Your homework assignment was:

• Thomas §9.1 9, 12, 17, 18

Question 1. Does sqrt mean square root?

Answer. Yes.

Question 2. I'm not sure what the answer is for suppose $y' = 2x \operatorname{sqrt}(1 - y^2)$. Suppose $y' = 2x \operatorname{sqrt}(1 - y^2)$, what is y? I have no clue but i tried. How do you do the question above? Is it separation of variables?

Answer. This was homework problem # 17, but not one has asked (yet) about the other problems...

Problem 1 (Thomas $\S9.1 \# 17$). Solve the differential equation

$$\frac{dy}{dx} = 2x\sqrt{1 - y^2} \quad \text{where } -1 < y < 1.$$

Solution. This is a separable differential equation. The first step is to put all the y stuff on the left hand side, and all the x stuff on the right hand side:

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

This doesn't really mean anything yet, until we slap integral signs in front:

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

Take the antiderivative of both sides, and don't forget the +C. However, there is not need for a constant on both sides, so I just usually only put the +C on the x side:

$$\arcsin y = x^2 + C$$

Solve for y:

 $y = \sin(x^2 + C).$

Problem 2 (Thomas $\S9.1 \# 12$). Solve the differential equation

$$\frac{dy}{dx} = 3x^2 e^{-y}.$$

Solution. Step 1: Separate the variables:

$$e^y \, dy = 3x^2 \, dx.$$

Step 2: Integrate both sides with respect to the appropriate variable:

$$\int e^y \, dy = \int 3x^2 \, dx.$$

Step 3: Integrate, and put a +C on the RHS:

$$e^y = x^3 + C.$$

Step 4: Solve for y:

$$y = \ln(x^3 + C).$$

Problem 3 (Thomas $\S9.1 \# 18$). Solve the differential equation

$$\frac{dy}{dx} = \frac{e^{2x-y}}{e^{x+y}}.$$

Solution. Step 0: Clarify how to separate:

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

Step 1: Separate:

$$e^{2y} \, dy = e^x \, dx.$$

Step 2: Form integrals:

$$\int e^{2y} \, dy = \int e^x \, dx$$

Step 3: Integrate:

$$e^{2y}/2 = e^x + C$$

Step 4: Solve for y:

$$e^{2y} = 2e^x + C \quad \Rightarrow \quad 2y = \ln(2e^x + C) \quad \Rightarrow \quad y = \frac{1}{2}\ln(2e^x + C)$$

Notice that 2C = C ... what does that even mean? It means that if C is any real number, then 2C can also be any real number, so we might as well call it C. This is a fairly common abuse of notation. Once you plug in an initial value, however, C needs to be a fixed constant.

Question 3. Are there any other resources to learn differential equations that you have? I'm still struggling with them.

Answer. I like to read. Here are a couple more books.

Larson Calculus 5th edition

Barron's AP Calculus 12th edition

You can try Kahn Academy. Also, the College Board has posted some videos for our current crisis:

AP Covid Classes

Question 4. How will slope fields be tested on the AP? Will we be asked to draw a slope field, identify how a function acts if we are given a point on a slope field, or another way?

Answer. In the past, they have asked for the students to draw a slope field. They have also asked to solve separable differential equations. I don't recall seeing a problem where you are given a slope field and asked to draw some curves in it, but there is no reason they wouldn't ask that. \Box

Question 5. What is the new format for the AP exam, and when are we taking it?

Answer. The College Board has promised to release more information about that on Friday April 3. \Box