RTMENT OF MATHEMATICS

Fall 2014

Student's Name _____ Course#_____ Prob.# #1 Date_____

Section Instructor__ _____ Sec.#_____

GRADING

HONOR PLEDGE: I pledge on my honor that I have not given or received any unauthorized assistance on this examination or assignment.

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Signature_____

a. $\lim_{x \to \frac{1}{2}} \frac{\sin(2x-1)}{8x-4}$ $\quad u = 2x-1$

$\lim_{u \to 0} \frac{\sin u}{4u} \quad \lim_{u \to 0} \frac{1}{4} \cdot \frac{\sin u}{u} = \frac{1}{4} \cdot 1 = \boxed{\frac{1}{4}}$

b. $\lim_{t \to 0} \sqrt{9-\sqrt{-t}}$

$\sqrt{9-\sqrt{-0}} = \sqrt{9-\sqrt{0}} = \sqrt{9-0} = \boxed{3}$

FALL 2014
2

DEPARTMENT OF MATHEMATICS

Student's Name_____ Course# FALL2014 Prob.# 2 Date_____
Section Instructor yankuk Sec.# 023

GRADING

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A) $f(t) = \frac{4}{t^2}$ $\quad f'(t) = \lim_{x \to t} \frac{F(x) - f(t)}{x - t}$

$$f'(t) = \lim_{x \to t} \frac{4/x^2 - 4/t^2}{x - t} \cdot \frac{x^2 t^2}{x^2 t^2}$$

$$= \lim_{x \to t} \frac{4t^2 - 4x^2}{(x-t)(x^2 t^2)}$$

$$= \lim_{x \to t} \frac{-4(x^2 - t^2)}{(x-t)(x^2 t^2)} = \frac{-4(x-t)(x+t)}{(x-t)(x^2 t^2)}$$

$$= \lim_{x \to t} \frac{-4(2t)}{t^4} = \frac{-8}{t^3}$$

$f'(t) = \frac{-8}{t^3}$

$f'(-1) = \frac{-8}{(-1)^3} = 8$

B) $q(x) = \frac{3}{x} = 3x^{-1}$ $\rightarrow (1, 3)$

$q'(x) = \frac{-3}{x^2}$

$q'(1) = \frac{-3}{1^2} = -3$

Tangent line:
$y - 3 = -3(x - 1)$
$y - 3 = -3x + 3$
$y = -3x + 6$

Fall 2014 # 2

DEPARTMENT OF MATHEMATICS

Student's Name_____ Course#_____ Prob.#_____ Date_____
Section Instructor_____ Sec.#_____

GRADING

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$f(x) = \frac{4}{x^2}$ $\quad f'(x) = \lim_{x \to -1} \left(\frac{\frac{4}{x^2} - \frac{4}{-1}}{x+1} \right)$

$$f'(x) = \lim_{x \to -1} \frac{\frac{4}{x^2} - \frac{4}{-1}}{x+1} = 4$$

$$f'(x) = \lim_{x \to -1} \frac{\frac{4}{x^2} + 4}{x+1} \Rightarrow \frac{4\left(\frac{1}{x^2}+1\right)}{x+1} \Rightarrow \frac{\frac{1}{x^2}\cdot\left(1+x^2\right)4}{x+1}$$

$$\Rightarrow \frac{\left(x^2+1\right)4}{x^2(x+1)} = \frac{(2x^2+2)4}{2x^2} \qquad \frac{x^2\left(1+\frac{1}{x^2}\right)4}{x^2(x+1)}$$

$$\frac{\frac{4}{x^2}+4}{x+1} \qquad \frac{\frac{1}{x^2}\left(4+4x^2\right)}{x+1} = \frac{\frac{1}{x^2}4\left(x^2+1\right)}{x+1} = \frac{4\left(x^2+1\right)}{x^2(x+1)} =$$

$$\frac{\frac{1}{x}\left(x^2+1\right)4}{x(x+1)} = \frac{\left(x+\frac{1}{x}\right)4}{x(x+1)} = \frac{4x\left(1+\frac{1}{x}\right)}{x(x+1)} = \frac{4x}{x} = \frac{4(-1)}{(-1)} = 4$$

