

# Solutions of a Differential Equation

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## Objective

To discuss the solutions of a differential equation.

## Narrative

In this project we plot several solutions to the differential equation  $\frac{dy}{dx} = x^2 + y$ . We use the command:

`DSolve[differential equation in x and y, y, x]` solves the differential equation in  $x$  and  $y$  for  $y = y(x)$ .

As illustrated below, in using `DSolve` we be careful in specifying  $y$  by “`y[x]`”.

## Task

1. Type the command lines below into Mathematica in the order in which they are listed. These commands find the solution to the differential equation  $\frac{dy}{dx} = x^2 + y, y(0) = C$ , and produce plots corresponding to the five values for  $C$  of 1, 2, 3, 4, and 5, on one set of axes.

```
In[1] := (* Your name, today's date *)
In[2] := (* Solutions of a Differential Equation *)
In[3] := DSolve[y'[x]==y[x]+x^2, y, x]
In[4] := y1[x_] = -2-2x-x^2+Exp[x]
In[5] := y2[x_] = -2-2x-x^2+2Exp[x]
In[6] := y3[x_] = -2-2x-x^2+3Exp[x]
In[7] := y4[x_] = -2-2x-x^2+4Exp[x]
In[8] := y5[x_] = -2-2x-x^2+5Exp[x]
In[9] := Plot[{y1[x], y2[x], y3[x], y4[x], y5[x]}, {x,-2,3}]
```

At this time, make a hard-copy of your typed input and Mathematica's responses. Then:

2. Label each curve in the graphic you created in Task 1 with its constant  $C$  by hand. (For example, label the graph of the first solution by “ $C = 1$ ”.)
3. Draw and label the solution curve that passes through the point  $P(2,1)$ .
4. Find the value of  $C$  for the solution curve you identified Task 3. Briefly explain (in writing) how you found this value.

Your lab report will be a hard-copy of your typed input and Mathematica's responses (both text and hand-labeled graphics).