Project 8 - Pretty Pictures!

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Problem 1

In[95]:=
```
fx = t;
fy = t^2;
pl1 = Plot[fx, {t, 0, 10}, PlotStyle → Red];
pl2 = Plot[fy, {t, 0, 10}, PlotStyle → Green];
Print["x(t)=", fx, " and y(t)=", fy, "\n"];
Show[pl1, pl2, PlotRange → All]
ParametricPlot[{fx, fy}, {t, 0, 10}]
fx = Sin[t] + Cos[t];
fy = Cos[t] - Sin[t];
pl1 = Plot[fx, {t, 0, 10}, PlotStyle → Red];
pl2 = Plot[fy, {t, 0, 10}, PlotStyle → Green];
Print["x(t)=", fx, " and y(t)=", fy, "\n"];
Show[pl1, pl2, PlotRange → All]
ParametricPlot[{fx, fy}, {t, 0, 10}]
fx = t (e^(-t));
fy = Log[e, (t^2)];
pl1 = Plot[fx, {t, 0, 10}, PlotStyle → Red];
pl2 = Plot[fy, {t, 0, 10}, PlotStyle → Green];
Print["x(t)=", fx, " and y(t)=", fy, "\n"];
Show[pl1, pl2, PlotRange → All]
ParametricPlot[{fx, fy}, {t, 0, 10}]
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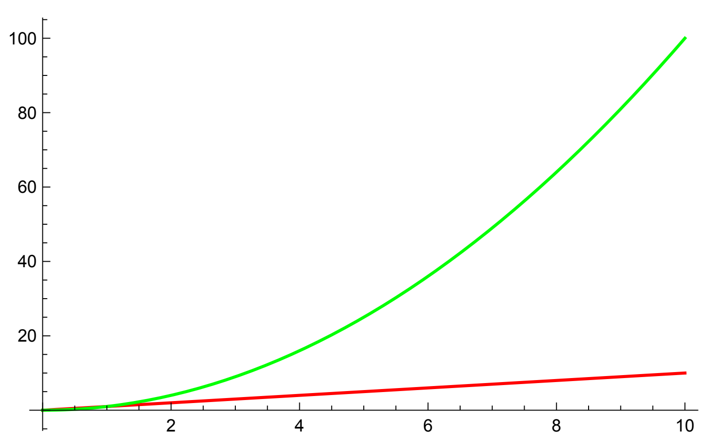
