Practical 7

To plot the characteristics plot for a first order partial differential equation

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Question 1:

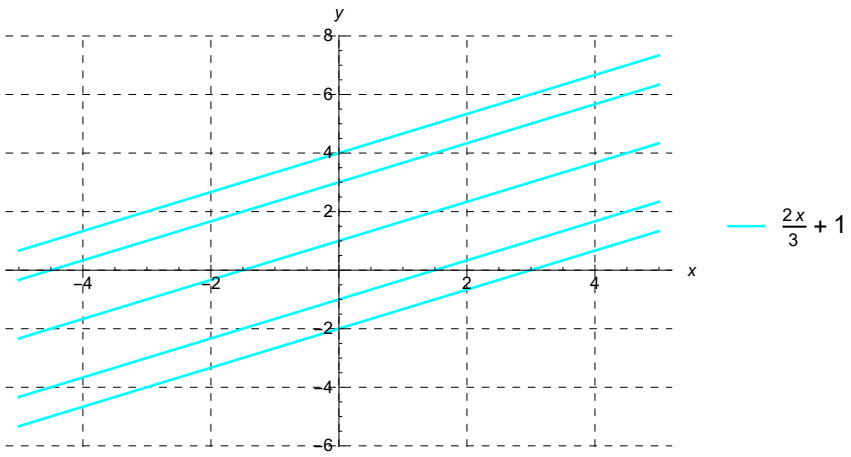
In[45]:=
```
eqn1 = 3 * y'[x] - 2 == 0
sol1 = DSolve[eqn1, y[x], x]
part1 = y[x] /. sol1 /. C[1] → {1, -2, -1, 3, 4}
Plot[part1, {x, -5, 5}, AxesLabel → {x, y}, PlotStyle → {Thickness[0.004], Cyan},
 PlotLegends → {part1}, GridLines → Automatic, GridLinesStyle → Directive[Black, Dashed]]
```

Out[45]= $-2 + 3\,y'[x] == 0$

Out[46]= $\left\{\left\{y[x] \to \frac{2x}{3} + c_1\right\}\right\}$

Out[47]= $\left\{\left\{1 + \frac{2x}{3}, -2 + \frac{2x}{3}, -1 + \frac{2x}{3}, 3 + \frac{2x}{3}, 4 + \frac{2x}{3}\right\}\right\}$

Out[48]=



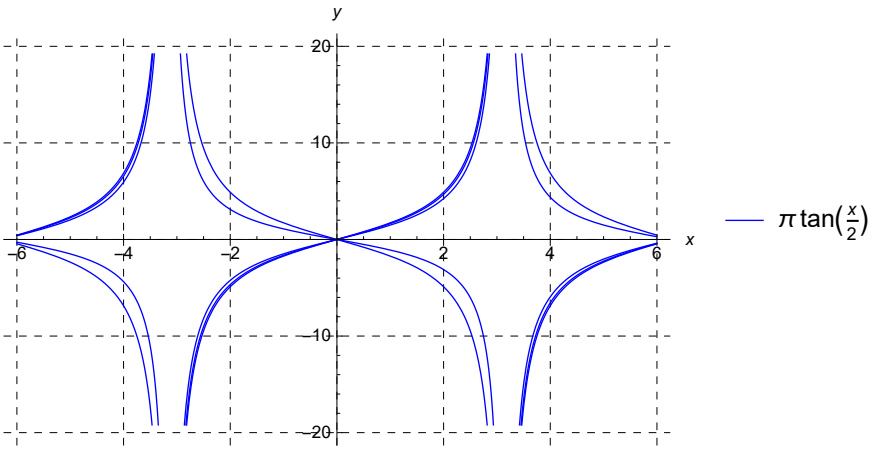
Question 2:

In[57]:=
```
eqn2 := Sin[x] * y'[x] - y[x] == 0
sol2 = DSolve[eqn2, y[x], x]
part2 = y[x] /. sol2 /. C[1] → {π, e, i, -2, 3, -π}
Plot[part2, {x, -6, 6}, AxesLabel → {x, y}, PlotStyle → {Thickness[0.002], Blue},
 PlotLegends → {part2}, GridLines → Automatic, GridLinesStyle → Directive[Black, Dashed]]
```

Out[58]= $\left\{\left\{y[x] \to c_1 \operatorname{Tan}\left[\frac{x}{2}\right]\right\}\right\}$

Out[59]= $\left\{\left\{\pi \operatorname{Tan}\left[\frac{x}{2}\right], e \operatorname{Tan}\left[\frac{x}{2}\right], i \operatorname{Tan}\left[\frac{x}{2}\right], -2 \operatorname{Tan}\left[\frac{x}{2}\right], 3 \operatorname{Tan}\left[\frac{x}{2}\right], -\pi \operatorname{Tan}\left[\frac{x}{2}\right]\right\}\right\}$

