§4.3 #s 81, 93, 51, 61

51 $\ln\left(\frac{6\sqrt{x-1}}{5x^3}\right) = \ln(6) + \ln\sqrt{x-1} - \ln(5) - \ln(x^3)$

$= \ln 6 + \frac{1}{2}\ln(x-1) - \ln(5) - 3\ln(x)$

$\ln(6\sqrt{x-1}) - \ln(5x^3)$

$= \ln 6 + \frac{1}{2}\ln(x-1) - [\ln 5 + \ln x^3]$

$\boxed{\ln 6 + \frac{1}{2}\ln(x-1) - \ln 5 - 3\ln x}$

Take it home

$\ln(6) + \ln\sqrt{x-1} - \ln 5 - \ln(x^3)$

$= \ln\left(\frac{6\sqrt{x-1}}{5x^3}\right)$

shiloh

61 $3\log_4(x^2) - 4\log_4(x^{-3}) + 2\log_4(x)$ Cody

$= \log_4((x^2)^3) - \log_4((x^{-3})^4) + \log_4(x^2)$

$+ \log_4((x^{-3})^{-4})$

$= \log_4(x^6) - \log_4(x^{-12}) + \log_4(x^2) = \log_4\left(\frac{x^6 \cdot x^2}{x^{-12}}\right)$

$\boxed{= \log_4(x^6 x^{12} \cdot x^2) = \log_4(x^{20})}$

#81 $(1+r)^3 = 2.3$ Variable in base is different.

My instinct is to take $\log_{1+r}((1+r)^3)$ but we're not trying to EXTRACT an exponent; rather, we're trying to get rid of it.

$$\sqrt[3]{(1+r)^3} = \sqrt[3]{2.3}$$

$$1+r = \sqrt[3]{2.3}$$

$$r = \sqrt[3]{2.3} - 1$$

$$\approx .3200$$

```
     6.614546582
10^Ans
         4116675
1257*3275
         4116675
2.3^(1/3)-1
     .3200061218
```

(98) 1960 a gallon of milk cost \$0.49
2009 " " " " " \$4.59

Use compound interest to the annual growth rate of the price of a gallon of milk.

Continuous? If not, how many periods/yr?

Annually compounded

$m=1$

4.7%

$$A(t) = P\left(1+\frac{r}{m}\right)^{mt} = P(1+r)^t$$

& we know @ $t=0$, we have

Madison

$$A(0) = P(1+r)^0 = P = 0.49$$

$$A(49) = .49(1+r)^{49} = 4.59$$

$$(1+r)^{49} = \frac{4.59}{.49}$$

$$\sqrt[49]{(1+r)^{49}} = \sqrt[49]{\frac{4.59}{.49}}$$

Keli: Write much think little.

$$1+r = \sqrt[49]{\frac{4.59}{.49}}$$

$$r = \sqrt[49]{\frac{4.59}{.49}} - 1$$

```
(4.59/.49)^(1/49
)-1
      .0467161145
```

$$\approx .0467161145$$

$\boxed{\text{Cnt}^{s} \text{ Version?}}$

$$A(t) = Pe^{rt}$$

$$A(0) = Pe^{r \cdot 0} = P = .49$$

$$A(t) = .49e^{rt}$$

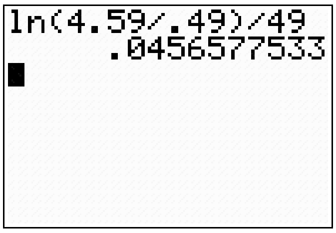
$$A(49) = .49e^{49r} = 4.59$$

$$e^{49r} = \frac{4.59}{.49}$$

$$\ln\left(e^{49r}\right) = \ln\left(\frac{4.59}{.49}\right)$$

$$49r = \ln\left(\frac{4.59}{.49}\right)$$

$$r = \frac{\ln\left(\frac{4.59}{.49}\right)}{49}$$



$$= \frac{\ln(4.59) - \ln(.49)}{49}$$

$$\approx .0456577533$$

$$= 4.56577533\ \%$$

When in doubt, & book WAS ambiguous, use continuous model.

$$Pe^{rt}$$

§4.4 Equations & Apps.

