Instructor:	Frank Secretain
Course:	Math 7
Date:	September 25, 2025
Assessment:	Test 1
Time allowed:	110 minutes
Devices allowed:	Pencil, pen, eraser, calculator
Notes from instructor:	Be neat. Show your work where needed. Box final answers.
Marks allocated:	3 question worth 20 marks
Percentage of final grade:	20% of final grade

Formula Sheet

Order of Operations

$$ac + bc = c(a + b)$$

exponent rules

$$a^n a^m = a^{n+m} \qquad (a^n)^m = a^{nm} \qquad (ab)^n = a^n b^n$$

$$a^0 = 1 \qquad a^{-n} = \frac{1}{a^n} \qquad a^{\frac{n}{m}} = \sqrt[m]{a^n}$$

logarithmic rules

$$\log_b(b^x) = x \qquad b^{\log_b a} = a \qquad \log_b x = \frac{\log(x)}{\log(b)}$$

$$\log(xy) = \log(x) + \log(y) \qquad \log(x/y) = \log(x) - \log(y)$$

Forms of a 1st order polynomial $y = ax + b$

Forms of a 2nd order polynomial

$y = ax^2 + bx + c$ (expanded form)

$y = a(x - h)^2 + k$ (plotting form)

$y = (x - m)(x - n)$ (factored form)

Quadratic Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Definition of the derivative

$$\frac{d}{dx} f(x) = \lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

Rules of differentiation

$$\frac{\mathrm{d}}{\mathrm{dx}}(fg) = \frac{\mathrm{d}(f)}{\mathrm{dx}} g + f \frac{\mathrm{d}(g)}{\mathrm{dx}}$$ (product rule)

$$\frac{\mathrm{d}}{\mathrm{dx}}\left(\frac{f}{g}\right) = \frac{\frac{\mathrm{d}(f)}{\mathrm{dx}} g - f \frac{\mathrm{d}(g)}{\mathrm{dx}}}{g^2}$$ (quotient rule)

$$\frac{\mathrm{d}}{\mathrm{dx}}(f(g)) = \frac{\mathrm{d}(f)}{\mathrm{dx}} \frac{\mathrm{d}(g)}{\mathrm{dx}}$$ (chain rule)

Derivatives of select functions

$$\frac{d}{dx}(ax^n) = anx^{n-1}$$

$$\frac{d}{dx}(sin(x)) = cos(x)$$

$$\frac{d}{dx}(cos(x)) = -sin(x)$$

$$\frac{d}{dx}(tan(x)) = \frac{1}{(cos(x))^2}$$

$$\frac{d}{dx}(a^x) = a^x ln(a)$$

$$\frac{d}{dx}(log_a x) = \frac{1}{x ln(a)}$$

Integrals of select functions

$$\int ax^n dx = \left\{ \begin{array}{ll} \frac{a}{n+1} x^{n+1} & , n \neq -1 \\ ln(|x|) & , n = -1 \end{array} \right\}$$ (polynomials)

$$\int sin(ax)dx = -\frac{1}{a} cos(ax)$$

$$\int cos(ax)dx = \frac{1}{a} sin(ax)$$

$$\int tan(ax)dx = ln(|sec(x)|)$$ (trigonometry)

$$\int a^x dx = \frac{1}{ln(a)} a^x$$

$$\int ln(x)dx = x ln(x) - x$$ (exponentials)

(10 marks) Solve for x in the following equations:

$$\frac{2^x + 3}{5} + 1 = 3.1$$

$$\log(x^2 - 1) + 1 = 1.34$$

$$\frac{\ln(3x+1)}{2} + 1 = 2.1$$

$$1 + \log_x(4) = 2.1$$

$$\frac{e^x(e^x-1)}{e^x+1}=1$$

(1 mark each) Determine the limits of the following expressions:

$$\lim_{x\to 2}\frac{3x^2-3x-6}{x^2-2x}$$

$$\lim_{x\to \infty}\frac{3x^2-3x-6}{x^2-2x}$$

(2 marks each) Determine the derivative with respect to x of the following equation.