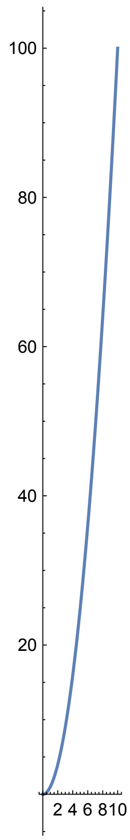
x(t)=t and y(t)=t^2

Out[100]=

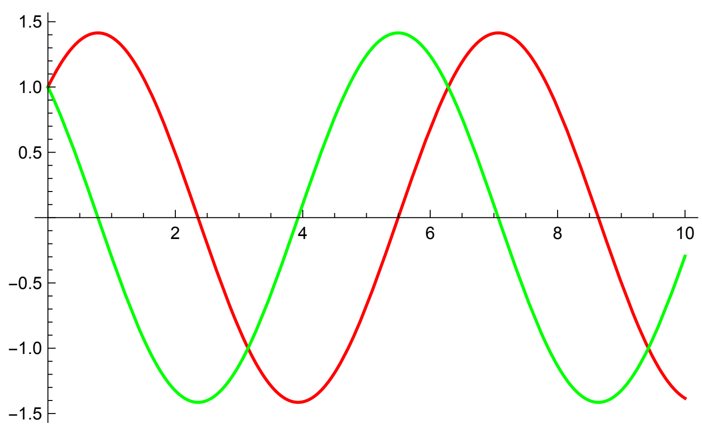


Out[101]=

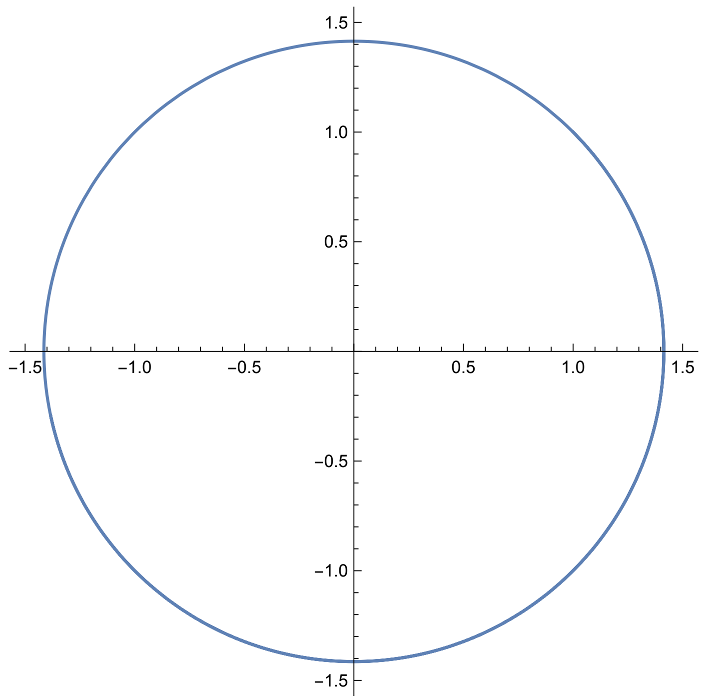


x(t)=Cos[t] + Sin[t] and y(t)=Cos[t] - Sin[t]

Out[107]=

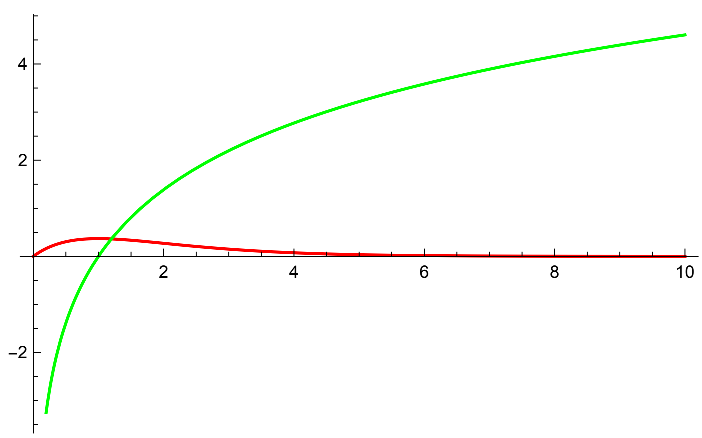


Out[108]=

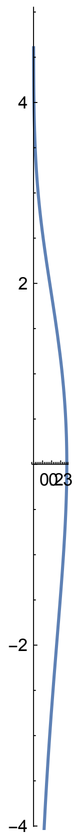


$x(t) = e^{-t}\, t$ and $y(t) = \text{Log}\left[t^2\right]$

Out[114]=



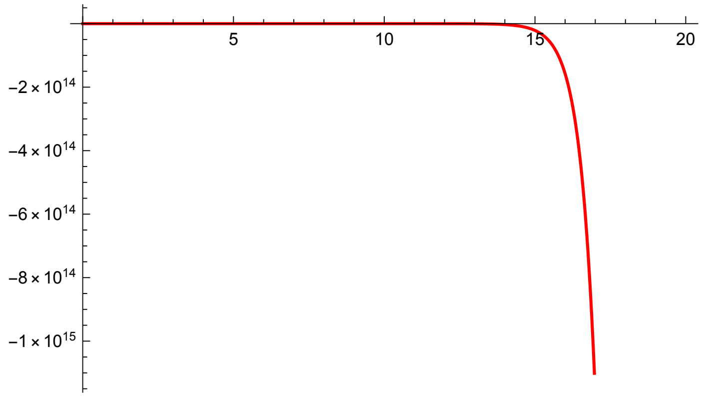
Out[115]=



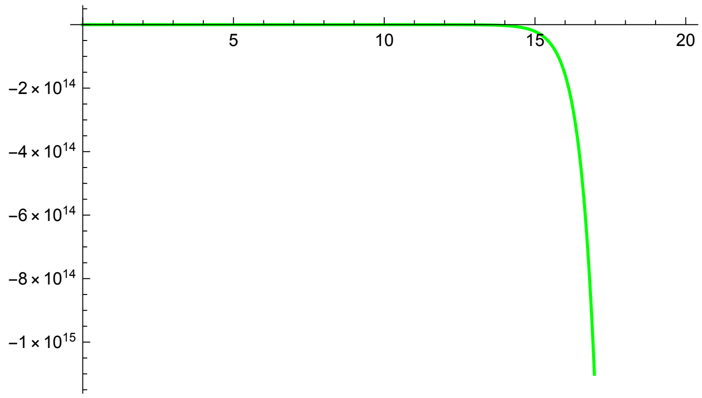
Problem 2

In[224]:=
```
Clear[xed, yed];
fvect = DSolve[{xed'[s] == 2 xed[s],
    yed'[s] == 3 xed[s] - yed[s], xed[0] == -2, yed[0] == -1}, {xed[s], yed[s]}, s];
fq = fvect[[1, 1, 2]];
fr = fvect[[1, 2, 2]];
pl1 = Plot[fq, {s, 0, 20}, PlotStyle → Red]
pl2 = Plot[fr, {s, 0, 20}, PlotStyle → Green]
Print["\nx(t) = ", fq, " and y(t) = ", fr, "\n"];
