Math 45, Fall 2020
September 23, Quiz 04

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Please show and explain your work where necessary. Good luck!!

1. (*7 points*) Consider the differential equation $y' = y\sqrt{y-x}$. ← already in $F(x,y)$

(i) For what (x, y) is it guaranteed that the differential equation above has a unique solution?

• continuous (x_0, y_0)? not cont at $-x$

• $\frac{d}{dy}F(x,y)$?

$y\sqrt{y-x} \to y - x \leq 0$

$y \geq x$

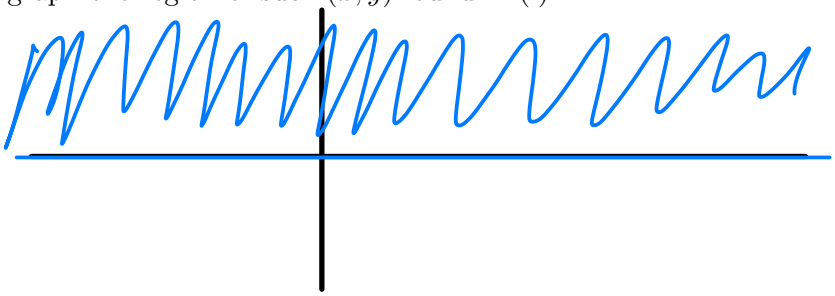
$\left[y\sqrt{y-x}\right]'$

$\to y\left[(y-x)^{\frac{1}{2}}\right]$

$\to -\frac{y}{2\sqrt{y-x}}$

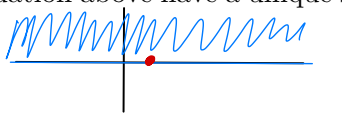
all x, y s.t. $y \geq x$?

(ii) In the xy-plane, graph the region of such (x, y) found in (i).



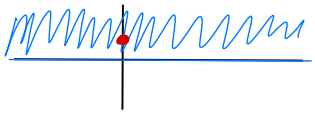
(iii) Is it guaranteed that the differential equation above have a unique solution at the point $(1, 0)$?

Yes ?



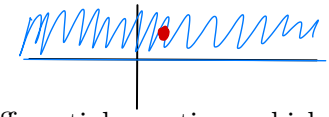
(iv) Same problem as in (iii) but for $(0, 1)$?

Yes



(v) Same problem as in (iii) but for $(1, 1)$?

Yes



2. (*3 points*) Circle all of the following differential equations which are separable equations.

(i) $\frac{dy}{dx} = x^2y^3$

(ii) $\frac{dy}{dx} = \ln(xy)$

(iii) $w\frac{dw}{dt} = 10 + t$

(iv) $\sqrt{y'} + xy = 0$

(v) $y' + xy + x = 0$

(vi) $xy\frac{dy}{dx} + 1 = 0$

Can make x, y on opposite sides of equal sign