Separate the following second order differential equation into two first order differential equations:

$$\frac{\mathrm{d}^2y}{\mathrm{d}t^2} + 5\left(\frac{\mathrm{d}y}{\mathrm{d}t}\right)^2 - 6y + e^{\sin(t)} = 0, \qquad \frac{1}{g}\frac{\mathrm{d}^2h}{\mathrm{d}t^2} = \frac{T}{w} - 1 - \frac{0.008}{w}\left(\frac{\mathrm{d}h}{\mathrm{d}t}\right)^2.$$

For ODE 1 we have

$$\begin{aligned}\frac{\mathrm{d}y}{\mathrm{d}t} &= q,\\ \frac{\mathrm{d}q}{\mathrm{d}t} &= 6y - 5q^2 - \exp\left[\sin(t)\right].\end{aligned}$$

For ODE 2 we have

$$\begin{aligned}\frac{\mathrm{d}h}{\mathrm{d}t} &= k,\\ \frac{\mathrm{d}k}{\mathrm{d}t} &= \frac{gT}{w} - g - 0.008\frac{g}{w}k^2.\end{aligned}$$

Define $\vec{u}$ and $\frac{\mathrm{d}\vec{u}}{\mathrm{d}t}$ for the ODE's above and write pseudo code to define a `dudt` function similar to the previous lecture assignment for each ODE.

For ODE 1 we have

$$\vec{u} = \begin{bmatrix} y \\ q \end{bmatrix}, \quad \mathrm{dud}t = \begin{bmatrix} q \\ 6y - \exp\left[\sin(t)\right] - 5q^2 \end{bmatrix}.$$

Where a `dudt` function might look as follows:

```
function dudt = f(t, u)
    dudt = zeros(2, 1);
    dudt(1) = u(2);
    dudt(2) = 6*u(1) - 5*u(2).^2 - exp(sin(t));
end
```

For ODE 2 we have

$$\vec{u} = \begin{bmatrix} h \\ k \end{bmatrix}, \quad \mathrm{dud}t = \begin{bmatrix} k \\ \frac{gT}{w} - g - 0.008\frac{g}{w}k^2 \end{bmatrix}.$$

Where a `dudt` function might look as follows:

```matlab
function dudt = f(t, u, T, g, w)
    dudt = zeros(2, 1);
    dudt(1) = u(2);
    dudt(2) = (g*T/w) - g - (0.008*g/w)*u(2).^2
end
```