Show[pl1, pl2, PlotRange → All]
ParametricPlot[{fq, fr}, {s, 0, 10}]
fvect = DSolve[{xbb'[s] == xbb[s] * ybb[s],
    ybb'[s] == ybb[s] / xbb[s], xbb[1] == 1, ybb[1] == 1}, {xbb[s], ybb[s]}, s];
fq = fvect[[1, 1, 2]];
fr = fvect[[1, 2, 2]];
pl1 = Plot[fq, {s, 0, 10}, PlotStyle → Red]
pl2 = Plot[fr, {s, 0, 10}, PlotStyle → Green]
Print["\nx(t) = ", fq, " and y(t) = ", fr, "\n"];
Show[pl1, pl2, PlotRange → All]
ParametricPlot[{fq, fr}, {s, 0, 10}]
```

Out[228]=

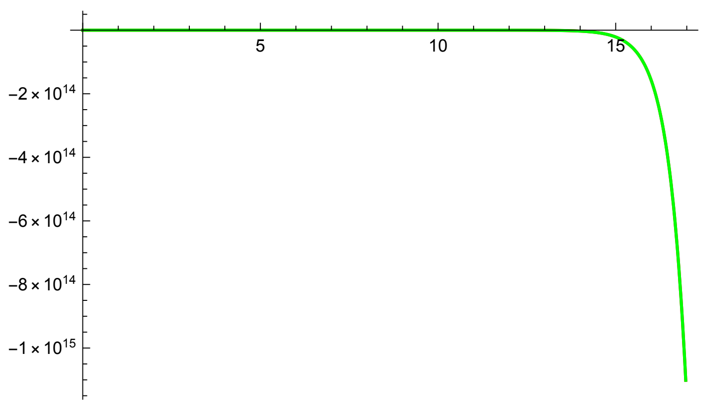


Out[229]=

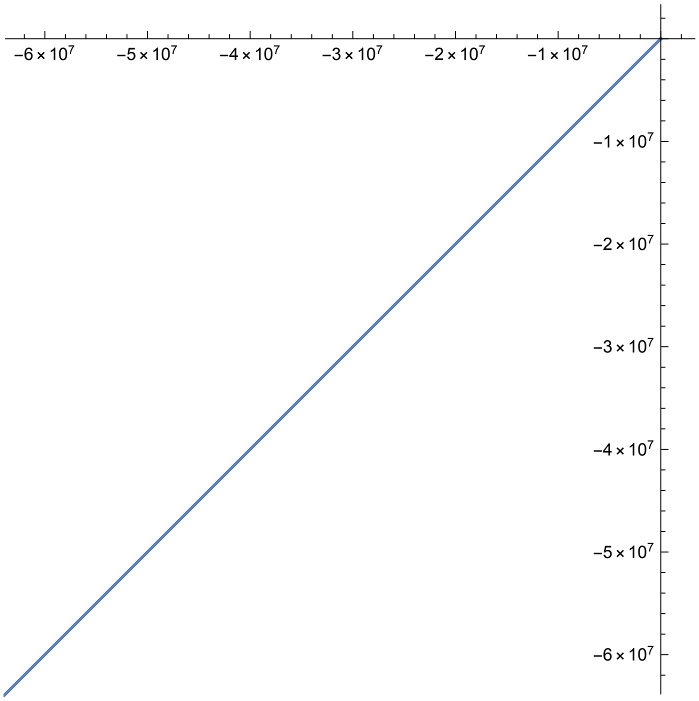


$x(t) = -2\,e^{2\,s}$ and $y(t) = -e^{-s}\left(-1 + 2\,e^{3\,s}\right)$

Out[231]=



Out[232]=

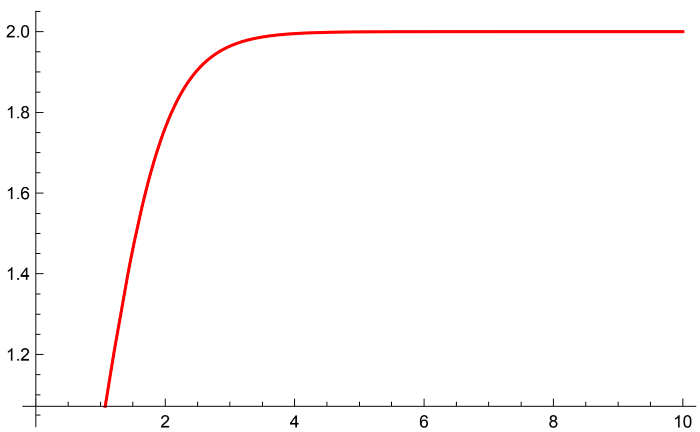


··· Solve: Inconsistent or redundant transcendental equation. After reduction, the bad equation is $\left(-2+\text{Log}\left[e^{C[1]}\right]\right)\text{Log}\left[e^{C[1]}\right]$ == 0.

