

# Example Technology Exercise 6

## John Smith and Tom Brown

```
(%i1) ratprint:false$  
      load(drawdf)$
```

### 1 *See Word document*

Maxima is NOT required for this problem,  
but I'm giving instructions on how to use it.

Set up some defaults for the graphs so the directives  
don't have to be repeated with each graph. This  
statement is optional, but can save time if you have multiple  
graphs.

```
(%i3) set_draw_defaults(  
      dimensions = [600,600],  
      xaxis = true,  
      yaxis = true,  
      xaxis_width = 3,  
      yaxis_width = 3,  
      grid = true,  
      user_preamble = "set terminal pngcairo crop",  
      terminal = pngcairo  
      )$
```

The last two lines are only for saving to a PNG file instead  
of displaying on the screen.

### 1.1

Only the first 3 arguments are required for a direction field.  
The rest is there to fancy up the graph.

```
(%i4) drawdf(
    0.4*x*(y-2),
    [x,-2.5,2.5],
    [y,-2.5,2.5],
    field_color = forest_green,
    field_grid = [20,20],
    color = red,
    line_width = 2,
    soln_at(1,-1),
    color = blue,
    point_size = 2,
    point_at(1,-1),
    file_name = "d:\\spring13\\m122\\tech\\ch6-1a"
)$
```

Once the graph is generated, you can copy it with Ctrl-C and then paste it into Word. The last 3 lines (beginning with `user_preamble`) allow you to save the image as a PNG file, which you can then add to Word.

## 1.2

```
(%i5) drawdf(
    y*exp(-x^2),
    [x,-2.5,2.5],
    [y,-2.5,2.5],
    field_color = forest_green,
    field_grid = [20,20],
    color = red,
    line_width = 2,
    soln_at(0,1),
    color = blue,
    point_size = 2,
    point_at(0,1),
    file_name = "d:\\spring13\\m122\\tech\\ch6-1b"
)$
```

**2 See Word document**

### 3 Problem 6.2.73 Newton's Law of Cooling

The rate at which a body cools is proportional to the difference between the temperature of the body and the temperature of the surrounding medium.

The ode2 command will solve the differential equation  
The ic1 specifies the initial values to find C

```
(%i6) 'diff(T,t)=k*(T-80);
      ode2(% ,T,t),expand;
      eqn1:ic1(% ,t=0,T=1500);
```

$$(\%o6) \frac{d}{dt} T = k(T - 80)$$

$$(\%o7) T = \%c \%e^{k t} + 80$$

$$(\%o8) T = 1420 \%e^{k t} + 80$$

When  $t = 1$ ,  $T = 1120$ . Find  $k$

```
(%i9) subst([T=1120,t=1],eqn1);
      solve(% ,k),float;
      eqn2:subst(% ,eqn1);
```

$$(\%o9) 1120 = 1420 \%e^k + 80$$

$$(\%o10) [k = -0.31143615845989]$$

$$(\%o11) T = 1420 \%e^{-0.31143615845989 t} + 80$$

Find temperature  $T$  when  $t = 5$

```
(%i12) subst(t=5,eqn2);
(%o12) T = 379.2356404914734
```