2.2.1 $\dot{x} = 4x^2 - 16 = 4(x^2-4) = 4(x-2)(x+2)$ (T2.1)

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

$f(x) = 0 \iff x = \pm 2$

[linear { stability $\Rightarrow$ stability / stable
instability. $\Rightarrow$ instability / unstable.

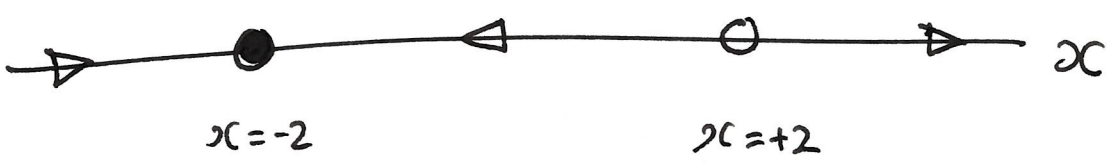
linear $= 0$ we don't know - further investigation]

$f'(x) = 4(2x) = 8x.$

$x = -2$ $f'(x) = -16$, stable

$x = +2$ $f'(x) = 16$, unstable

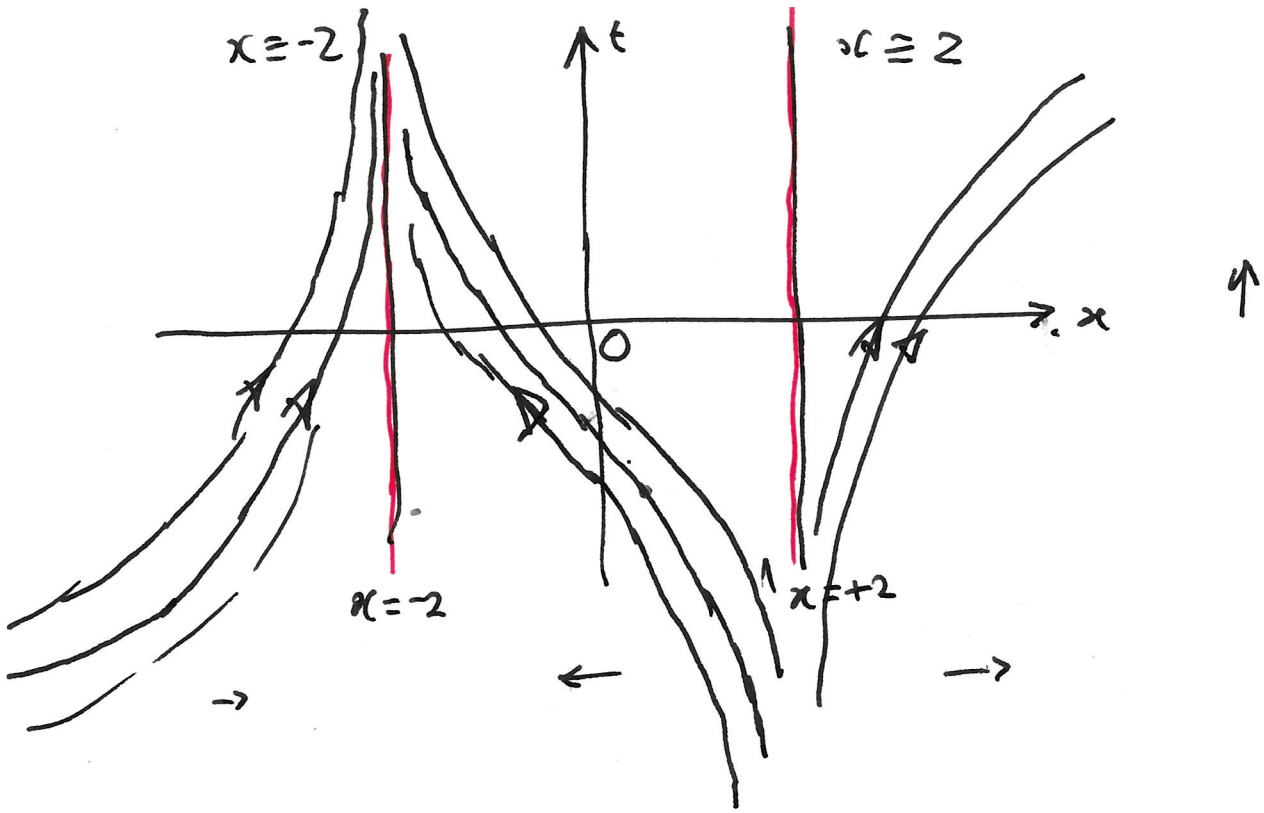
Phase portrait -



unstable?

??

T2.2



Quiz 1 "Changed from Tutorial class." (T.2.3)

Q2 $\dot{x} = xr + x^2$ FPs: x_0, x_1, $x_0 < x_1$

r positive

$xr + x^2 = 0$ $\quad x(r+x) = 0 \Rightarrow x = 0, \; x = -r$

$x_0 = 0$

$x_0 = -r < x_1 = 0$ when r is postive

Stability, $f_r(x) = xr + x^2 \Rightarrow f_r'(x) = r + 2x$.

