Instructor:	Frank Secretain
Course:	Math 2000
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:	1 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

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

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

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

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

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

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

Integrals of select functions

(polynomials)

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

(trigonometry)

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

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

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

(exponentials)

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

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

(2 marks each) Solve for x in the following equations:

$$3^x = 10$$

$$\log(x) = 0.23$$

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

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

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

$$e^{3x-1} + 1 = 2.1$$

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

$$\frac{\log_x(3) - 1}{\ln(3) - 1} = 3$$

$$e^{3x}e^{1-x} + 1 = 32$$

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

(2 marks each) Solve for x in the following equations:

$$3^x = 10$$

$$\log_3(3^x) = \log_3(10)$$

$$x = \log_3(10)$$

$$= \frac{\log(10)}{\log(3)}$$

$$\boxed{x = 2.1}$$

$$\log(x) = 0.23$$

$$10^{\log(x)} = 10^{0.23}$$

$$\boxed{x = 1.7}$$

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

$-1 \quad -1$

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

$$2^x + 3 = 10.5$$

$-3 \quad -3$

$$2^x = 7.5$$

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

$$x = \log_2(7.5)$$

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

$$\boxed{x = 2.9}$$

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

$-1 \quad -1$

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

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

$$x^2 - 1 = 2.19$$

$+1 \quad +1$

$$\sqrt{x^2} = \sqrt{3.19}$$

$$\boxed{x = 1.79}$$

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

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

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

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

$$3x + 1 = 9.03$$

$$\frac{3x}{3} = \frac{8.03}{3}$$

$$\boxed{x = 2.7}$$

$$e^{3x-1} + 1 = 2.1$$

$$e^{3x-1} = 1.1$$

$$\ln\left(e^{3x-1}\right) = \ln(1.1)$$

$$3x - 1 = 0.0953$$

$$\frac{3x}{3} = \frac{1.0953}{3}$$

$$\boxed{x = 0.37}$$

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

$$\log_x(4) = 1.1$$

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

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

$$\boxed{x = 3.5}$$

$$(\ln(3)-1)\left(\frac{\log_x(3) - 1}{\ln(3) - 1}\right) = (3)(\ln(3)-1)$$

$$\log_x(3) - 1 = 3(\ln(3) - 1)$$

$$\log_x(3) - 1 = 0.296$$

$$\log_x(3) = 1.296$$

$$x^{\log_x(3)} = x^{1.296}$$

$$3 = x^{1.296}$$

$$\sqrt[1.296]{3} = \sqrt[1.296]{x^{1.296}}$$

$$\boxed{x = 2.3}$$

$$e^{3x}e^{1-x}+1=32$$

$$e^{3x+1-x}+1=32$$

$$e^{2x+1}=31$$

$$\ln(e^{2x+1})=\ln(31)$$

$$2x+1=3.43$$

$$\frac{2x}{2}=\frac{2.43}{2}$$

$$\boxed{x=1.2}$$

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

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

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

let $u=e^x$

so

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

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

$$u=2.41\ ,\ -0.41$$

and

$$u=e^x$$

$$x=\ln(u)$$

so

$$x=\ln(2.41)\ ,\ \ln(-0.41)$$ (error)

$$\boxed{x=0.88}$$

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(quotient rule)

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

(trigonometry)

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

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

(exponentials)

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

$$2^x = 19$$

$$\log x = 0.12$$

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

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

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

$$e^{2x-1} - 1 = 2$$

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

$$\frac{\log_x(2) - 1}{\log(2) + 1} = 4$$

$$e^{2x}e^{x-1} + 1 = 17.2$$

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

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

$$2^x = 19$$

$\log_2(2^x) = \log_2(19)$

$x = \log_2(19)$

$= \frac{\log(19)}{\log(2)}$

$x = 4.25$

$$\log x = 0.12$$

$10^{\log(x)} = 10^{0.12}$

$x = 1.32$

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

$$1 + 4^x = 6$$

$$4^x = 5$$

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

$$x = \log_4(5)$$

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

$$\boxed{x = 1.16}$$

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

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

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

$$2x - 1 = 100$$

$$2x = 101$$

$$\boxed{x = 50.5}$$

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

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

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

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

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

$$\boxed{x = 7.46}$$

$$e^{2x-1}-1=2$$

$$e^{2x-1} = 3$$

$$\ln\left(e^{2x-1}\right) = \ln(3)$$

$$2x-1 = \ln(3)$$

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

$$\boxed{x = 1.05}$$

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

$$\log_x(2) = 2$$

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

$$2 = x^2$$

$$x = \sqrt{2}$$

$$\boxed{x = 1{,}41}$$

$$\frac{\log_x(2) - 1}{\log(2) + 1} = 4$$

$$\log_x(2) - 1 = 4(\log(2) + 1)$$

$$x^{\log_x(2)} = x^{4(\log(2)+1)+1}$$

$$2 = x^{6{,}20}$$

$$x = \sqrt[6{,}2]{2}$$

$$\boxed{x = 1{,}12}$$

$$e^{2x}e^{x-1}+1=17.2$$

$$e^{2x+x-1}=16.2$$

$$\ln\left(e^{3x-1}\right)=\ln(16.2)$$

$$3x-1=\ln(16.2)$$

$$x=\frac{\ln(16.2)+1}{3}$$

$$\boxed{x=1.26}$$

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

$$e^{x}+\left(e^{x}\right)^{2}=3-e^{x}$$

$$\left(e^{x}\right)^{2}+2e^{x}=3$$

let $u=e^{x}$

so

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

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

$$u=1,-3$$

$$x=\ln(u)$$

$$x=\ln(1)$$

$$\boxed{x=0}$$