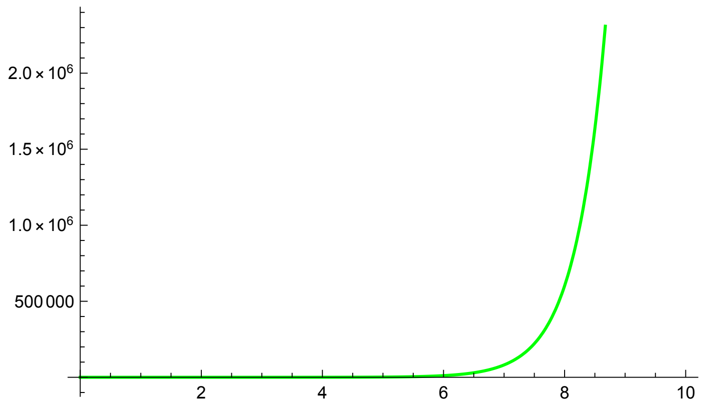
··· Solve: Inconsistent or redundant transcendental equation. After reduction, the bad equation is $2-\text{Log}\left[e^{C[1]}\right]$ == 0.

··· Solve: Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information.

Out[236]=

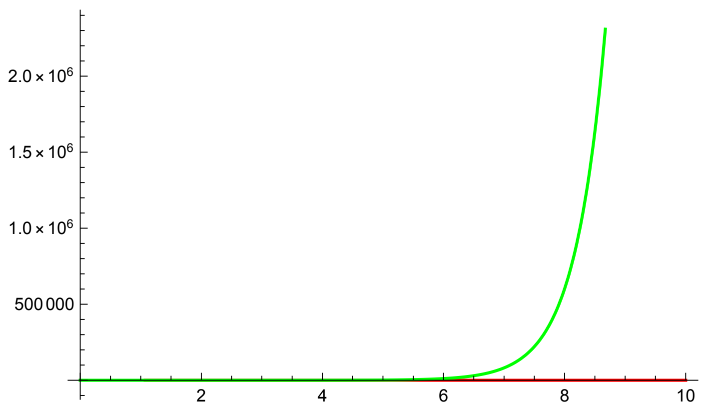


Out[237]=

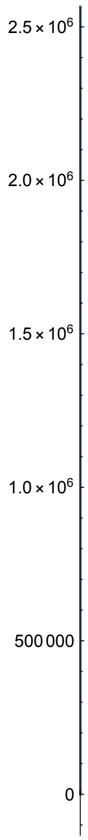


$$x(t) = \frac{2\, e^{2\,s}}{e^2 + e^{2\,s}} \text{ and } y(t) = \frac{e^2 + e^{2\,s}}{2\, e^2}$$

Out[239]=



Out[240]=

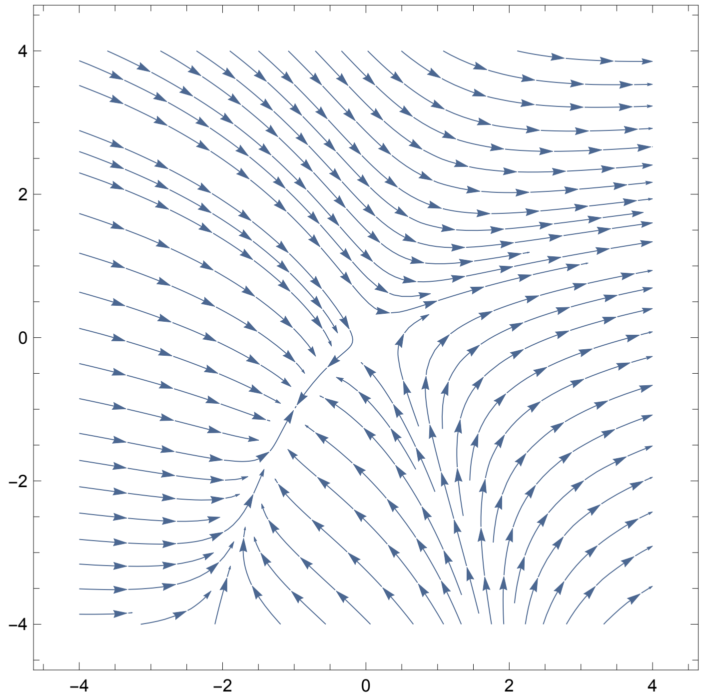


Problem 3

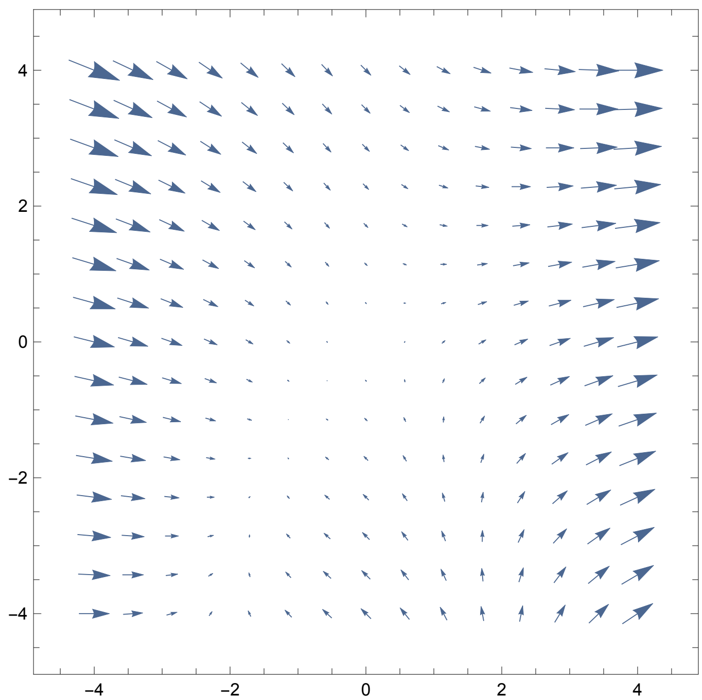
a.

In[278]:=
```
pl1 = StreamPlot[{x' = (x^2) + y, y' = x - y}, {x, -4, 4}, {y, -4, 4}]
pl2 = VectorPlot[{x' = (x^2) + y, y' = x - y}, {x, -4, 4}, {y, -4, 4}]