$f(x,r)$ $\quad \frac{\partial f}{\partial x}(x,r)$

$x_0 = 0$ $\quad f_r'(x_0) = r$ unstable

$x_1 = -r$ $\quad f_r'(x_1) = -r$ stable.

Q3 $\dot{x} = b + x^2$ FPs $x^2 = -b$, $x = \pm\sqrt{-b}$.

2 fixed p $b < 0$

1 $b = 0$

0 $b > 0$.

$x_0 = +\sqrt{-b}$. as $x_0 \geq 0$.

$x_0 \geq 0$. $f'(x_0) = 2x_0$

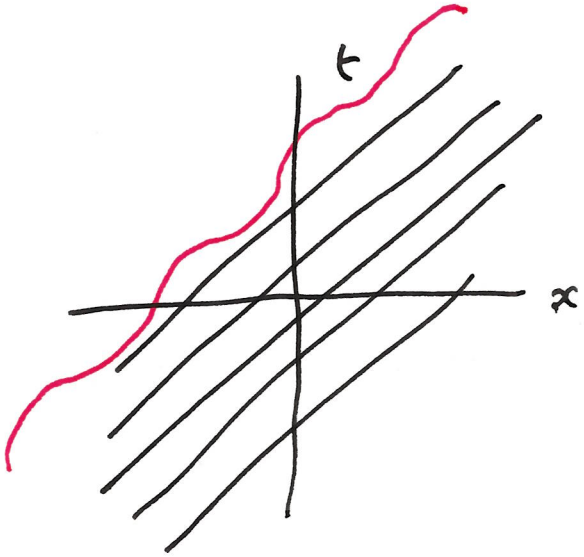
$\rightarrow$ unstable

$\dot{x} = 1 + \frac{1}{2}\cos x$ $\quad -1 \le \cos x \le 1$ $\quad$ T2.4

$\left[-\frac{1}{2}, \frac{1}{2}\right]$

PP

$\dot{x} > 0 \quad \forall x$

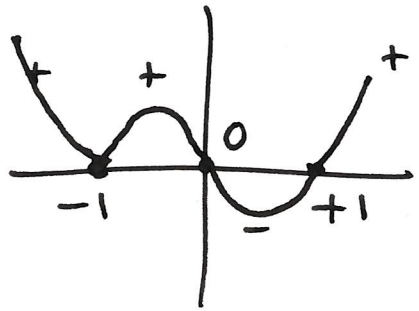


NSt $-x^2$ $\Rightarrow$ only 2 root

x^6: ?? $(x+1)^4(x-1)x$. ✓✓

x^8: $8(x+1)^4(x-1)^3 x$ ✓?

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



x^4

✓✓ $(x+1)^2 x(x-1)$

$-a < -b < -c$. $(x+a)^2(x+b)(x+c)$