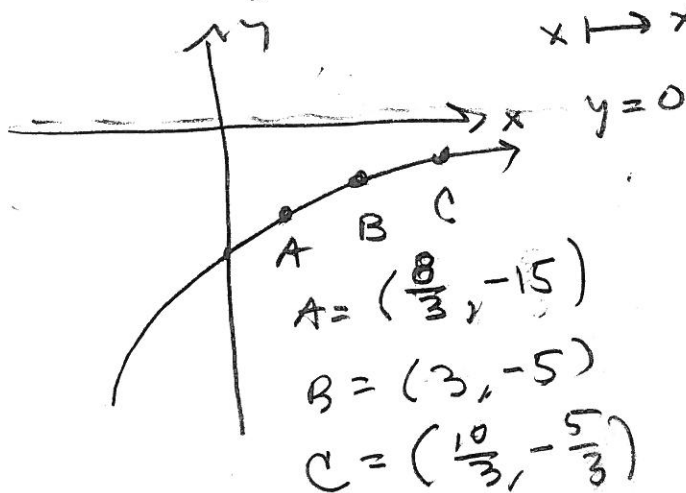
m1

$x \mapsto -\frac{1}{3}x$

$= -5(f(-3(x-3)))$

m2

$x \mapsto x+3$



A = $(\frac{10}{3}, -\frac{5}{3})$

B = $(3, -5)$

C = $(\frac{1}{3}, -15)$

m2

$-\frac{1}{3} + 3 = \frac{-1+9}{3} = \frac{8}{3} \checkmark$

$0 + 3 = 3 \checkmark$

$\frac{1}{3} + 3 = \frac{1+9}{3} = \frac{10}{3} \checkmark$

$\frac{-8}{-3} = \frac{8}{3} \checkmark$

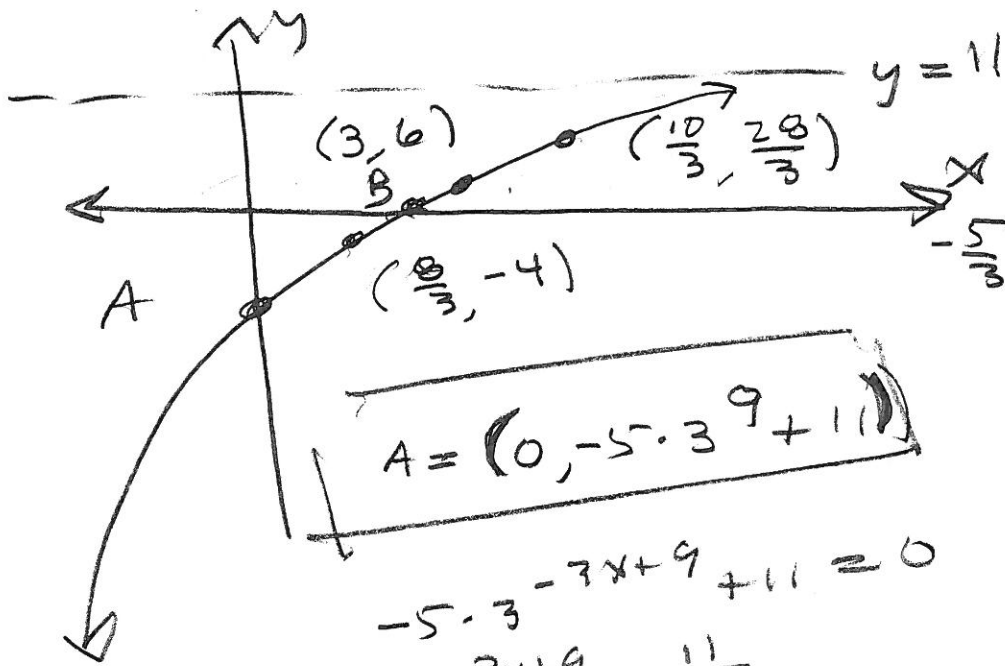
$\frac{-9}{-3} = 3 \checkmark$

$\frac{-10}{-3} = \frac{10}{3} \checkmark$

m1

38 entfel

$g(x) = -5 \cdot 3^{-3x+9} + 11$ up 11



$-\frac{5}{3} + \frac{33}{3} = \frac{28}{3}$

$A = (0, -5 \cdot 3^9 + 11)$

$-5 \cdot 3^{-3x+9} + 11 = 0$

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

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

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

x-int $B = (\frac{\log_3(11/5) - 9}{-3}, 0) = B$

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TY

(B9) (5 pts)

(15)

Want $FV = 100,000$

Don't know monthly pmts

$$r = 0.05, m = 12$$

$$t = 18 \text{ yrs}$$

Deriving Annuity Formula from

$$S = FV = R + R(1+i) + \dots + R(1+i)^{n-1} = \text{Scratch.}$$

$$-S(1+i) = R(1+i) + \dots + R(1+i)^{n-1} + R(1+i)^n$$

$$S - S(1+i) = R - R(1+i)^n$$

$$i = \frac{r}{m}, n = mt$$

$$S(1-i) = R(1-(1+i)^n)$$

$$-iS = R(1-(1+i)^n)$$

$$S = FV = \frac{R(1-(1+i)^n)}{-i} = \frac{R((1+i)^n - 1)}{i} = 100000$$

$$\rightarrow \frac{100000 \left(\frac{0.05}{12} \right)}{\left(1 + \frac{0.05}{12} \right)^{18 \cdot 12} - 1} \approx 286.3671853$$

$$\left(1 + \frac{0.05}{12} \right)^{18 \cdot 12} - 1$$

$$R \approx \$286.37 / \text{month}$$