Assignment 16: Separable Differential Equations (7.2) **Name_____**
Please provide a handwritten response.

1a. The separable differential equation $y' = \dfrac{x^2 + \sqrt{x}}{e^{2y} + y - \sin y}$ is written $\int \left(e^{2y} + y - \sin y\right) dy = \int \left(x^2 + \sqrt{x}\right) dx$ with variables separated. To solve the equation in *Maple* we first treat each side separately; execute

```
G:=int(exp(2*y)+y-sin(y),y);
```

to calculate $G(y) = \int \left(e^{2y} + y - \sin y\right) dy$ and record the result below.

Then execute

```
H:=int(x^2+sqrt(x),x);
```

to calculate $H(x) = \int \left(x^2 + \sqrt{x}\right) dx$ and record the result below.

1b. Execute **`gensoln:=G=H+c;`** to enter the general solution of the differential equation. (Review the comments in Assignment 9, Question **1a** regarding the single equal and colon equal signs.) Record the result below.

1c. We can form an IVP by adding the initial condition $y(1.5) = 1$ to our differential equation. To extract the value of *c* corresponding to this initial condition, first execute

```
subs(x=1.5,y=1,gensoln);
```

to watch *Maple* substitute $x = 1.5$ and $y = 1$ into the general solution using the replacement operator **`subs`**; record the result below.

Now execute

```
const:=fsolve(subs(x=1.5,y=1,gensoln),c);
```

to find our value of *c*, and record the result below.

To substitute this value of *c* in the general solution, execute

```
partsoln:=subs(c=const,gensoln);
```

and record the result below.

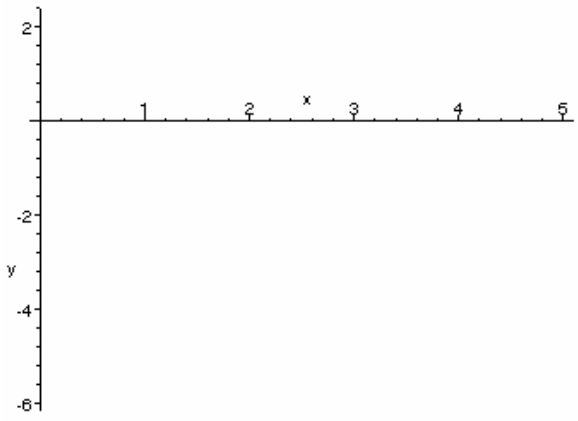
1d. As you can see, it would be impossible to solve this particular solution for *y*; so, to graph this solution we will resort to the **`implicitplot`** command as in Assignment 9. Execute

```
with(plots);
```

Execute

```
implicitplot(partsoln,x=0..5,
          y=-6..6);
```

to graph the solution of our IVP over the viewing window $0 \le x \le 5,\ -6 \le y \le 6$. Sketch the result on the axes at right. Use a large dot to mark the point on the curve corresponding to the initial condition.



1e. Did the graph include the entire *y*–range $-6 \le y \le 6$? Why? Try to get a bigger view by changing **`x=0..5`** to **`x=-1..5`** in the preceding command; do things get better or worse? Why?

1f. If there were no initial condition attached to our differential equation, then we could create a family of particular solutions by letting *c* range, say, from -5 to 5; all these solutions could then be graphed on the same axes, showing how the solutions vary with *c*. Execute

```
solnfamily:=seq(gensoln,
        c=-5..5);
```

(You need not record the result!) followed by

```
implicitplot({solnfamily},
     x=0..7,y=-10..3);
```

and sketch the result on the axes at right. Can you get a better view using different viewing windows?