



- 1 For which values of  $a \in \mathbb{R}$  does the function  $y(t) = \arctan(t)$  satisfy the second order differential equation

$$(t^2 + 1)y''(t) + aty'(t) = 0?$$

- 2 By introducing new variables, write the following differential equations as first order systems  $\dot{x} = f(x)$ .

a)

$$y''(t) - ay'(t) - by(t) - c = 0$$

b)

$$y'(t) - g(t)y(t) = 0,$$

where  $g$  is some given function.

c)

$$y^{(4)}(t) - \sin(y(t))(y'(t))^2 = 0$$

- 3 What can you say about the qualitative behaviour to the solutions of

$$\dot{x} = f(x),$$

where  $f: \mathbb{R} \rightarrow \mathbb{R}$  is defined by

a)  $f(x) = x \left( \frac{1}{2} - \exp(-|x|) \right),$

b)  $f(x) = |x| - 1,$

c)  $f(x) = \sin(x).$