Homework 3

(1)

(#3)

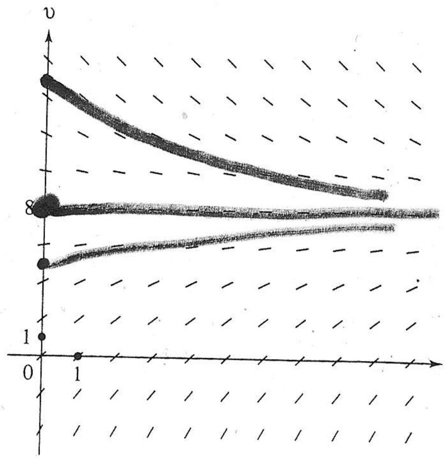


Figure 1.14 Direction field for $\frac{dv}{dt} = 1 - \frac{v}{8}$

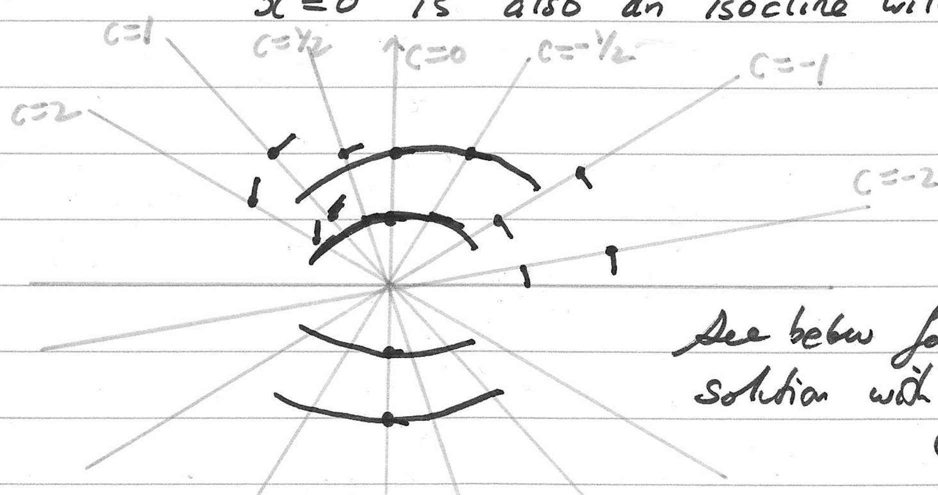
It appears that for each solution $\lim_{t \to \infty} v(t) = 8$.

This is reason $v=8$ is called the terminal velocity.

(#11) $\frac{dy}{dx} = \frac{-x}{y}$

Isoclines: $\frac{-x}{y} = c$, $y = \left(-\frac{1}{c}\right) x$ where $c \neq 0$ is constant.

$x = 0$ is also an isocline with $c = 0$.



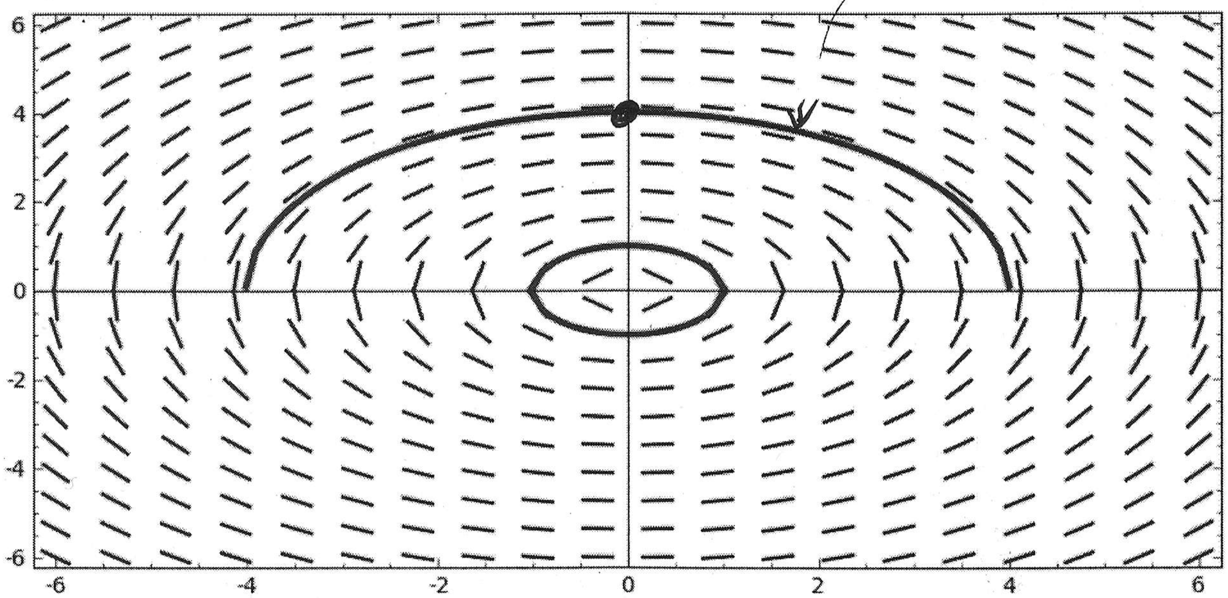
See below for solution with $y(0)=4$

```
# Problem 11
var('x,y')
df=plot_slope_field(-x/y, (x,-6,6), (y,-6,6))
PA=desolve_rk4(-x/y,y,ics=[0,4],ivar=x,output='plot',end_points=[-4,4],\
    thickness=3)

PB=desolve_rk4(-x/y,y,ics=[0,1],ivar=x,output='plot',end_points=[-1,1],\
    thickness=3)
PC=desolve_rk4(-x/y,y,ics=[0,-1],ivar=x,output='plot',end_points=[-1,1],\
    thickness=3)

show(df+PA+PB+PC)
(x, y)
```

