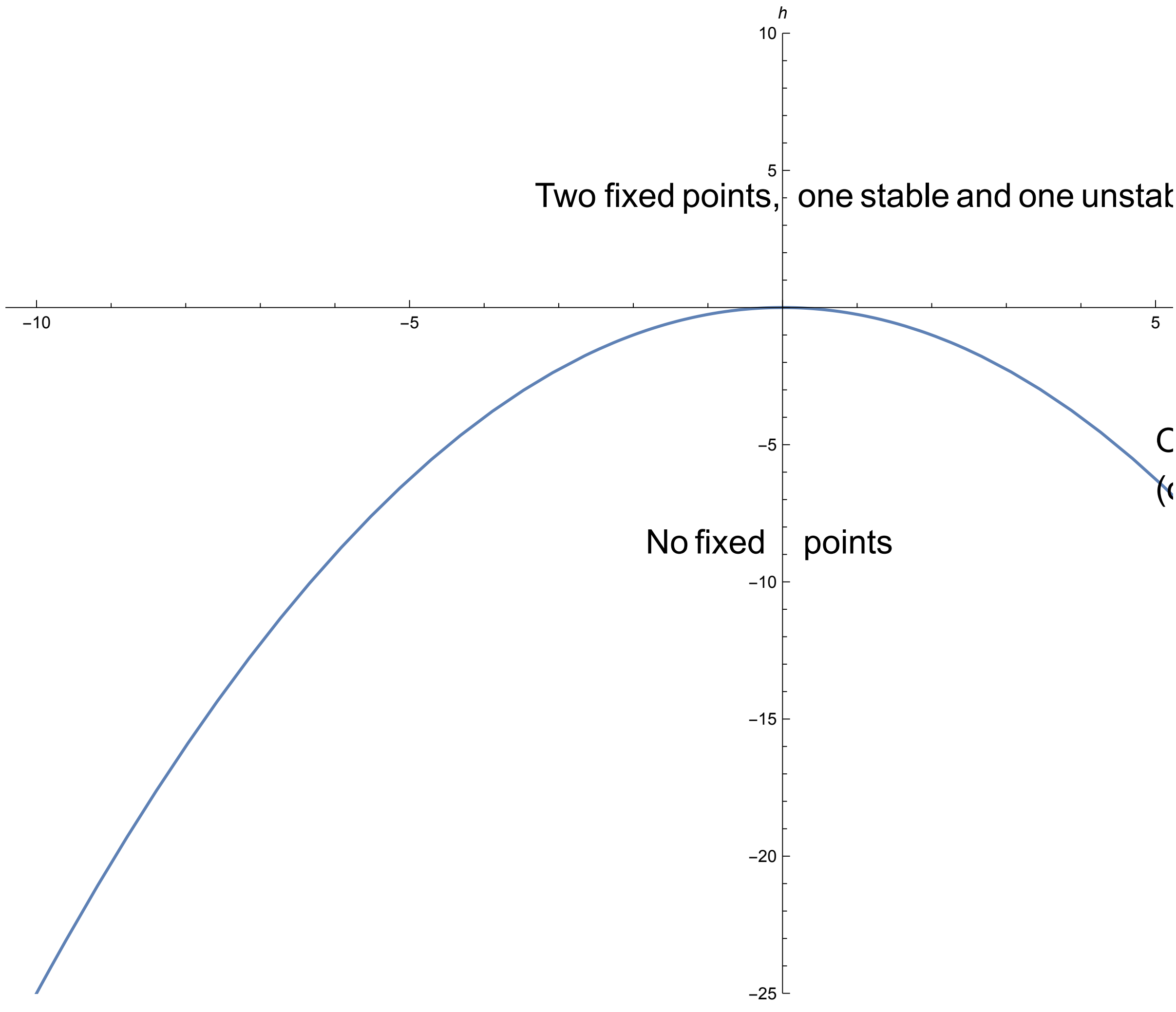
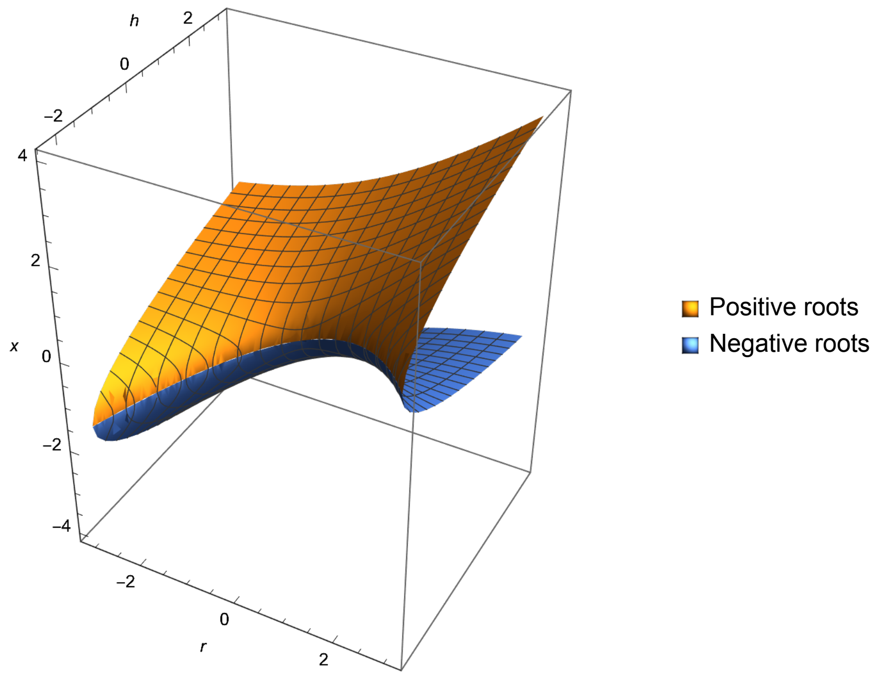
```
(*1a Make a plot of the (h,r)plane.*)
f := x * r - x^2 + h;
df = D[f, x];
xsolution = Solve[df == 0, x];
fsolution = f /. {xsolution}
hsolution = Solve[{fsolution} == 0, {h}]; (*få ut svaret på h=*)
sol = hsolution[[All, 1, 2]] ;
p1 = Plot[ sol[[1]], {r, -10, 10}, PlotRange → {-25, 10}, AxesLabel → {r, h} ]
```



```
(*1b Make a three-dimensional (x*,h,r)-plot of the surface of fixed points*)
f2 = h + x (r - x);
x2solution = Solve[f2 == 0, x];
x2 = x2solution[[All, 1, 2]];
p2 = ParametricPlot3D[{{r, h, x2[[2]]}, {r, h, x2[[1]]}}, {r, -3, 3}, {h, -3, 3},
  PlotLegends → {"Positive roots", "Negative roots"}, AxesLabel → {r, h, x}]
(*using export instead to include the legends with the plot*)
(*Export["exportp2.png",p2]*)
```




```
(*1c*)(*Write[h_c(r),r] depending on r*)
(*This answer is calculated above and
  obtained from the variable "sol" which is = -r^2/4 *)
sol
```

$\left\{-\frac{r^2}{4}\right\}$

```
(*1d*)
(*Similarly,for each point,[h_c(r),r],on the bifurcation curve,
a transcritical bifurcation occurs in one direction
 that depends on r. Find this direction analytically*)
(*To obtain the value we can derive the answer in 1.1c and normalize it*)
```

```
dh = D[sol⟦1⟧, r];
Normalize[{dh, 1}]
```

$$\left\{-\frac{r}{2\sqrt{1+\frac{\text{Abs}[r]^2}{4}}},\ \frac{1}{\sqrt{1+\frac{\text{Abs}[r]^2}{4}}}\right\}$$