Dead Sea Scrolls Willard Libby, a nuclear chemist from the University of Chicago, developed radiocarbon dating in the 1940s. This dating method, effective on specimens up to about 40,000 years old, works best on objects like shells, charred bones, and plants that contain organic matter (carbon). Libby's first great success came in 1951 when he dated the Dead Sea Scrolls. Carbon-14 has a half-life of 5730 years. If Libby found 79.3% of the original carbon-14 still present, then in about what year were the scrolls made?

$$A(t) = Ae^{-kt}$$

Melissa

$$A(5730) = Ae^{-5730k} = \frac{1}{2}A$$

$$k = -\frac{\ln(\frac{1}{2})}{5730}$$

$$A(t) = Ae^{-kt}$$

$$Ae^{-kt} = .793A$$

once you have k, you can solve for t & answer final question.

A is the amount of (radioactive) Carbon-14 remaining in the sample.

Read about Potassium-Argon dating in §4.4.

$$-kt = \ln(.793)$$

$$t = \frac{\ln(.793)}{-k} = \frac{\ln(.793)}{\ln(\frac{1}{2})} \cdot 5730$$

$$\approx 34\text{AD}.$$

How long will it take an investment to double if it's earning 5.7% APR, compounded...

... monthly?

... daily?

... continuously?

Test 3 #10

$$\boxed{R(x) = \frac{x^3-8x^2+x+42}{x^3-x^2-10x-8}} = \frac{(x-3)\cancel{(x+2)}(x-7)}{\cancel{(x+2)}(x-4)(x+1)}$$

In lowest terms, $R^*(x) = \frac{(x-3)^1(x-7)^1}{(x-4)^1(x+1)^1}$

$\mathcal{D} = \mathbb{R} \setminus \{-2,-1,4\}$

$\boxed{\text{V.A.: } x=4,\ x=-1}$

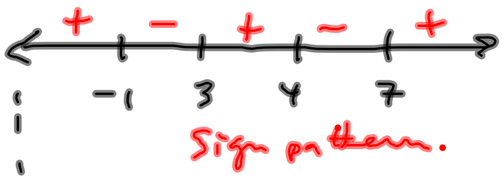
$\boxed{\text{Hole:}}$ $\boxed{x=-2:}$ $R^*(-2) = \frac{(-2-3)(-2-7)}{(-2-4)(-2+1)} = \frac{(-5)(-9)}{(-6)(-1)} = \frac{45}{6} = \frac{15}{2}$

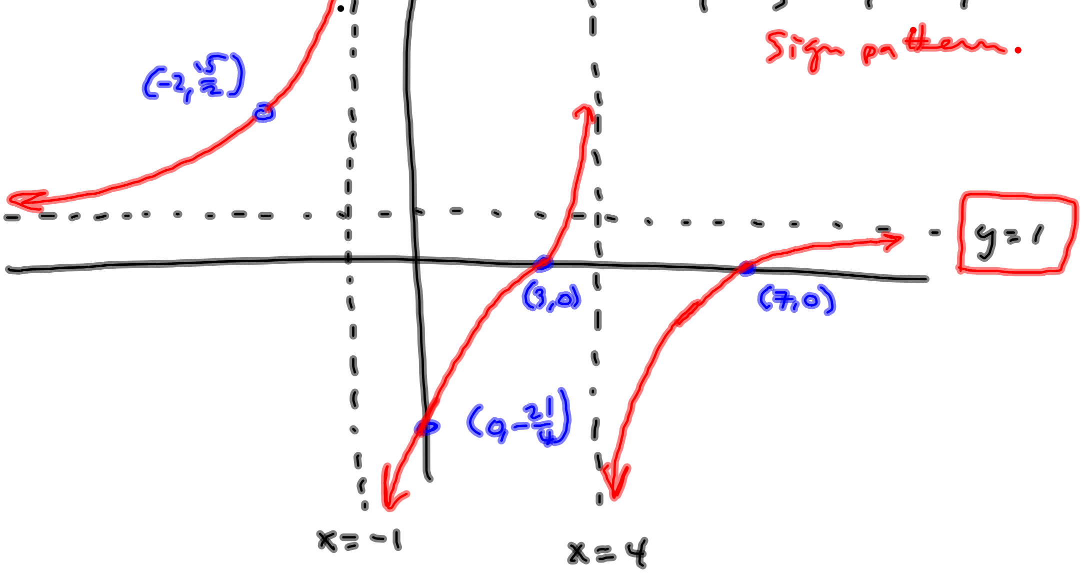
$\boxed{(-2, \tfrac{15}{2})}$

H.A.: $\frac{x^3}{x^3} = \boxed{1 = y}$ H.A.

