#LAMIN JAMMEH
#EE597
#HW1

#Problem Sets for Chapter1

#Pr1.2 Direction field

restart

#Step1 import the necessary Libraries

with(*DEtools*)

#Step2 Define the ODE $y'=\frac{-13x^2}{17\,y}$

$$ode1 := diff(y(x), x) = -\frac{13\cdot x^3}{17\cdot y(x)}$$

$$ode1 := \frac{\mathrm{d}}{\mathrm{d}x}\, y(x) = -\frac{13\, x^3}{17\, y(x)} \quad (1)$$

#Step3 Define initial conditions [0,1] and [0,1.4]

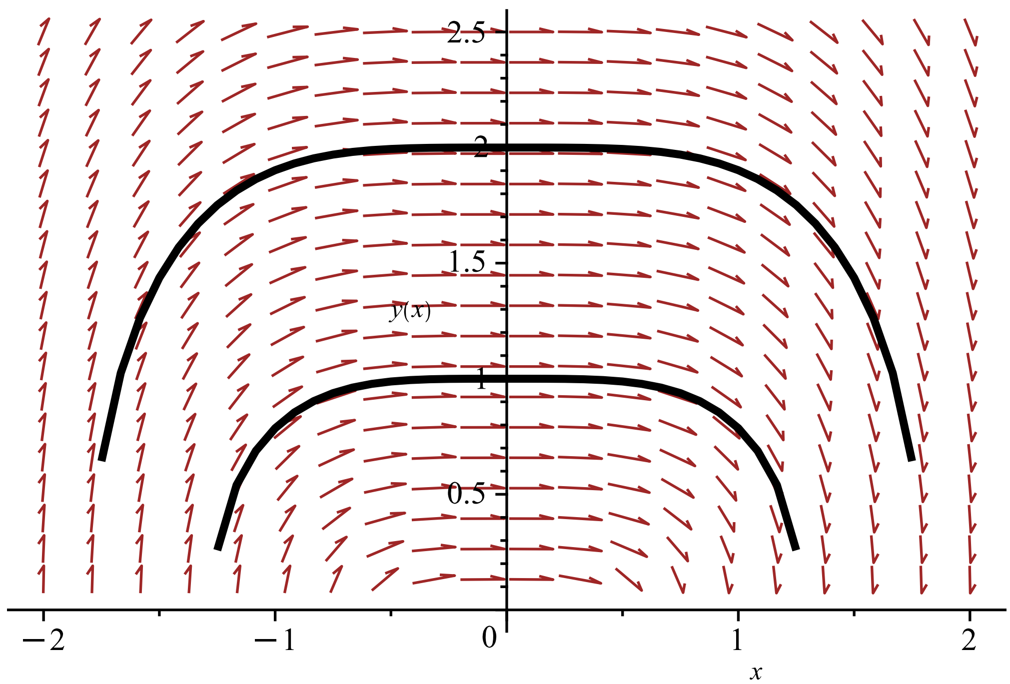
inits := {[0, 1], [0, 2]};

$$inits := \{[0, 1], [0, 2]\} \quad (2)$$

#Step3 perform the DE plot of the ODE with the initial condition and scale if necessary

DEplot(*ode1*, *y*(*x*), *x* = −2 ..2, *y* = 0 ..2.5, *inits*, *scaling* = *constrained*, *linecolor* = *black*);

```
Warning, plot may be incomplete, the following errors(s) were issued:
   cannot evaluate the solution further right of 1.2716978, probably a
singularity
   cannot evaluate the solution further left of -1.2716978, probably a
singularity
Warning, plot may be incomplete, the following errors(s) were issued:
   cannot evaluate the solution further right of 1.7984522, probably a
singularity
   cannot evaluate the solution further left of -1.7984522, probably a
singularity
```