Fall 2014

DEPARTMENT OF MATHEMATICS

Student's Name__ Course# 140 Prob.# 3 Date 5/4/17

Section Instructor__ Sec.# 011

GRADING

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3. a. $f(x) = \left(\frac{3x+5}{x^2+7}\right)^2$

$$f'(x) = 2\left(\frac{3x+5}{x^2+7}\right)\left(\frac{3(x^2+7) - (2x)(3x+5)}{(x^2+7)^2}\right)$$

b. $g(t) = t^{1/3}(e^{\sec t}) + \ln(4\pi)$

$$g'(t) = \left(\frac{1}{3}t^{-2/3}(e^{\sec t}) + \sec(t)\tan(t)e^{\sec t}(t^{1/3}) + 0\right)$$

Fall 2014 #4

4a) ~~$g(x) = x^3 - 5x + 3$~~ $2y^3 - 4x^2y + xy = 10$

$6y^2\frac{dy}{dx} - 4x^2\frac{dy}{dx} - 8xy + x\frac{dy}{dx} + y = 0$

$6y^2\frac{dy}{dx} - 4x^2\frac{dy}{dx} + x\frac{dy}{dx} = -8xy - y$

$\frac{dy}{dx}(6y^2 - 4x^2 + x) = -8xy - y$

~~$y'(1) = \frac{8(1)(2) - 2}{6(2)^2 - 4(1)^2 + 1} = \frac{14}{21} = \frac{2}{3}$~~

$\frac{dy}{dx} = \frac{8xy - y}{6y^2 - 4x^2 + x} = \frac{8(1)(2) - 2}{6(2)^2 - 4(1)^2 + 1} = \frac{14}{21} = \frac{2}{3}$

$\left.\frac{dy}{dx}\right|_{x=1} = \frac{2}{3}$

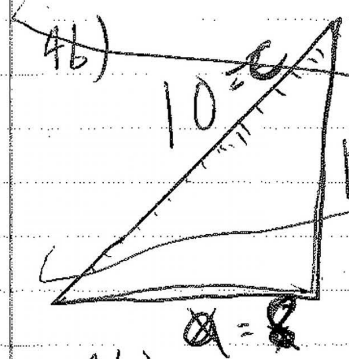
(1,2) $2(2)^3 - 4(1)^2(2) + (1)(2) = 10$

$16 - 8 + 2 = 10$

$10 = 10$ ✓

(1,2) ✓

4b)



When $a = 8$ $\frac{da}{dt} = \frac{1}{2} \times 1\ ft/s = 4\ ft/s$

Find $\frac{db}{dt}$

$8^2 + b^2 = 10^2$

$b^2 = 36$

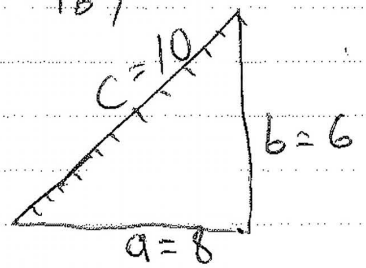
$b = 6$

$a^2 + b^2 = 100$

$2a\frac{da}{dt} + 2b\frac{db}{dt} = 0$

$2(8)\left(\frac{da}{dt}\right) + 2(6)\left(\frac{db}{dt}\right) = 0$

4b)



When $a = 8$ $\frac{da}{dt} = \frac{1}{2}(8)\ ft/s = 4\ ft/s$

Find $\frac{db}{dt}$

$a^2 + b^2 = 100$

$2a\frac{da}{dt} + 2b\frac{db}{dt} = 0$

$2(8)(4) + 2(6)\frac{db}{dt} =$

$64 + 12\frac{db}{dt} = 0$

$\frac{db}{dt} = -\frac{64}{12}$

$\frac{db}{dt} = -\frac{16}{3}$

Ladder falling at $\frac{16}{3}$ ft/s

DEPARTMENT OF MATHEMATICS

Student's Name_____ Course# 140 Prob.# F'14 #5 Date 5/4/17

Section Instructor_____ ec.#_____

GRADING

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a) $g(x) = x^3 - 5x + 3$ $[1, 2]$