$$y(x) = \frac{3}{4}x^2 + \cos(x)$$

$$y(x) = x^3 \cos(x) - \frac{4}{x^2}$$

$$y(x) = x \sin(\alpha x^2 - x)$$

$$y^2 + \alpha y + \beta = A \sin(fx)$$

(10 marks) Solve for x in the following equations:

$$\frac{2^x + 3}{5} + 1 = 3.1$$

$$5\left(\frac{2^x + 3}{5}\right) = (2.1)5$$

$$2^x + 3 = 10.5$$

$$2^x = 7.5$$

$$\log_2(2^x) = \log_2(7.5)$$

$$x = \log_2(7.5)$$

$$= \frac{\log(7.5)}{\log(2)}$$

$$\boxed{x = 2.91}$$

$$\log(x^2 - 1) + 1 = 1.34$$

$$\log(x^2 - 1) = 0.34$$

$$10^{\log(x^2-1)} = 10^{0.34}$$

$$x^2 - 1 = 2.188$$

$$x^2 = 3.188$$

$$\sqrt{x^2} = \sqrt{3.188}$$

$$\boxed{x = 1.79}$$

$$\frac{\ln(3x+1)}{2} + 1 = 2.1$$

$$\frac{\ln(3x+1)}{2} = 1.1$$

$$\ln(3x+1) = 2.2$$

$$e^{\ln(3x+1)} = e^{2.2}$$

$$3x+1 = 9.025$$

$$\frac{3x}{3} = \frac{8.025}{3}$$

$$x = 2.68$$

$$1 + \log_x(4) = 2.1$$

$$\log_x(4) = 1.1$$

$$x^{\log_x(4)} = x^{1.1}$$

$$\sqrt[1.1]{4} = \sqrt[1.1]{x^{1.1}}$$

$$x = 3.53$$

$$\frac{e^x(e^x-1)}{e^x+1}=1$$

$$(e^x)^2 - e^x = e^x + 1$$

$$(e^x)^2 - 2e^x - 1 = 0$$

let $u = e^x$

so

$$u^2 - 2u - 1 = 0$$

$$u = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

$$u = 2.41 \text{ , } -0.41$$

and

$$u = e^x \text{ , } x = \ln(u)$$

so

$$\boxed{x = 0.88}$$

(1 mark each) Determine the limits of the following expressions:

$$\lim_{x\to 2} \frac{3x^2-3x-6}{x^2-2x}$$

$$\lim_{x\to 2} \frac{3(x-2)(x+1)}{x(x-2)} = \boxed{\frac{9}{2} = 4.5}$$

x^+	2.1	2.01	2.001
	4.429	4.493	4.499

x^-	1.9	1.99	1.999
	4.579	4.508	4.501

$\boxed{4.5}$

$$\lim_{x\to\infty} \frac{3x^2-3x-6}{x^2-2x} \frac{\left(\frac{1}{x^2}\right)}{\left(\frac{1}{x^2}\right)}$$

$$\lim_{x\to\infty} \frac{3 - \frac{3}{x}^{0} - \frac{6}{x^2}^{0}}{1 - \frac{2}{x}^{0}} = \boxed{3}$$

x^-	10^3	10^6	10^9
	3.003	3.000	3.000

$\boxed{3}$

(2 marks each) Determine the derivative with respect to x of the following equation.

$$y(x) = \frac{3}{4}x^2 + \cos(x)$$

$\frac{d}{dx}$

$$\frac{dy}{dx} = \frac{6}{4}x - \sin(x)$$

$$y(x) = x^3\cos(x) - \frac{4}{x^2}$$

$$y(x) = x^3\cos(x) - 4x^{-2}$$

$\frac{d}{dx}$

$$\frac{dy}{dx} = 3x^2\cos(x) - x^3\sin(x) + 8x^{-3}$$

$$y(x) = x\sin(\alpha x^2 - x)$$

$\frac{d}{dx}$

$$\frac{dy}{dx} = \sin(\alpha x^2 - x) + x\cos(\alpha x^2 - x)(2\alpha x - 1)$$

$$y^2 + \alpha y + \beta = A\sin(fx)$$

$\frac{d}{dx}$

$$2y\frac{dy}{dx} + \alpha\frac{dy}{dx} = A\cos(fx)(f)$$

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(product rule) (quotient rule) (chain rule)

Derivatives of select functions

$$\frac{d}{dx}(ax^n) = anx^{n-1}$$

$$\frac{d}{dx}(sin(x)) = cos(x)$$

$$\frac{d}{dx}(cos(x)) = -sin(x)$$

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Integrals of select functions

$$\int ax^n dx = \left\{ \begin{array}{ll} \frac{a}{n+1} x^{n+1} & , n \neq -1 \\ ln(|x|) & , n = -1 \end{array} \right\}$$ (polynomials)

$$\int sin(ax)dx = -\frac{1}{a} cos(ax)$$

$$\int cos(ax)dx = \frac{1}{a} sin(ax)$$ (trigonometry)

$$\int tan(ax)dx = ln(|sec(x)|)$$

$$\int a^x dx = \frac{1}{ln(a)} a^x$$

$$\int ln(x)dx = x ln(x) - x$$ (exponentials)

