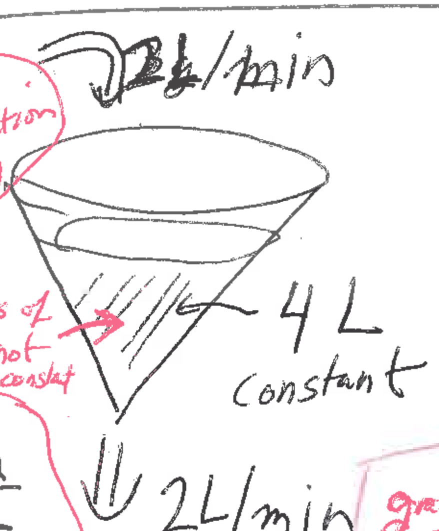
$$\boxed{\text{DERIVATIVE} = \text{RATE OF Change} = \text{Slope of tangent line}}$$

Long-term behavior

Ex: $Q(t) \to \underline{12\,g}$ as $t \to \infty$

As $t \to \infty$, salt concentration $\to 3g/L$

$$\Rightarrow Q(t) \to \left(\frac{3g}{4}\right)(4L) = \underline{12g}$$



Let $Q(t)$ = amount of salt in tank after t minutes

$Q(0) = 5g$

$$\frac{\text{grams}}{\text{min}} = \frac{dQ}{dt} = \text{rate in} - \text{rate out}$$

$$= \frac{3g}{L} \cdot \frac{2L}{\text{min}} - \frac{Qg}{4L} \cdot \frac{2L}{\text{min}}$$

Initial Value Problem $\frac{dQ}{dt} = 6 - \frac{Q}{2}$, $Q(0) = 5g$

Slope field = Direction field

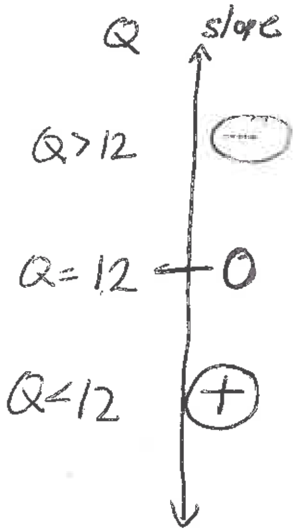
= Plot of slopes in (t, Q) plane

small portion of tangent line

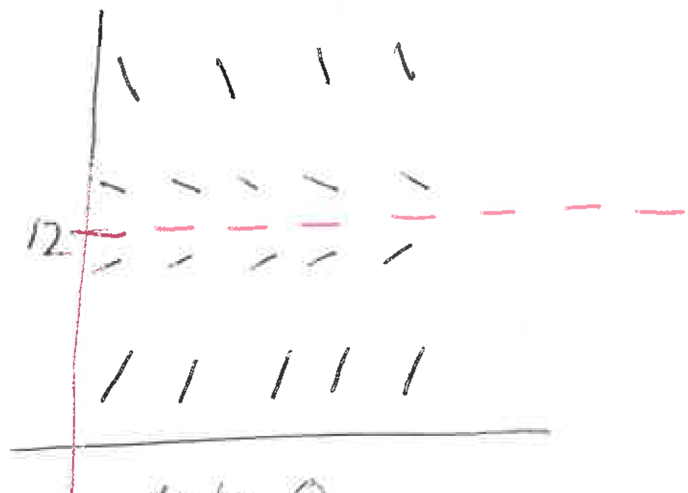
t	Q	$dQ/dt = 6 - \frac{Q}{2}$
	12	0
	12.1	small ⊖
	14	larger ⊖
	11.9	small ⊕
	10	larger ⊕

does not depend on Q

Slope 0 $\Rightarrow 0 = 6 - \frac{Q}{2} \Rightarrow Q = 12$



Calc 1 # line



Note Q

Equilibrium sol'n = Constant sol'n

$$Q = C$$

$$\Rightarrow \frac{dQ}{dt} = 0$$

Thus To find equil sol'n (when it exists)

set $\frac{dQ}{dt} = 0$ & solve for Q

EX $\frac{dQ}{dt} = 6 - \frac{Q}{2} \Rightarrow 0 = 6 - \frac{Q}{2} \Rightarrow \boxed{Q = 12}$