$g(1) = -1$

$g(2) = 1$

$g(x)$ goes from $-$ to $+$ on $[1, 2]$, so it has to have a zero on $[1, 2]$

Newton Raphson: $c_2 = c_1 - \frac{g(x)}{g'(x)}$

$$c_2 = 1 - \frac{(-1)}{(-2)}$$

$$\boxed{c_2 = \frac{1}{2}}$$

b) $f(x) = x\sqrt{x+1}$ for $-1 \le x \le 1$ $[-1, 1]$

$$f'(x) = \sqrt{x+1} + \frac{x}{2\sqrt{x+1}}$$

$$0 = \sqrt{x+1} + \frac{x}{2\sqrt{x+1}}$$

$$-\sqrt{x+1} = \frac{x}{2\sqrt{x+1}}$$

$$\frac{-(2x+2)}{2\sqrt{x+1}} = \frac{x}{2\sqrt{x+1}}$$

$$0 = \frac{3x+2}{2\sqrt{x+1}}$$

$$\boxed{x = -\frac{3}{2}}$$

crit #'s @ $\frac{-3}{2}, -1$ (-1 not in domain of $f'(x)$)

x	$f(x)$
-1	0
$\frac{-3}{2}$	$-\frac{2}{3}\sqrt{\frac{1}{3}}$ $\quad -\frac{2}{3}\left(\sqrt{-\frac{3}{2}+1}\right) \rightarrow -\frac{2}{3}\sqrt{\frac{1}{3}}$
1	$\sqrt{2}$

min @ $x = -\frac{3}{2}$ $y = -\frac{2}{3}\sqrt{\frac{1}{3}}$

max @ $x = 1$ $y = \sqrt{2}$

Fall 2014 #6

$f(x) = x^2 + \frac{8}{x}$ $\quad f'(x) = \frac{2x^3 - 8}{x^2}$ $\quad f''(x) = \frac{2(x^3+8)}{x^3}$