(10 marks) Solve for x in the following equations:

$$\frac{1+4^x}{2} = 3$$

$$log(2x-1)+1 = 3$$

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

$$1+\log_x(2)=3$$

$$\frac{e^x(1+e^x)}{3} = 1 - \frac{e^x}{3}$$

(1 mark each) Determine the limits of the following expressions:

$$\lim_{x \to 1} \frac{x^2 + x - 2}{x - 1}$$

$$\lim_{x \to \infty} \frac{3x^2 + 2x + 12}{2x^2 - 1000}$$

(2 marks each) Determine the derivative with respect to x of the following equation.

$$y(x) = 4x - 2$$

$$y(x) = \frac{\alpha\epsilon^2}{2}x^4 + \beta\cos(x) + 1$$

$$y(x) = \frac{\alpha\epsilon^2}{2}x^4\cos(x) + 1$$

$$\frac{y(x)^2}{2} + xy(x) = \sin x$$

(10 marks) Solve for x in the following equations:

$$\frac{1+4^x}{2} = 3$$

$1 + 4^x = 6$

$4^x = 5$

$\log_4(4^x) = \log_4(5)$

$x = \log_4(5)$

$x = \frac{\log(5)}{\log(4)}$

$\boxed{x = 1.16}$

$$log(2x-1)+1 = 3$$

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

$10^{\log(2x-1)} = 10^2$

$2x - 1 = 100$

$x = \frac{101}{2}$

$\boxed{x = 50.5}$

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

$$\ln(x^2-1)=4$$

$$e^{\ln(x^2-1)}=e^4$$

$$x^2-1=e^4$$

$$x=\sqrt{e^4+1}$$

$$\boxed{x=7.46}$$

$$1+\log_x(2)=3$$

$$\log_x(2)=2$$

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

$$2=x^2$$

$$x=\sqrt{2}$$

$$\boxed{x=1.41}$$

$$\frac{e^x(1+e^x)}{3} = 1 - \frac{e^x}{3}$$

$e^x + (e^x)^2 = 3 - e^x$

$(e^x)^2 + 2e^x = 3$

let $u = e^x$

so

$u^2 + 2u - 3 = 0$

$u = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$u = 1, -3$

$x = \ln(u)$

$x = \ln(1)$

$\boxed{x = 0}$

(1 mark each) Determine the limits of the following expressions:

$$\lim_{x \to 1} \frac{x^2 + x - 2}{x - 1}$$

$\lim\limits_{x \to 1} \dfrac{(x-1)(x+2)}{x-1} = \boxed{3}$

x^+	1.1	1.01	1.001
	3.1	3.01	3.001

x^-	0.9	0.99	0.999
	2.9	2.99	2.999

$> \boxed{3}$

$$\lim_{x \to \infty} \frac{3x^2 + 2x + 12}{2x^2 - 1000} \frac{\left(\frac{1}{x^2}\right)}{\left(\frac{1}{x^2}\right)}$$

$\lim\limits_{x \to \infty} \dfrac{3 + \frac{2}{x} + \frac{12}{x^2}}{2 - \frac{1000}{x^2}} = \boxed{\frac{3}{2}}$

x^-	10^3	10^6	10^9
	1.502	1.50	1.50

$\boxed{1.5}$

(2 marks each) Determine the derivative with respect to x of the following equation.

$$y(x) = 4x - 2$$

$\frac{d}{dx}$

$$\frac{dy}{dx} = 4$$

$$y(x) = \frac{\alpha\epsilon^2}{2}x^4 + \beta\cos(x) + 1$$

$\frac{d}{dx}$

$$\frac{dy}{dx} = \frac{4\alpha\epsilon^2}{2}x^3 - \beta\sin(x)$$

$$y(x) = \frac{\alpha\epsilon^2}{2} x^4 \cos(x) + 1$$

$\frac{d}{dx}$

$$\frac{dy}{dx} = \frac{4\alpha\epsilon^2}{2} x^3 \cos(x) - \frac{\alpha\epsilon^2}{2} x^4 \sin(x)$$

$$\frac{y(x)^2}{2} + xy(x) = \sin x$$

$\frac{d}{dx}$

$$y\frac{dy}{dx} + y + x\frac{dy}{dx} = \cos(x)$$