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

1. (7 points) Consider the differential equation $y' = y\sqrt{y-x}$. \leftarrow 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 $-x$

• $\frac{d}{dy} F(x,y)$?

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

$$y \geq x$$

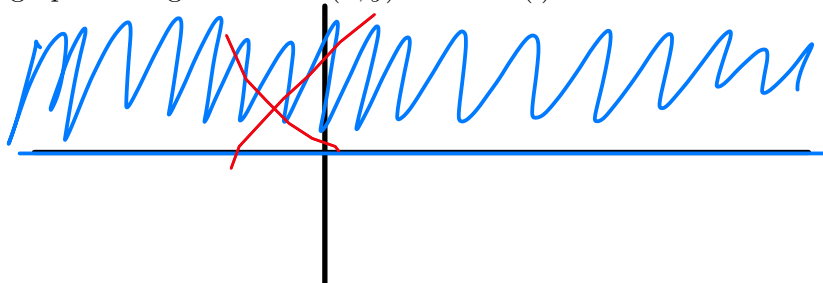
$$[y\sqrt{y-x}]'$$

$$\rightarrow y[(y-x)^{-1/2}]'$$

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

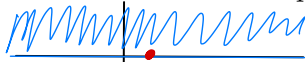
all x, y s.t.
 $y \geq x$

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



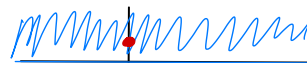
(iii) Is it guaranteed that the differential equation above have a unique solution at the point $(1,0)$?

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

(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