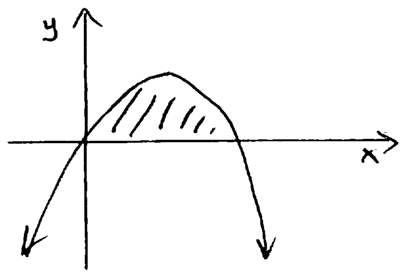
NORTH CAROLINA STATE UNIVERSITY   Department of Mathematics
Test #3   MA121-004   Form A   Wednesday, March 25, 2009   Dr. J. Griggs

Please put all work and answers in the stamped blue book provided. Begin new problems on a new page; it is OK to use the back of the paper as a new page. Do not use the graphics mode of a graphing calculator on a problem that requires YOU to graph. Do not use a calculator that does calculus. You may keep the test copy itself.

1.) The average salary of a major league baseball player in 1971 was \$139,502. The average salary had grown to \$615,654 by 1985. Use the exponential growth model to predict the average salary for a player for 2009.

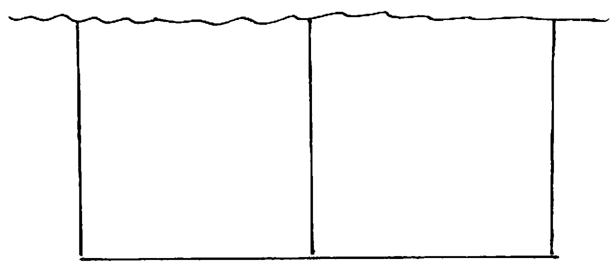
2.) Find the area bounded between the curve $f(x) = 4x - x^2$ and the x-axis.



3.) Find the derivative:

a.) $y = 3^x e^{5x}$ b.) $y = \ln(x^5 + 2x - 3)$

4.) A rancher wants to enclose two rectangular areas bordering a river, one for sheep and one for cattle. There is 240 yd of fencing available. What is the largest area that can be enclosed?



5.) Find the indefinite integrals:

a.) $\int (4x - 2\sqrt{x} + \frac{11}{x^4})dx$ b.) $\int (\frac{2}{x} + 5e^{2x})dx$

6.) After 11 days, a sample of radon-222 decayed to 38% of its original amount. What is the half-life of radon 222? How long will it take for the sample to decay to 10% of its original amount?

MA121-00 TEST #3 | 10 J. GRIGGS

FORM A

TEST SOLUTIONS (16 POINTS EACH)

1.) $y = y_0 \cdot e^{kt}$

1971 $(t=0)$ \$139,502

1985 $(t=14)$ \$615,654

2009 $(t=38)$???

$y = 139{,}502\, e^{kt}$

$615{,}654 = 139{,}502\, e^{k(14)}$

$\dfrac{615{,}654}{139{,}502} = e^{14k}$

$\ln\left(\dfrac{615{,}654}{139{,}502}\right) = 14k$

$k = \dfrac{\ln\left(\dfrac{615{,}654}{139{,}502}\right)}{14}$

$k \approx .10604$

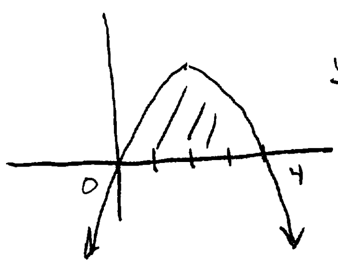
$y = 139{,}502\, e^{(.10604)t}$

$t = 38 \quad y = ??$

$y = 139{,}502\, e^{(.10604)(38)}$

$y = \$7{,}844{,}743.\underline{26}$

2.)



$y = 4x - x^2$

$y = x(4-x)$

$0 = x(4-x)$

$x=0, \; x=4$

$$\int_0^4 (4x - x^2)\,dx$$

$$= \left.\frac{4x^2}{2} - \frac{x^3}{3}\right]_0^4$$

$$= \left.2x^2 - \frac{x^3}{3}\right]_0^4 = \left(2(4)^2 - \frac{(4)^3}{3}\right) - (0-0)$$

$$= 32 - \frac{64}{3} = \frac{96}{3} - \frac{64}{3} = \frac{32}{3} \approx 10.67$$

3.) a.) $y' = 3^x \cdot d(e^{5x}) + e^{5x} \cdot d(3^x)$

$y' = 3^x \cdot e^{5x}(5) + e^{5x} \cdot 3^x \cdot \ln 3$

$y' = 3^x \cdot e^{5x}\,[5 + \ln 3]$

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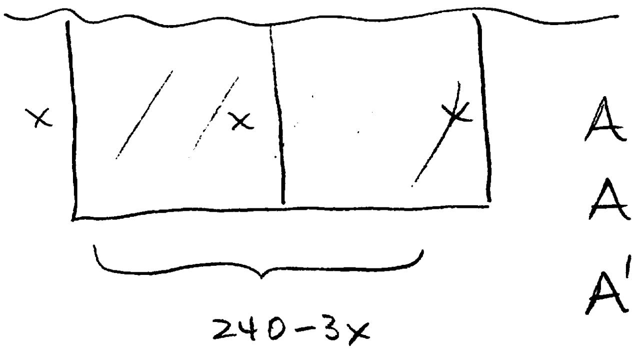
3.) b.) $y = \ln(x^5+2x-3)$

$$y' = \frac{1}{x^5+2x-3} \cdot d(x^5+2x-3)$$

$$y' = \frac{5x^4+2}{x^5+2x-3}$$

4.)



$A = x(240-3x)$

$A = 240x - 3x^2$

$A' = 240 - 6x$

$0 = 240 - 6x$

$6x = 240$

$x = 40$

$A'' = -6$

∴ CONC DOWN

∴ MAX

$x = 40$ $\quad 240-3x = 240-3(40)$

$= 240 - 120$

$= 120$

40 yds by 120 yds

$A = 4800$ sq. yds

5.) a.) $\int (4x - 2\sqrt{x} + \frac{11}{x^4})\,dx$

$= \int (4x - 2x^{1/2} + 11x^{-4})\,dx$

$= \frac{4x^2}{2} - 2\frac{x^{3/2}}{3/2} + 11\frac{x^{-3}}{-3} + C$

$= 2x^2 - \frac{4}{3}x^{3/2} - \frac{11}{3}x^{-3} + C$

b.) $\int \left(\frac{2}{x} + 5e^{2x}\right)dx$

$= \int \left(2 \cdot \frac{1}{x} + 5 \cdot e^{2x}\right)dx$

$= 2 \ln|x| + 5 \cdot \frac{1}{2} e^{2x} + C$

$= 2 \ln|x| + \frac{5}{2} e^{2x} + C$

6.) $t = 0$ 100%

$t = 11$ 38%

$y = y_0 \cdot e^{kt}$

$38\% = 100\% \, e^{k(11)}$

$.38 = e^{11k}$

$\ln .38 = 11k$

$k = \frac{\ln .38}{11}$

$\boxed{k \approx -.087962}$

half-life: $(t = ?)$

$50\% = 100\% \cdot e^{-.087962t}$

$.50 = e^{-.087962t}$

$\ln .50 = -.087962t$

$t = \frac{\ln .50}{-.087962} \approx \boxed{7.88 \text{ days}}$ half-life

$10\% = 100\% \cdot e^{-.087962t}$

$.10 = e^{-.087962t}$

$\ln .10 = -.087962t$

$t = \frac{\ln .10}{-.087962} \approx \boxed{26.18 \text{ days}}$ to reduce to 10% of orig amt.