```

Out[278]=

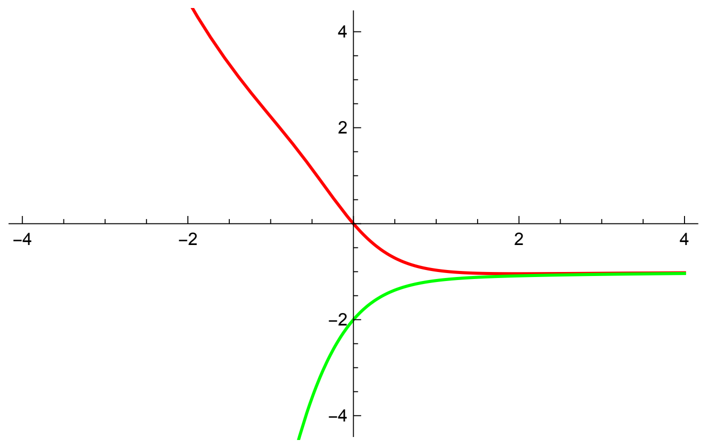


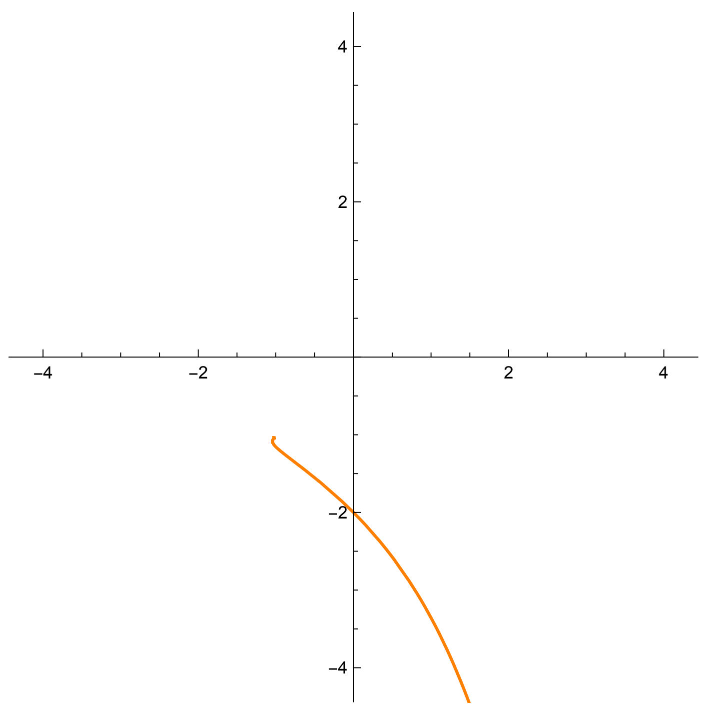
Out[279]=



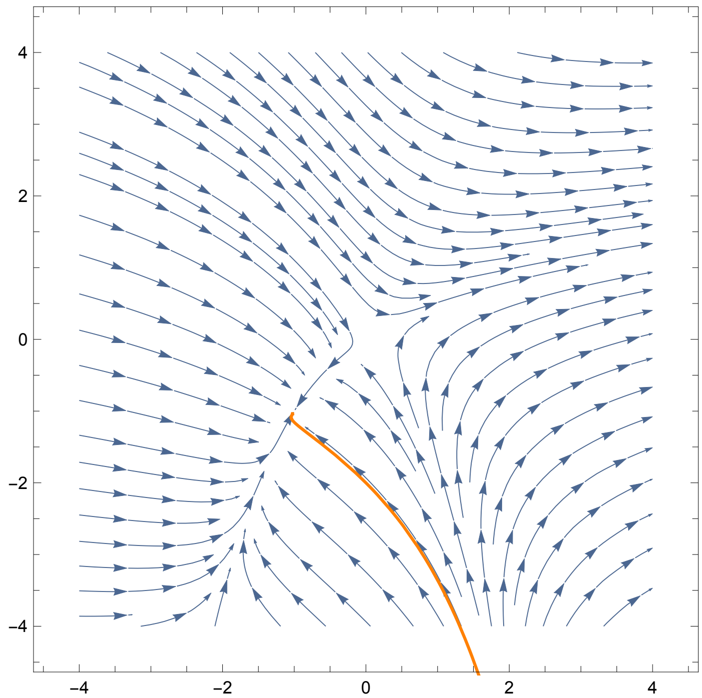
b. The stream plot is better at showing the overall shape of what a solution might look like but it sacrifices some degree of precision. The vector plot looks more like a scattered mesh and is less capable of portraying overall shape. It shines however in its precision as each vector is a straight line showing the derivative of the function at any values for x and y.

In[514]:=
```
Clear[xed, yed];
fvect = NDSolve[{xed'[s] == (xed[s])^2 + yed[s], yed'[s] == xed[s] - yed[s],
    xed[0] == 0, yed[0] == -2}, {xed[s], yed[s]}, {s, -4, 4}];
fq = fvect[[1, 1, 2]];
fr = fvect[[1, 2, 2]];
pl3 = Plot[fq, {s, -4, 4}, PlotStyle → Red];
pl4 = Plot[fr, {s, -4, 4}, PlotStyle → Green];
pl5 = ParametricPlot[{fq, fr}, {s, -4, 4}, PlotStyle → Orange];
Show[pl3, pl4, PlotRange → {{-4, 4}, {-4, 4}}]
Show[pl5, PlotRange → {{-4, 4}, {-4, 4}}]
Show[pl1, pl5]
```

Out[521]=


Out[522]=


Out[523]=



c. As t approaches infinity, the coordinates of x and y move asymptotically toward a single point that appears to be at roughly (-1,-1) on the graph. This is because both functions approach a derivative of zero as t becomes infinitely large. With infinitesimally miniscule movement in the x and y directions, the line appears to just stop at a single point because the coordinates only become closer and closer to that one specific spot.