(4) $\log(x-6) = 1$

$\log(16-6) = \log(10) = 1$

$10^{\log(x-6)} = 10^1$

$x-6 = 10^1$

$\boxed{x = 16}$

(10) weird when base is variable in the log.

$-\frac{1}{2} = \log_x(9)$

$x^{-\frac{1}{2}} = x^{\log_x(9)}$

$x^2 = 4$

$\sqrt{x^2} = \sqrt{4}$

$x = 2$

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

$\frac{1}{\sqrt{x}} = 9$

$\sqrt{x^2} = |x|$

#4?

$1 = 9\sqrt{x}$

$\frac{1}{9} = \sqrt{x}$

$(\sqrt{x})^2 = x$

$\left(\frac{1}{9}\right)^2 = (\sqrt{x})^2$

$\boxed{\frac{1}{81} = x}$

#16 $\log_6(x-1)+\log_6(x-2)=1$

$\log_6((x-1)(x-2))=1$

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

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

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

$x^2-3x-4=0$ *

$(x-4)(x+1)=0$

$x-4=0$ OR $x+1=0$

$\boxed{x=4}$ OR $x=-1 \notin D$

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

$\log_6(4-1)+\log_6(4-2)=1$?

$\log_6(3)+\log_6(2)=1$?

$\log_6(6)=1$?

$1=1$ ✓

$\log_6(-1-1)+$ ~~ → Not Real

$x=-1 \notin D$ (question)

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

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

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

etc.

Radiometric Dating

C-14 has a $\frac{1}{2}$-life of 5730 yrs.

C-12 is the "natural" state of Carbon.

C-14 has an extra pair of neutrons.

chemically identical to C-12.

But radioactive, from the extra neutrons.

Forms in atmosphere when C-12 is bombarded by Cosmic Rays.

Happens at a steady rate & C-14 in atmosphere is constant.

when you / tree / ... dies, you separate from C-14 cycle. the C-14 is locked in your body & decays.

So something that has 20% as much C-14 in it as found in our atmosphere is how old?

$\frac{1}{2}$-life is 5730 years.

$A(t) = Pe^{rt}$

$A(5730) = Pe^{5730r} = \frac{1}{2}P$ Solve for r

$$e^{5730r} = \frac{1}{2}$$

$$\ln(e^{5730r}) = \ln\left(\frac{1}{2}\right) = -\ln 2$$

$$5730r = -\ln 2$$

$$r = -\frac{\ln 2}{5730}$$

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So $A(t) = Pe^{-\frac{\ln 2}{5730}t}$

Now to the main question: 20% C-14 is left.

$$Pe^{rt} = .2P$$

$$e^{rt} = .2$$

$$\ln(e^{rt}) = \ln(.2)$$

$$rt = \ln(.2)$$

$$t = \frac{\ln(.2)}{r} = \frac{\ln(.2)}{-\frac{\ln 2}{5730}}$$

$$= -\frac{5730\ln(.2)}{\ln(2)} \approx \boxed{13{,}304.64798 \text{ yrs.}}$$

```
-5730*ln(.2)/ln(
2)
      13304.64798
```

Does this make sense?

t	%	g
0	100	100g
5730	50	50g
11,460	25	25g
17190	12.5	12.5g

20% is here

Misc Probs.

a

$(x-2)(x+1)$

$= x^2 - x - 2$

Solve

$e^{2x} - e^{x} - 2 = 0$ $\qquad$ $e^{x} - 1 - 2e^{-x} = 0$

is quadratic in form.

Let $u = e^{x}$

$e^{2x} = (e^{x})^2$ Then we have

$u^2 - u - 2 = 0$

$(u-2)(u+1) = 0$

$u = -1$ OR $u = 2$

$\cancel{e^{x} = -1}$ $\qquad$ $e^{x} = 2$

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

$x = \ln(2)$

$e^{2x} - e^{x} - 2 = 0$

$e^{2\ln(2)} - e^{\ln 2} - 2 = 0$?

$e^{\ln(2^2)} - e^{\ln 2} - 2 = 0$?

$4 - 2 - 2 = 0$ ✓

§4.4 #s 1, 5, 9, 11, 15-21, 26, 27, 30, 41, 43, 49, 53, 59, 63, 65, 68, 75

#21 $\emptyset$

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