MATH 1180
MATHEMATICS FOR LIFE SCIENTISTS
Computer Assignment I
Due January 19, 2003

We will use `dsolve` to compare a **pure-time differential equation** with an **autonomous differential equation**. Our pure time differential equation is

$$\frac{dV}{dt} = 2 - t. \tag{1}$$

Our autonomous equation is Newton's law of cooling

$$\frac{dH}{dt} = 2 - H, \tag{2}$$

with ambient temperature $A = 2$ and rate of decay $\alpha = 1$. We will solve each equation starting from two initial conditions.

To get Maple to solve these with the initial condition $V(0) = 0$ or $H(0) = 0$, try

```
> diffv0 := {diff(v(t),t)=2-t,v(0)=0};
> V0 := unapply(rhs(dsolve(diffv0,v(t))),t);
> diffh0 := {diff(h(t),t)=2-h(t),h(0)=0};
> H0 := unapply(rhs(dsolve(diffh0,h(t))),t);
```

Create functions $V4$ and $H4$ by solving the same differential equations with initial conditions $V(0) = 4$ and $H(0) = 4$.

PROBLEMS

1. Plot $V0$, $V4$, $dV0/dt$ and $dV4/dt$ as functions of time for $t = 0$ to $t = 4$. Plot the derivatives with commands like `diff(V0(t),t)`. Label the curves and write the corresponding formulas. Where is $V0$ increasing? $V4$? Does V have an equilibrium? If so, where is it?

2. Do the same for $H0$ and $H4$.

3. For Newton's law of cooling plot the rate of change of temperature as a function of temperature for $0 \le H \le 4$. Now think of the solution $H0$. Points on your graph correspond to different values of t. At $t = 0$, the temperature is 0 and the rate of change is 2, corresponding to the point $(0, 2)$. Mark this point. Find and mark the points corresponding to t =1, 2, 3 and 4. Do the same for the solution $H4$. Draw arrows on your graph to indicate which way the temperature is changing. Draw a phase-line diagram below your picture and draw arrows corresponding to those on your graph.