



## Handout 5

MATH 172 Lab: Sections 7 and 8

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Note: This handout covers only differential equations and integration by parts.

Instruction: Work in groups to solve the following mathematical problems. DON'T AFRAID TO MAKE MISTAKES BECAUSE WE LEARN FROM OUR MISTAKES!

Problem 1: Find the general solution of the given differential equation:

$$\frac{dy}{dx} = \frac{\sqrt{1 - y^2}}{\sqrt{1 - x^2}}$$

(Hint: General solution means that you need to write it as y(x) as we did in the Differential Equations Lab on Thursday)

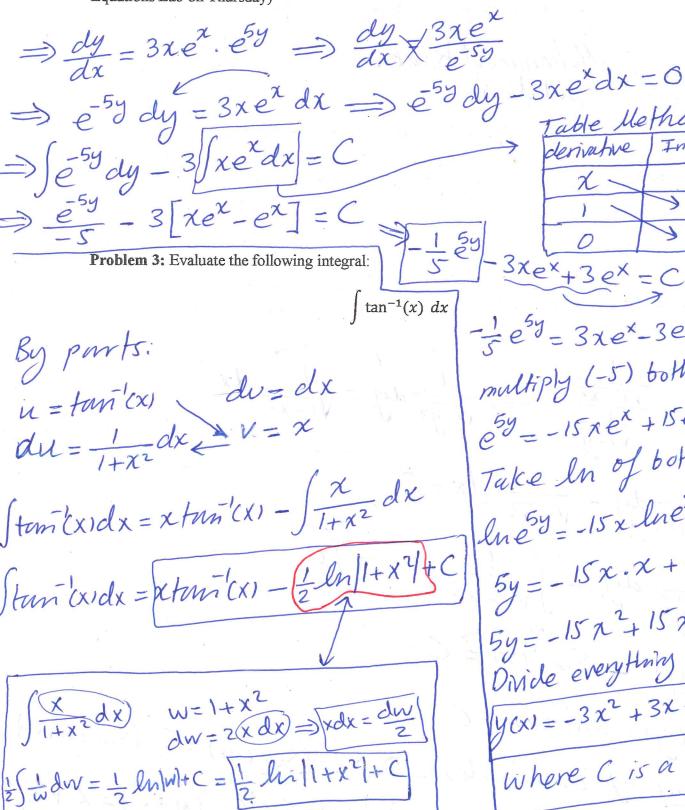
 $\frac{dy}{dx} \times \frac{1}{\sqrt{1-x^2}} \implies \frac{1}{\sqrt{1-y^2}} dy = \frac{1}{\sqrt{1-x^2}} dx$   $\Rightarrow \frac{1}{\sqrt{1-y^2}} dy - \frac{1}{\sqrt{1-x^2}} dx = 0$   $\Rightarrow \int \frac{1}{\sqrt{1-y^2}} dy - \int \frac{1}{\sqrt{1-x^2}} dx = \int 0$   $\Rightarrow \int \sin^{-1}(y) - \sin^{-1}(x) = C$   $\Rightarrow \sin^{-1}(y) = \sin^{-1}(x) + C$   $\Rightarrow \sin^{-1}(y) = \sin^{-1}(x) + C$ 

Tarke Sin of both sides = Sin (Sin (y)) = Sin (Sin (x)+C) = X+C = Sin (Sin (x)+C) = X+C = Sin (Sin (x)+C) = X+C

**Problem 2:** Find the general solution of the given differential equation:

$$\frac{dy}{dx} = 3xe^{(x+5y)} \longrightarrow e^{x} \cdot e^{5y}$$

(Hint: General solution means that you need to write it as y(x) as we did in the Differential Equations Lab on Thursday)



-1 e3 = 3xex-3ex+C multiply (-5) both sides e3 = - 15xex + 15ex + C Take In of both sides lue"= -15x luex+15luex+C  $5y = -15x \cdot x + 15x + C$ 5y=-1522+15x+C Divide everything by 50  $|y(x) = -3x^2 + 3x + C$ where C is a constant.

Challenging Problem: Solve the following differential equation:

$$\frac{dy}{dx} = \frac{\sin(5x+y)}{\cos(5x+y) - 2\sin(5x+y)} - 5$$

(Hint: No need to write your solution as y(x))

$$\frac{dw}{dx} = 5 + \frac{dy}{dx} \implies \frac{dy}{dx} = \frac{dw}{dx} - 5$$

$$= \frac{dw}{dx} - 5 = \frac{\sin(5x+y)}{\cos(5x+y) - 2\sin(5x+y)} - 8$$

$$=) \frac{dw}{dx} = \frac{\sin(w)}{\cos(w) - 2\sin(w)}$$

$$\Rightarrow \frac{dw}{dx} \times \frac{1}{(\cos(w) - 2\sin(w))}$$

Sin(w)
$$\frac{\sin(w)}{\sin(w)} = dx \Rightarrow \frac{\cos(w) - 2\sin(w)dw}{\sin(w)} dx = 0$$
Sin(w)

$$\Rightarrow \left(\frac{\cos(w) - 2\sin(w)}{\sin(w)}dw - \int dx = \int 0$$

$$=) \frac{(\cos(w))}{\sin(w)} dw - 2 = C$$

$$= \frac{(\cos(w))}{\sin(w)} dw - 2 = C$$

$$\Rightarrow \ln |Sin(w)| - 2w - x = C$$
Good Luck in Quiz 3
$$\Rightarrow \ln |Sin(w)| - 2w - x = C$$
Best Regards,
Mohammed Kaahar

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=) 
$$\ln \left| Sin(5x+y) \right| + 2(5x+y) - X = C$$