

Discovery Exercise for Overview of Ordinary Differential Equations

1. A certain function $y(x)$ has the following property: its *derivative* is $6x$. We can express this mathematically by writing $dy/dx = 6x$.

- (a) Solve this equation; that is, find a function $y(x)$ that works.

- (b) Find a *different* function that also works. (*Hint*: It will only be slightly different from the first function.)

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- (c) Test your solutions by taking their derivatives and making sure you get $6x$ both times.

2. A certain function has the following property: its *second derivative* is $6x$.

- (a) Write an equation that expresses the sentence “The second derivative of the function y is $6x$.”

- (b) Solve the equation; that is, find a function y that works.

- (c) Find a *different* function that also works.

- (d) Test your solutions.

3. A certain function has the following property: *the function is its own derivative*.

- (a) Write an equation that expresses the sentence “Function y is its own derivative.”

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- (b) Solve the equation; that is, find a function y that works.

- (c) Test your solution by taking its derivative and making sure you get the same function you started with.

- (d) Find a *different* function that also works and test it. (*Hint*: adding a constant to your first solution will not work!)

4. A certain function has the following property: *when you take the derivative of the function, you get the same function back, times 2.*
- (a) Write an equation that expresses the sentence “When you take the derivative of function y , you get the original function y times 2.”
 - (b) Solve the equation; that is, find a function y that works.
 - (c) Find a *different* function that also works.
 - (d) Test your solutions.
5. A certain function $y(x)$ is the solution to the equation $dy/dx = xy^2$.
- (a) Express this equation in words. (This is the reverse of what you were doing before, where we gave you the words and you gave us the equation.)
 - (b) Which of the following functions could be $y(x)$? *Hint:* the only way you can approach this is to *try* each function in that equation. One function will work, the others will not. For the left side of the equation, find dy/dx . For the right side, square y and then multiply the answer by x . If the two sides come out the same, you have found a solution!
 - i. $y = \sqrt{x^2 + 9}$
 - ii. $y = e^{\sqrt{x}+3}$
 - iii. $y = -2/(x^2 + 3)$
 - iv. $y = x^3/3 + 6$