y-int: $\frac{42}{-8} = \frac{21}{-4} = -\frac{21}{4} \rightsquigarrow \boxed{(0,-\tfrac{21}{4}) = \text{y-int}}$

x-int: $(3,0)$, $(7,0)$





Solve

$$300e^{-.5x} = \frac{1}{2}\cdot 300$$

Apparently started with 300g. This number is arbitrary.

Find the $\frac{1}{2}$-life of a radioactive substance with a decay rate of 50%.

Started with 300. When do we get to half that amount?

In general

$A(t) = Ae^{-kt}$ is the exponential decay model.

$A(t) = Ae^{kt}$ " " " growth model.

A population grew from 10,000 to 15000 in 5 years. (1) what's the growth rate?

(2) How long does it take for pop. to double?

(3) .... to triple?

Assume Pop. growth is exponential.

what's the model?

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

what do we know?

$$A(0) = Ae^{k \cdot 0} = A = 10000$$

we know

$$\boxed{A(t) = 10000e^{kt}}$$

&

$$A(5) = 10000e^{5k} = 15000$$

Solve for k.

$$\frac{10000e^{5k}}{10000} = \frac{15000}{10000}$$

$$e^{5k} = 1.5$$

$$\ln(e^{5k}) = \ln(1.5)$$

$$5k\ln(e) = \ln(1.5)$$

$$5k = \ln(1.5)$$

$$\frac{5k}{5} = \frac{\ln(1.5)}{5}$$

$$\boxed{k = \frac{\ln(1.5)}{5}} \approx .0810930216$$

$$A(t) = 10000e^{\frac{\ln(1.5)}{5}t}$$

$$\approx 10000e^{.0810930216t}$$

(2) What's doubling time?

Don't use .081 for k!

$$10000e^{kt} = 20000$$

In gen'l,

$$Ae^{kt} = 2A$$

$$e^{kt} = 2$$

$$\ln(e^{kt}) = \ln 2$$

$$kt = \ln 2$$

See how I just use 'k' until last step?

```
     7166.647073
ln(2)/(12*ln((1+
.04/12)))
     17.35754463
     17.35754463
ln(2)*5/ln(1.5)
     8.547556457
```

$$t = \frac{\ln 2}{k} = \frac{\ln 2}{\frac{\ln(1.5)}{5}} = \ln 2 \cdot \frac{5}{\ln(1.5)}$$

$$\approx 8.547556457 \approx 8.55$$

What if you used $k = .081$?

```
.04/12)))
     17.35754463
     17.35754463
ln(2)*5/ln(1.5)
     8.547556457
ln(2)/.081
     8.5573726
```

$8.5573726 \approx 8.56$

Save rounding to last step.

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Some 4.4

Solve:

$$6^{a+b} = 6^a 6^b$$

$$6^{\log_6(w-1) + \log_6(w-2)} = 6^1$$

$$\left(6^{\log_6(w-1)}\right)\left(6^{\log_6(w-2)}\right) = 6$$

$$(w-1)(w-2) = 6$$

$$w^2 - 3w + 2 = 6$$

$$w^2 - 3w - 4 = 0 \quad \text{etc.}$$

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$$\log(A)+\log(B)=\log(AB)$$

Solve:

$$\log_6(w-1)+\log_6(w-2)=1$$

$$6^{\log_6((w-1)(w-2))}=6^{1}$$

$$(w-1)(w-2)=6$$

Mar 23-9:35 AM

Mar 23-9:38 AM