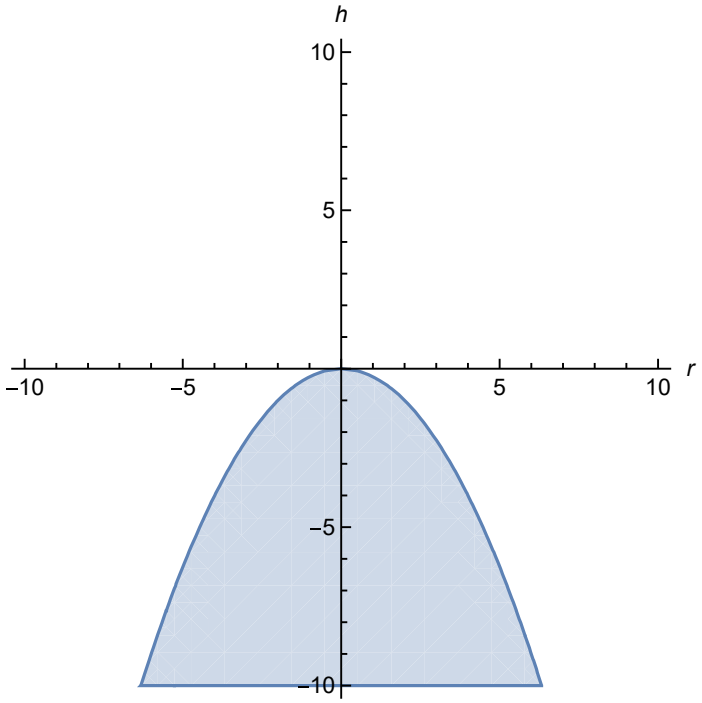
1.1 Imperfect transcritical bifurcation

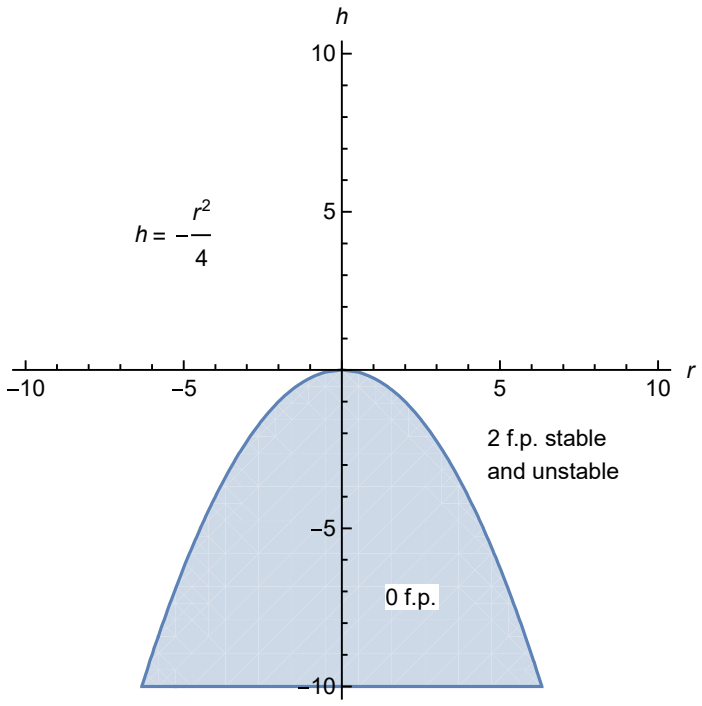
a)

In[ ]:=
```
Clear["Global`*"]

RegionPlot[h < -r^2/4, {r, -10, 10}, {h, -10, 10},
 AxesLabel → Automatic,
 Axes → True,
 Frame → None,
 FrameLabel → {r, h},
 RotateLabel → False,
 LabelStyle → (FontSize → 12)]
```

Out[ ]=




h
10
5
−5
−10
−10
−5
5
10
r
$h = -\frac{r^2}{4}$
2 f.p. stable
and unstable
0 f.p.

b)

In[ ]:=
```
Clear["Global`*"]

x1 = (r + Sqrt[r^2 + 4*h])/2;

x2 = (r - Sqrt[r^2 + 4*h])/2;

Show[
 Plot3D[x1, {r, -10, 10}, {h, -10, 10},
  AxesOrigin -> {0, 0, 0},
  PlotRange -> {-11, 11}],
 Plot3D[x2, {r, -10, 10}, {h, -10, 10},
  AxesOrigin -> {0, 0, 0},
  PlotRange -> {-11, 11}],
 Graphics3D[{Text["r", {10, 0, 0}],
   Text["h", {0, 10, 0}],
   Text["x*", {0, 0, 11}]}],
 Boxed -> False]
```

Out[ ]=