solution $y(0)=4$

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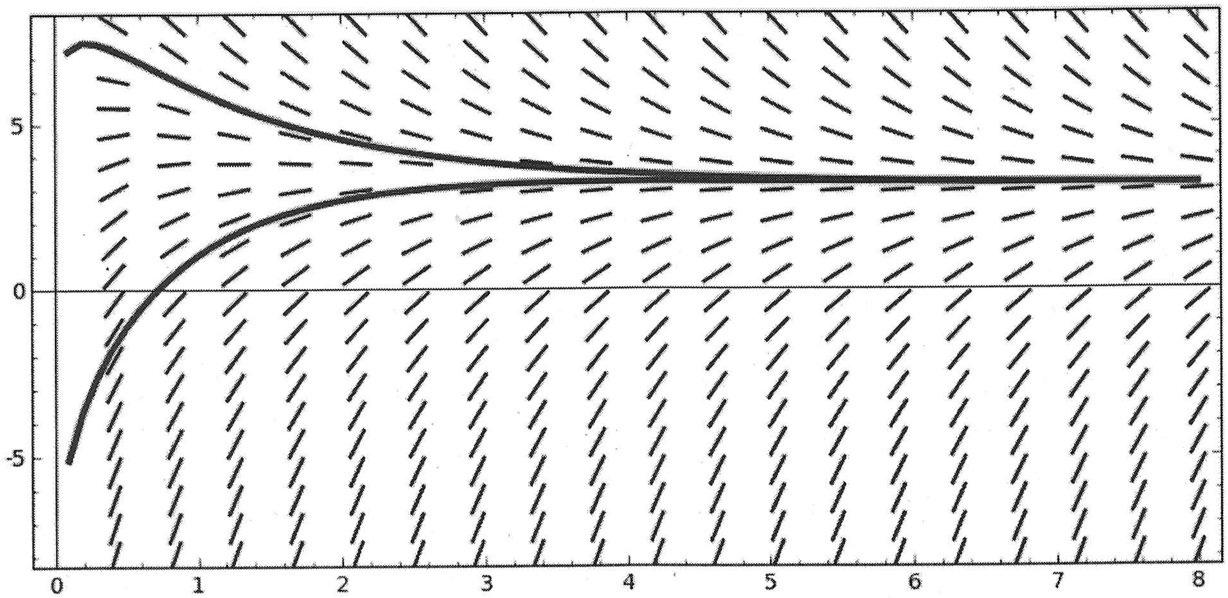
# Problem 17
var('x,y')
df=plot_slope_field(3 - y +1/x, (x,0,8), (y,-8,8))
PA=desolve_rk4(3 - y + 1/x,y,ics=[1,1],ivar=x,output='plot',end_points\
    =[0,8],thickness=3)
PB=desolve_rk4(3 - y + 1/x,y,ics=[1,6],ivar=x,output='plot',end_points\
    =[0,8],thickness=3)


show(df+PA+PB)
(x, y)
```

(3)

$$\frac{dy}{dx} = 3 - y + \frac{1}{x}$$



It appears that for each solution

$$\lim_{x \to \infty} y(x) = 3.$$