#Pr1.4 Exponential approach

restart

#Step1 Define the ODE y'+0.5y=1

$ode := diff(y(x), x) + 0.5\, y(x) = 1;$

$$ode := \frac{\mathrm{d}}{\mathrm{d}x}\, y(x) + 0.5\, y(x) = 1 \tag{3}$$

#Step2: solve the ODE with visualize the genric solution for the ODE

$sol1 := dsolve(ode);$

$$sol1 := y(x) = 2 + \mathrm{e}^{-\frac{x}{2}}\, c_1 \tag{4}$$

#Step3: apply the initial conditions x=0, and y=0 [y(0)=0] to the ode

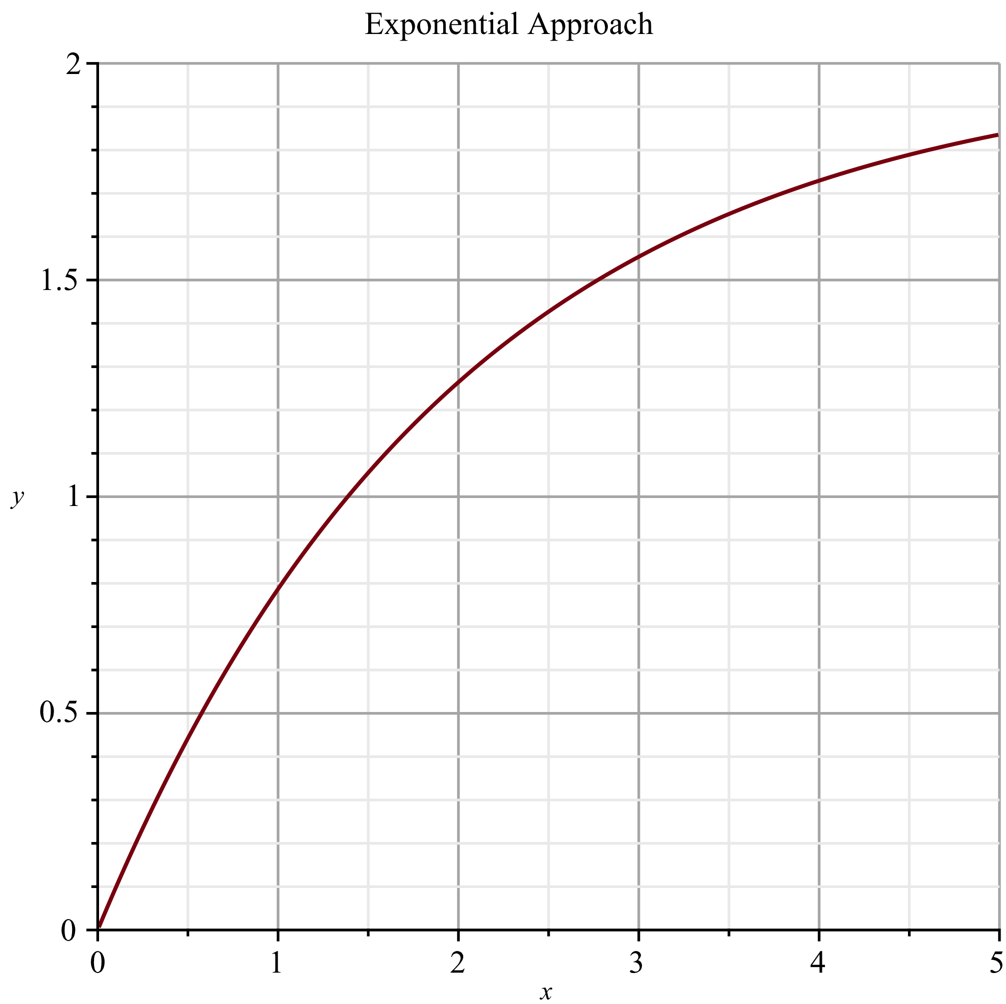
$sol2 := dsolve(\{ode, y(0) = 0\})$

$$sol2 := y(x) = 2 - 2\,\mathrm{e}^{-\frac{x}{2}} \tag{5}$$

 # sol2 indicates that the initial condition is true @x=0 y(0)=2-2e^0 = 0

#Step4: Plot the graph to visualize the model

$plot(rhs(sol2), x=0..5, y=0..2, labels=[x,y], title=\text{"Exponential Approach"}, gridlines=true);$



#Pr1.12 Beat

restart;

#Step1: define P and Q of the ODE

$P := \csc(x);$

$$P := \csc(x) \tag{6}$$

$Q := y\cdot\cot(x)\cdot\csc(x) + 100\cdot\cos(30\cdot x);$

$$Q := y\cot(x)\csc(x) + 100\cos(30\,x) \tag{7}$$

#Step1 obtain partial diff of P and Q

$P\_diff := diff(P, x);$

$$P\_diff := -\cot(x)\csc(x) \tag{8}$$

$Q\_diff := diff(Q, y);$

$$Q\_diff := \cot(x)\csc(x) \tag{9}$$

#Therefore the Two equations are not exact P_diff is not equal to Q_diff

#Step3: use F(x) as integration factor

$eq1 := diff(F(x) \cdot P, x) - diff(F(x) \cdot Q, y) = 0;$

$$eq1 := \left(\frac{d}{dx} F(x)\right) \csc(x) - 2 F(x) \cot(x) \csc(x) = 0 \tag{10}$$

$simplify\left(\frac{eq1}{\csc(x)}\right);$

$$-2 F(x) \cot(x) + \frac{d}{dx} F(x) = 0 \tag{11}$$

$sol := dsolve(\%);$

$$sol := F(x) = -\frac{c_1 (-1 + \cos(2x))}{2} \tag{12}$$

#Pr1.18 RL-Circuit

restart;

 # Step1 Obtain mathematical Model for the given RL circuit

#Use this equation $L\frac{d}{dt} i(t) + R \cdot i(t) = v(t)$ *where* $L = 0.5\ H$, $R = 7\ ohms$, **and** $V = 5\ V$

$ode := 0.5 * diff(i(t), t) + 7 * i(t) = 5;$

$$ode := 0.5 \frac{d}{dt} i(t) + 7\, i(t) = 5 \tag{13}$$

#Step2: define i(0) at the diffrent given values

#use i(0) = 5amps

$sol1 := dsolve(\{ode, i(0) = 5\}, i(t));$

$$sol1 := i(t) = \frac{5}{7} + \frac{30\, e^{-14 t}}{7} \tag{14}$$

#use i(0) = 2.5amps

$sol2 := dsolve(\{ode, i(0) = 2.5\}, i(t));$

$$sol2 := i(t) = \frac{5}{7} + \frac{25\, e^{-14 t}}{14} \tag{15}$$

#use i(0) = 1amps

$sol3 := dsolve(\{ode, i(0) = 1\}, i(t));$

$$sol3 := i(t) = \frac{5}{7} + \frac{2\,e^{-14\,t}}{7} \quad \textbf{(16)}$$

#use i(0) = 0amps
sol4 := *dsolve*({ *ode*, *i*(0) = 0}, *i*(*t*));

$$sol4 := i(t) = \frac{5}{7} - \frac{5\,e^{-14\,t}}{7} \quad \textbf{(17)}$$

 # Plot the functions
plot({ *rhs*(*sol1*), *rhs*(*sol2*), *rhs*(*sol3*), *rhs*(*sol4*) }, *t* = 0 .. 2, *y* = 0 ..5, *labels* = [*t*, *i*(*t*)], *title* = "RL-Circuit", *gridlines* = *true*);