06-262 NAME:______________________________

Math. Methods of ChE

1. Differentiate the following:

$$\frac{d}{dq}\cos(q) = -\sin(q)$$

$$\frac{d^2}{dy^2}(y^5 + 4y) = \frac{d}{dq}(5y^4 + 4) = 20\,y^3$$

2. Solve the following integrals:

$$\int \frac{1}{r}\,dr = \ln(r) + \mathbf{C}$$

$$\int_0^{\pi} \sin(\omega)\,d\omega = -\cos(\omega)\Big|_0^{\pi} = -(-1) + 1 = 2$$

$$\int_0^{\tau} e^{-3t}\,dt = -\frac{1}{3}e^{-3t}\Big|_0^{\tau} = -\frac{1}{3}e^{-3\tau} + \frac{1}{3}$$

(Evaluate at $\tau \to \infty$) $\to 1/3$

3. Solve the following for f(x):

$$\frac{df}{dx} = 4 \qquad f(x) = \int 4\,dx = 4x + C$$

$$\frac{df}{dx} = x \qquad f(x) = \int x\,dx = \frac{1}{2}x^2 + C$$

4. Evaluate or re-express the following:

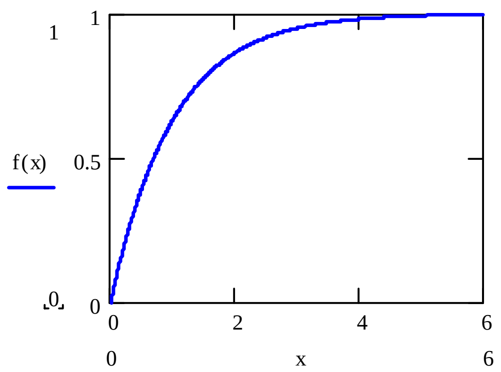
$$\frac{e^{2x}}{e^{-4x}} = \quad \exp(6x)$$

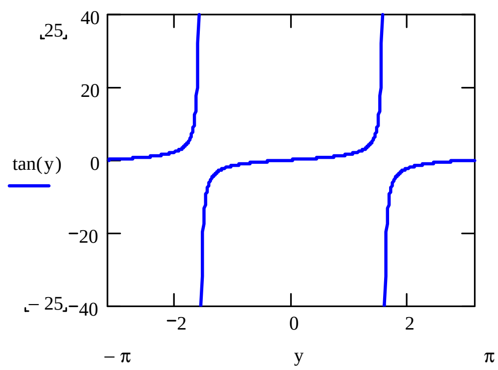
$$\ln(xy/z) = \ln(x) + \ln(y) - \ln(z)$$

$$\sin^2(\theta) + \cos^2(\theta) = 1$$

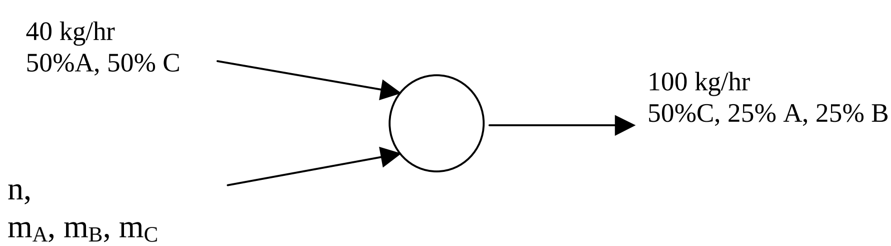
5. Sketch the following two functions and label any descriptive features:

f(x) = 1 - exp(-x)   g(y) = tan(y)





6. The mixer drawn below combines two streams containing A, B and the infamous C. Assuming steady state operation, what is the rate and composition of the unknown stream?



Accumulation = Input – Output + Generation – Consumption

Total: 0 = 40 kg/hr + n – 100 kg/hr => n = 60 kg/hr

Balance on A: 0 = 20 kg/hr + m_A n – 25 kg/hr => m_A = 5/60 = 0.08

Balance on B: 0 = m_B n – 25 kg/hr => m_B = 25/60 = 0.42

Balance on C: 0 = 20 kg/hr + m_C n – 50 kg/hr => m_C = 30/60 = 0.5

So, the unknown stream flows at **60 kg/hr and is 8%A, 42% B and 50% C**