(a) $f(0) = DNE$

$0 = x^2 + \frac{8}{x}$

$-\frac{8}{x} = x^2$

$-8 = x^3$

$x = -2$

y-int: DNE

x-int: $(-2, 0)$

$x = 0$

Vertical asymptote: $x = 0$

No Horizontal Asymptote

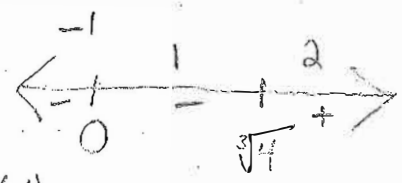
(b) $f'(x) = \frac{2x^3 - 8}{x^2}$

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

$2x^3 - 8 = 0$

$x^3 = 4$

$x = \sqrt[3]{4}$



$f'(-1) = -$

$f'(1) = -$

$f'(2) = +$

f is decreasing from $(-\infty, 0], [0, \sqrt[3]{4}]$

f is increasing from $[\sqrt[3]{4}, \infty)$

(c) $f''(x) = \frac{2(x^3+8)}{x^3}$

$x^3 = 0$

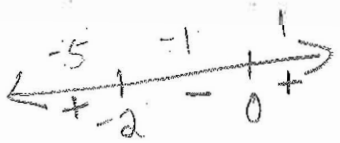
$x = 0$

$2x^3 + 16 = 0$

$2x^3 = -16$

$x^3 = -8$

$x = -2$



$f''(-5) = +$

$f''(-1) = -$

$f(1) = +$

Concave up from $(-\infty, -2) \cup (0, \infty)$

Concave down from $(-2, 0)$

(d) $f'(x) = \frac{2x^3 - 8}{x^2}$

$2x^3 - 8 = 0$

$x^3 = 4$

$x = \sqrt[3]{4}$

$f'(1) = -$

$f'(2) = +$

$f(\sqrt[3]{4}) = 4^{2/3} + \frac{8}{\sqrt[3]{4}} = 7.56$

relative min at $(\sqrt[3]{4}, 7.56)$

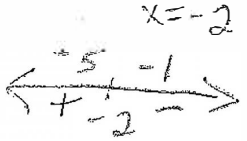
no relative max

(e) $\frac{2(x^3+8)}{x^3}$

$2x^3+16=0$

$x^3=-8$

$x=-2$

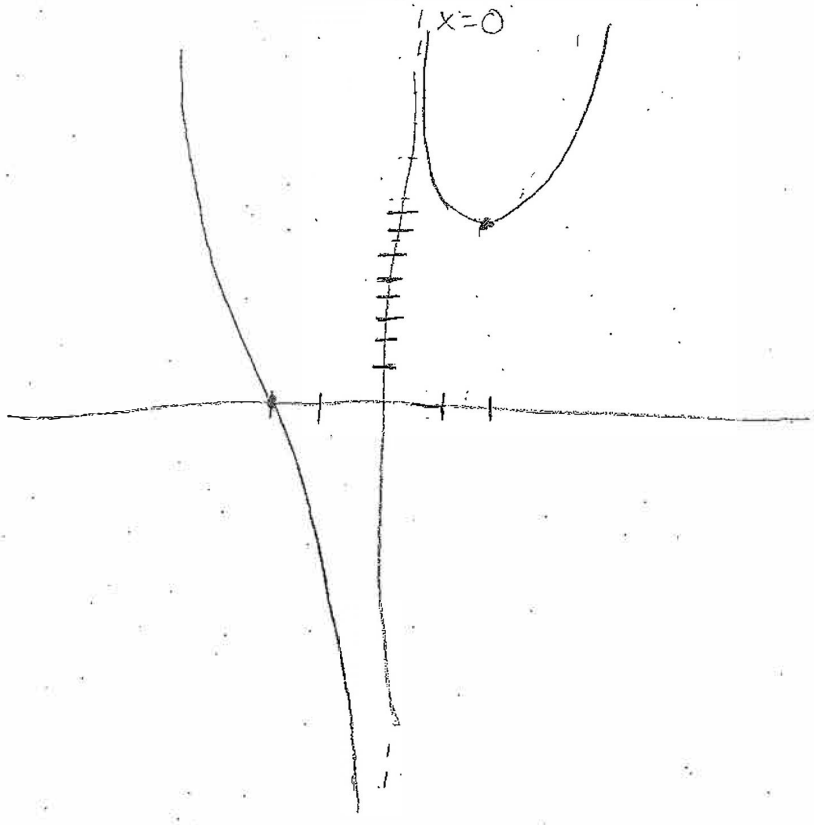


$f''(-5)=+$ $f''(-2)=\frac{0}{-8}=0$

$f''(-1)=-$

inflection point at $(-2,0)$

(f)



VA at $x=0$

$(-2,0)$ inflection and intercept

increase $[\sqrt[3]{4},\infty)$

decrease $[-\infty,0]\cup[0,\sqrt[3]{4}]$

up $(-\infty,-2)\cup(0,\infty)$

down $(-2,0)$

min $(\sqrt[3]{4}, 7.56)$

DEPARTMENT OF MATHEMATICS Fall 2014

Student's Name___ _____ Course#_____ Prob.# 7a Date_____
Section Instructor_ _____ Sec.#_____

GRADING

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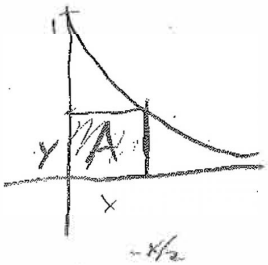
(7a) Max area of rectangle in first quadrant w/vertex at origin and opp. vertex at $y = e^{-x/2}$



$y = e^{-x/2}$

$A = x \cdot y = x \cdot e^{-x/2}$

$A'(x) = x \cdot \left(-\frac{1}{2}e^{-x/2}\right) + e^{-x/2} = \frac{-xe^{-x/2}}{2} + e^{-x/2} = \frac{-xe^{-x/2} + 2e^{-x/2}}{2} = -\left(\frac{e^{-x/2}(x-2)}{2}\right)$

set to 0 $\rightarrow$ $\frac{e^{-x/2}(x-2)}{2} = 0$

$e^{-x/2}$, no zeroes / $(x-2)$, 2

$A = 2 \cdot e^{-1}$

DEPARTMENT OF MATHEMATICS

Student's Name_____ Course# MATH Prob.# 140 Date May. 4. 2017
Section Instructor _____ Sec.#_____

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Fall 2014

8. (a) $H(x)=\int_{\sin x}^{\ln x}\tan(\pi t)\,dt = [H(x)]_{\sin x}^{\ln x} = H(\ln x)-H(\sin x)$

$H'(x)=\tan(\pi\ln x)\cdot(\ln x)'-\tan(\pi\sin x)\cdot(\sin x)'$

$=\tan(\pi\ln x)\frac{1}{x}-\tan(\pi\sin x)\cos x$

(b) $f(x)=3x^2-x$. $g(x)=x^2+3x$.

$f(x)=g(x)$

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

$(x-2)x=0$.

$x_1=0,\ x_2=2$.

