

2.1.3

(a) $\ddot{x} = \frac{d}{dt} \dot{x} = \frac{d}{dt} \sin x = \frac{d}{dx}(\sin x) \frac{dx}{dt} = \cos x \sin x = \frac{1}{2} \sin(2x)$

(b) $\ddot{x}$ is maximum when $x = (1+4k)\frac{\pi}{4}$, $k \in \mathbb{Z}$

(a) +2 for $\frac{d}{dx} \sin x$

+2 for chain rule

(b) +1 for correct answer

2.2.3

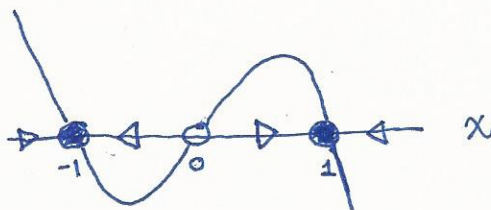
$\dot{x} = x - x^3$ has fixed pts at $x=0$ and $x=\pm 1$

+1 for fixed pts

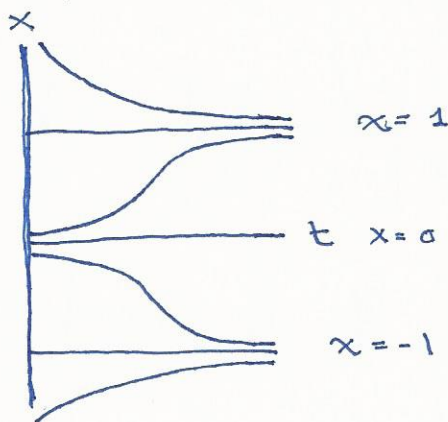
+1 for vector field

+1 for stability

+2 for graph of $x(t)$



$x^* = \pm 1$ are stable, $x^* = 0$ is unstable.



2.4.4

$\dot{x} = x^2(6-x)$ has fixed pts at $x=0$ and $x=6$

$f(x) = x^2(6-x)$, $f'(x) = 12x - 3x^2$

So $f'(0) = 0 \rightarrow$ inconclusive

$f'(6) = -36 \rightarrow$ stable

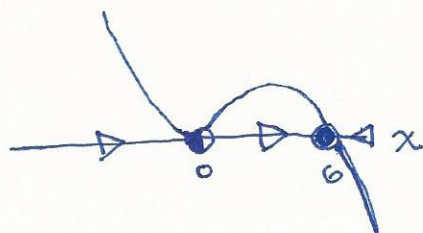
L.S.A.

+1 for fixed pts

+2 for L.S.A.

+1 for vector field

+1 for stability at $x=0$



$\Rightarrow x^* = 0$ is semistable