3.1 Lorenz model

a)

```
x =.; y =.; z =.; S =.; stabMat =.;

f = sigma * (y - x);
g = r * x - y - x * z;
h = x * y - b * z;
sigma = 10;
b = 8 / 3;
r = 28;
flow = {f, g, h};


S = NSolve[flow == 0, {x, y, z}]
stabMat = D[flow, {{x, y, z}}] /. %[[1]]; (*Change values from 1 to 3*)
Eigenvalues[stabMat]

lim = 20;
StreamPlot3D[P, {x, -lim, lim}, {y, -lim, lim}, {z, -lim, lim}];
```

Out[1854]= {{x → 8.48528, y → 8.48528, z → 27.},
{x → -8.48528, y → -8.48528, z → 27.}, {x → 0., y → 0., z → 0.}}

Out[1856]= {-13.8546 + 0. i, 0.0939556 + 10.1945 i, 0.0939556 - 10.1945 i}

b)

In[1888]:=
```
x =.; y =.; z =.; S =.; stabMat =.;
system = {x'[t] == sigma * (y[t] - x[t]),
   y'[t] == r * x[t] - y[t] - x[t] * z[t], z'[t] == x[t] * y[t] - b * z[t]};

sol[T_] := NDSolve[
   Join[system, Thread[{x[0], y[0], z[0]} == 7]], {x[t], y[t], z[t]}, {t, 0, T}];
Tmax = 20;
p0 = Show[ParametricPlot3D[
    Evaluate[{x[t], y[t], z[t]} /. sol[Tmax]], {t, 0, Tmax}, PlotStyle → Green,
    PlotRange → {{-40, 40}, {-40, 40}, {-0, 50}}, AxesLabel → {x, y, z}]];
(p0 // Normal) /.
 Line[x_] :→ {Arrowheads[{0.05, 0.05, 0.05, 0.05, 0.05}], Arrow[x], PlotStyle → Black}
```

Out[1893]=