$A=\int_0^2[g(x)-f(x)]\,dx$

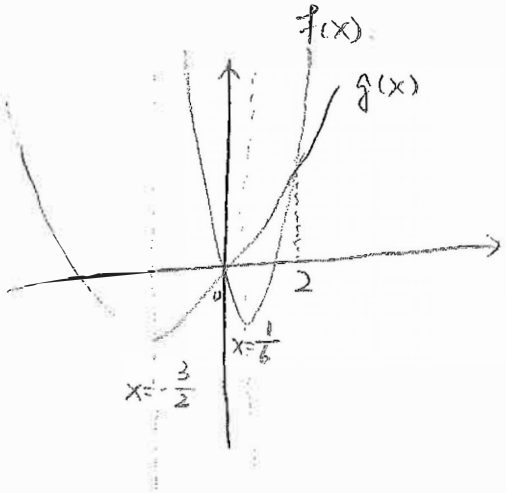
$=\int_0^2(-2x^2+4x)\,dx$

$=[-\frac{2}{3}x^3+2x^2]_0^2$

$=-\frac{2}{3}\cdot 8+2\cdot 4-0$

$=-\frac{16}{3}+\frac{24}{3}$

$=\frac{8}{3}$



DEPARTMENT OF MATHEMATICS

Student's Name_ _____ Course# Math 140 Prob.# 8 Date May. 4, 2017
Section Instructor_ _____ Sec.# 0113

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Fall 2014 #8

8.) a.) let $H(x) = \int_{\sin x}^{\ln x} \tan(\pi t)\,dt$, Find $H'(x)$.

$$H'(x) = \tan(\pi(\ln x)) \cdot \frac{1}{x} - \tan(\pi(\sin x)) \cdot \cos x$$

$$= \frac{\tan(\pi(\ln x))}{x} - \tan(\pi(\sin x))\cos x$$

b) let graph $f(x) = 3x^2 - x$ and $g(x) = x^2 + 3x$. Find the area A of the graphs f and g.

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

$2x^2 - 4x = 0$

$2x(x-2) = 0$

$x = 0, \; x = 2$

$3(1) - (1) = 2$ lower

$(1)^2 + 3(1) = 4$ upper

$$\int_0^2 x^2 + 3x - (3x^2 - x)\,dx$$

$$\int_0^2 -2x^2 + 4x\,dx \Rightarrow \frac{-2x^3}{3} + \frac{4x^2}{2}\Big|_0^2$$

$$\frac{-2(2)^3}{3} + \frac{4(2)^2}{2} - 0 = \frac{-16}{3} + \frac{16}{2} = \frac{-16}{3} + \frac{24}{3} = \boxed{\frac{8}{3}}$$

DEPARTMENT OF MATHEMATICS fall 2014

Student's Name__ Course# 140 Prob.# 9 Date_____
Section Instructor_ Sec.# 0123

GRADING

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Fall 2014 Problem 9

a) $\int_0^3 |y-2|\,dy$

$u = y-2$
$du = 1$
$f(0) = 0-2 = -2$
$f(3) = 3-2 = 1$

$\int_{-2}^{1} |u|\,du$

$\int_{-2}^{0} |u|\,du + \int_0^1 |u|\,du$

$\left|\frac{u^2}{2}\Big|_{-2}^{0}\right| + \left|\frac{u^2}{2}\Big|_0^1\right|$

$\left|0 - \frac{4}{2}\right| + \left|\frac{1}{2} - 0\right|$

$2\frac{1}{2}$

b) $\int_{-1}^{0} t^2\sqrt{1+t}\,dt$

$u = \sqrt{1+t}$ $\quad f(-1) = 0$
$du = \frac{1}{2\sqrt{t}}$ $\quad f(0) = 1$

$2\int_0^1 u^2(u^2-1)^2\,du$

$2\int_0^1 u^2(u^4-2u^2+1)\,du$

$2\int_0^1 u^6 - 2u^4 + u^2\,du$

$2\left(\frac{u^7}{7} - \frac{2u^5}{5} + \frac{u^5}{3}\Big|_0^1\right)$

$2\left(\frac{1}{7} - \frac{2}{5} + \frac{1}{3}\right)$

$2\left(\frac{15 - 42 + 35}{105}\right)$

$2\left(\frac{-27+35}{105}\right)$

$2\left(\frac{8}{105}\right)$

$\frac{16}{105}$