c)

```
Solve[x * (r - x) + h == 0, x]
```

$$Out[\bullet]= \left\{\left\{x \to \frac{1}{2}\left(r - \sqrt{4h + r^2}\right)\right\}, \left\{x \to \frac{1}{2}\left(r + \sqrt{4h + r^2}\right)\right\}\right\}$$

```
In[•]:= Solve[D[x * (r - x) + h, x] == 0, x]
```

$$Out[\bullet]= \left\{\left\{x \to \frac{r}{2}\right\}\right\}$$

```
x = r / 2;
f = Solve[x * (r - x) + h == 0, h]
```

$$Out[\bullet]= \left\{\left\{h \to -\frac{r^2}{4}\right\}\right\}$$

a)

```
In[•]:= align[Right] = {1, 0};
align[Center] = {0, 0};
align[Left] = {-1, 0};

Text1 = Text["0 F.P's under curve", {0.5, -2}, align[Left]];
Text2 = Text["1 F.P on the curve, half stable", {1.6, -1}, align[Center]];
Text3 = Text["2 F.P's above curve, 1 stable 1 unstable", {2.5, 0.1}, align[Right]];

txt = Graphics[{Text1, Text2, Text3}];
plot = Plot[-r^2 / 4, {r, -4, 4}];

Show[plot, txt]
```
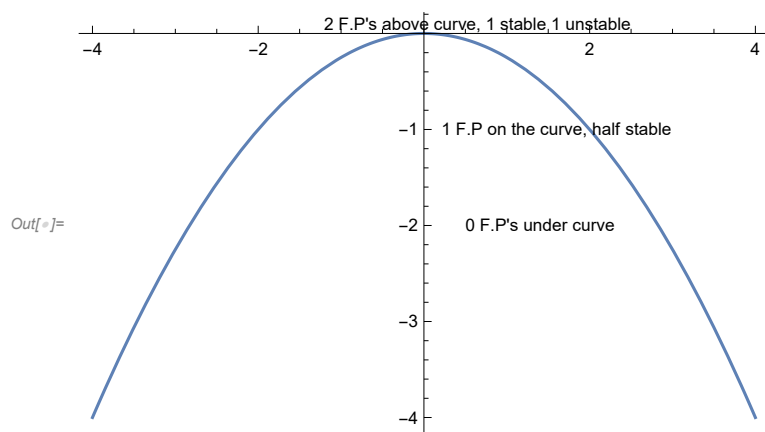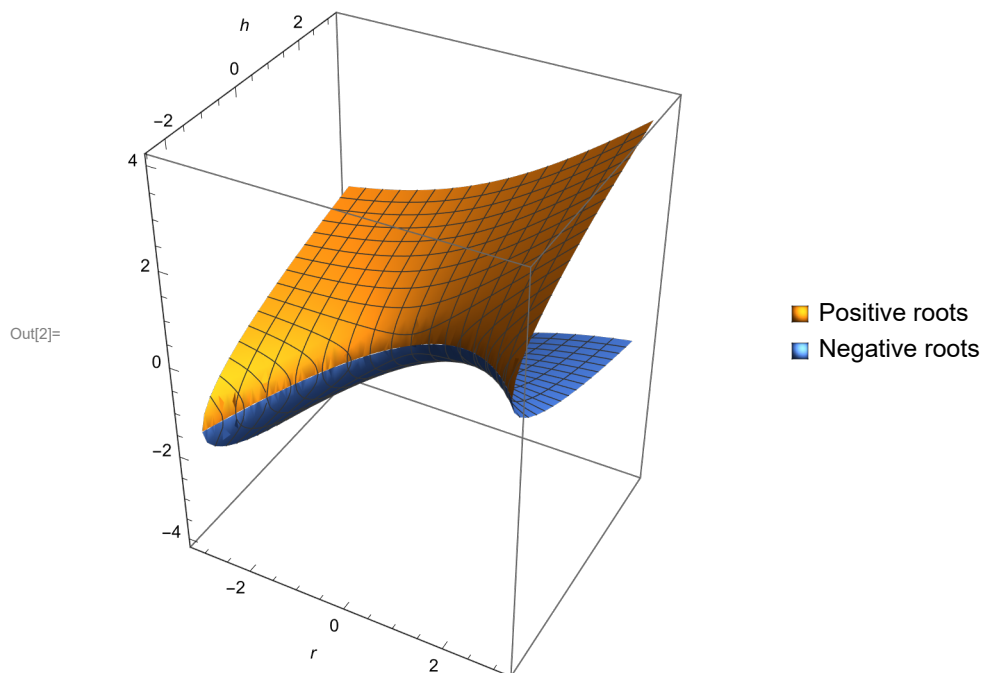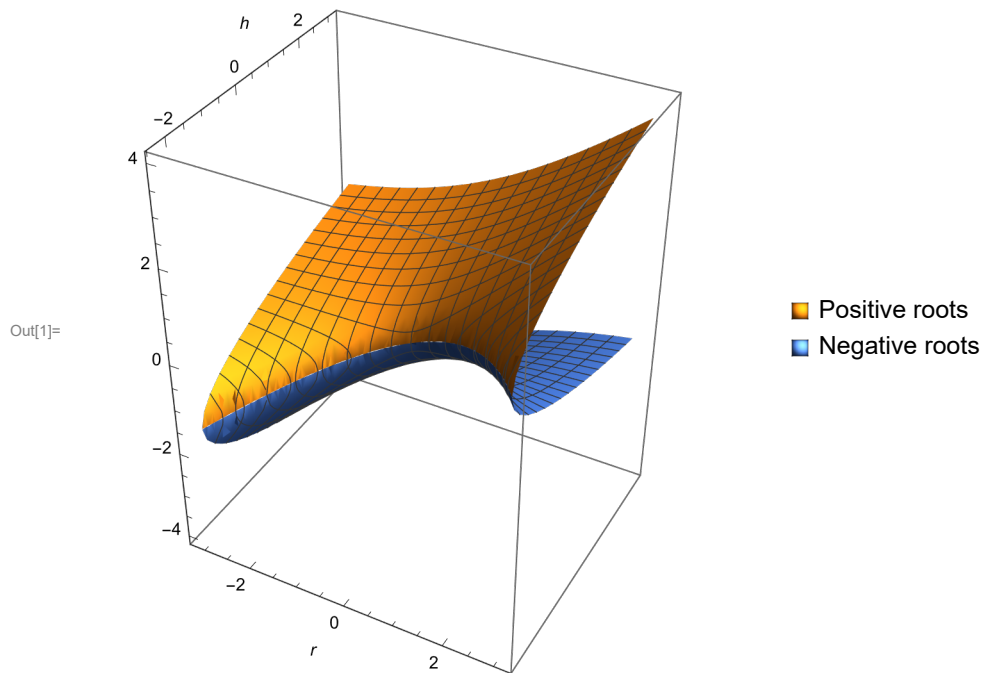
b)

In[ ]:= `Clear[x]`
`Solve[x * (r - x) + h == 0, r];`

In[1]:= `plot3 = ParametricPlot3D[{{r, h, 1 / 2 (r + Sqrt[4 h + r^2])},`
`{r, h, 1 / 2 (r - Sqrt[4 h + r^2])}}, {r, -3, 3}, {h, -3, 3},`
`PlotLegends → {"Positive roots", "Negative roots"}, {AxesLabel → {r, h}}]`
`Show[plot3]`

Out[1]=

Out[2]=

d)

In[ ]:= `Solve[((r / 2)^2 - h) / (r / 2) == 0, h];`

In[ ]:= `v = {-r^2 / 4, r};`
`v = D[v, r];`
`Normalize[v]`

Out[ ]= $\left\{ -\dfrac{r}{2\sqrt{1 + \dfrac{Abs[r]^2}{4}}}, \dfrac{1}{\sqrt{1 + \dfrac{Abs[r]^2}{4}}} \right\}$