Out[60]=



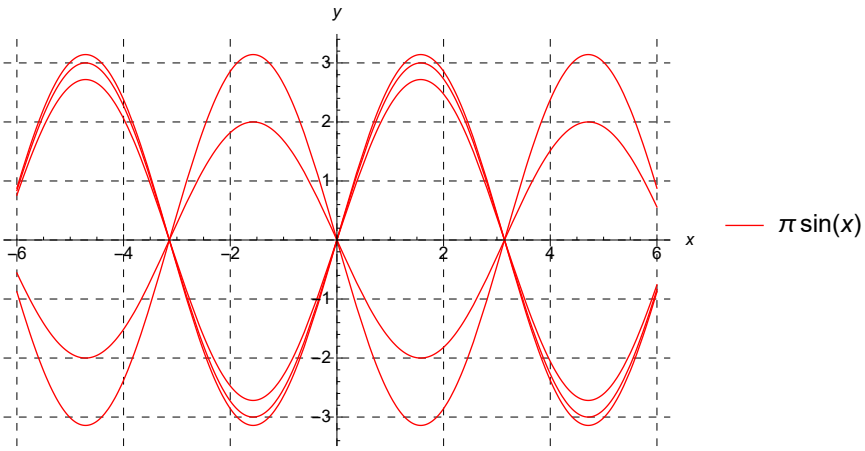
Question 3:

In[77]:=
```
eqn2 := Sin[x] * y'[x] - Cos[x] y[x] == 0
sol2 = DSolve[eqn2, y[x], x]
part2 = y[x] /. sol2 /. C[1] → {π, e, i, -2, 3, -π}
Plot[part2, {x, -6, 6}, AxesLabel → {x, y}, PlotStyle → {Thickness[0.002], Red},
 PlotLegends → {part2}, GridLines → Automatic, GridLinesStyle → Directive[Black, Dashed]]
```

Out[78]=
$$\{\{y[x] \to c_1 \, \text{Sin}[x]\}\}$$

Out[79]=
$$\{\{\pi \, \text{Sin}[x], e \, \text{Sin}[x], i \, \text{Sin}[x], -2 \, \text{Sin}[x], 3 \, \text{Sin}[x], -\pi \, \text{Sin}[x]\}\}$$

Out[80]=



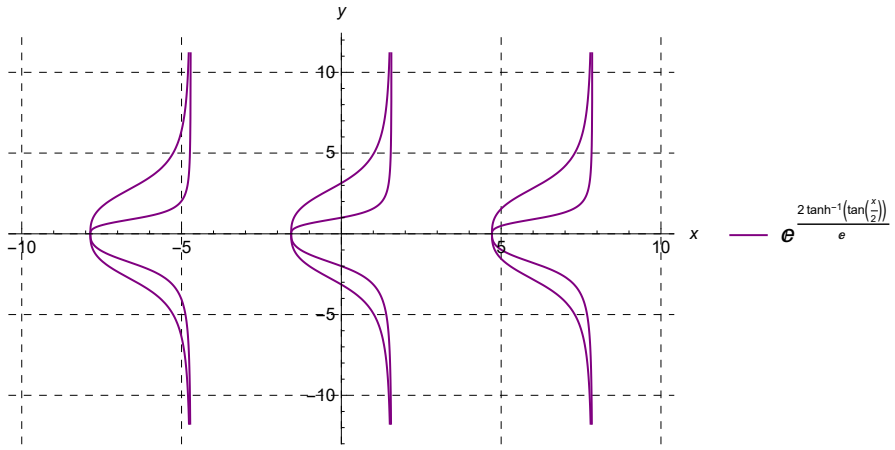
Question 4:

In[81]:=
```
eqn2 := e * y'[x] - Sec[x] y[x] == 0
sol2 = DSolve[eqn2, y[x], x]
part2 = y[x] /. sol2 /. C[1] → {1, -2, -π, Pi}
Plot[part2, {x, -10, 10}, AxesLabel → {x, y}, PlotStyle → {Thickness[0.003], Purple},
 PlotLegends → {part2}, GridLines → Automatic, GridLinesStyle → Directive[Black, Dashed]]
```

Out[82]= $\left\{\left\{y[x] \to e^{\frac{2\,\text{ArcTanh}\left[\text{Tan}\left[\frac{x}{2}\right]\right]}{e}} C_1\right\}\right\}$

Out[83]= $\left\{\left\{e^{\frac{2\,\text{ArcTanh}\left[\text{Tan}\left[\frac{x}{2}\right]\right]}{e}}, -2\,e^{\frac{2\,\text{ArcTanh}\left[\text{Tan}\left[\frac{x}{2}\right]\right]}{e}}, -e^{\frac{2\,\text{ArcTanh}\left[\text{Tan}\left[\frac{x}{2}\right]\right]}{e}}\pi, e^{\frac{2\,\text{ArcTanh}\left[\text{Tan}\left[\frac{x}{2}\right]\right]}{e}}\pi\right\}\right\}$

Out[84]=



Question 5:

In[89]:=
```
eqn2 := y'[x] + x^2 * y[x] == 0
sol2 = DSolve[eqn2, y[x], x]
part2 = y[x] /. sol2 /. C[1] → {1, -2, -π, Pi}
Plot[part2, {x, -3, 3}, AxesLabel → {x, y}, PlotStyle → {Thickness[0.004], Green},
 PlotLegends → {part2}, GridLines → Automatic, GridLinesStyle → Directive[Black, Dashed]]
```

Out[90]= $\left\{\left\{y[x] \to e^{-\frac{x^3}{3}} C_1\right\}\right\}$

Out[91]= $\left\{\left\{e^{-\frac{x^3}{3}}, -2\, e^{-\frac{x^3}{3}}, -e^{-\frac{x^3}{3}} \pi, e^{-\frac{x^3}{3}} \pi\right\}\right\}$

Out[92]=