In[1]:= **I a**

Out[1]= a

In[2]:=
$$\xi 0[R\_] = 0$$
$$\xi 1[R\_] = \frac{1 + \text{Sqrt}\left[1 - 4\left(1 - R\right)\right]}{2}$$
$$\xi 2[R\_] = \frac{1 - \text{Sqrt}\left[1 - 4\left(1 - R\right)\right]}{2}$$

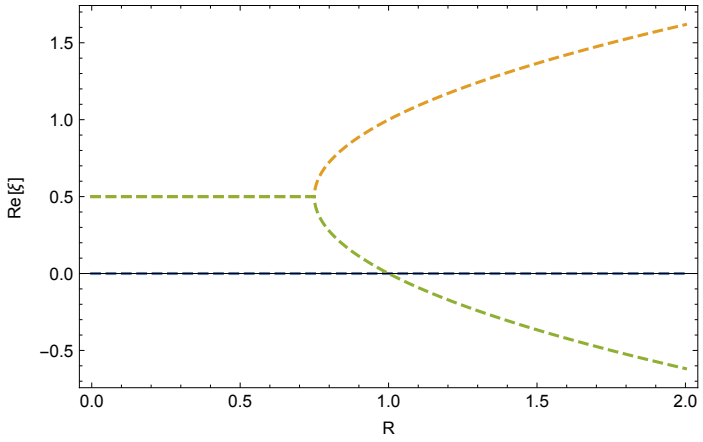
Out[2]= 0

Out[3]= $\frac{1}{2}\left(1 + \sqrt{1 - 4\ (1 - R)}\right)$

Out[4]= $\frac{1}{2}\left(1 - \sqrt{1 - 4\ (1 - R)}\right)$

In[5]:=
```
Plot[{Re[ξ0[r]], Re[ξ1[r]], Re[ξ2[r]]}, {r, 0, 2},
 Frame → True, FrameLabel → {"R", "Re[ξ]"}, PlotStyle → Dashed]
```

Out[5]=

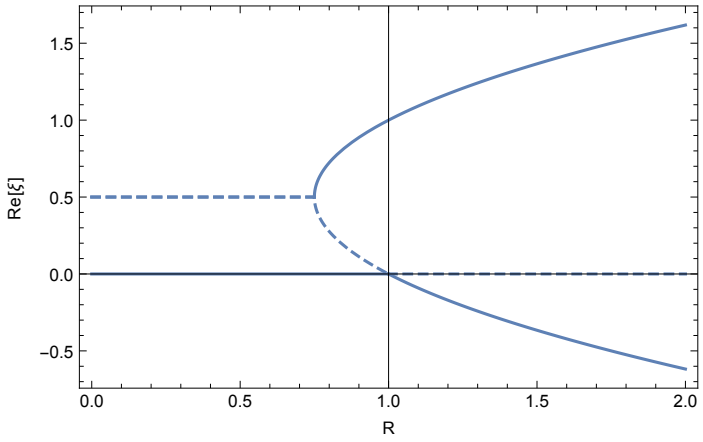


In[6]:= **I b**

Out[6]= b

In[7]:=
```
a1 = Plot[{Re[ξ0[r]]}, {r, 1, 2}, PlotStyle → Dashed];
a2 = Plot[{Re[ξ1[r]]}, {r, 0, 3/4}, PlotStyle → Dashed];
a3 = Plot[{Re[ξ2[r]]}, {r, 0, 1}, PlotStyle → Dashed];
a4 = Plot[{Re[ξ0[r]]}, {r, 0, 1}];
a5 = Plot[{Re[ξ1[r]]}, {r, 3/4, 2}];
a6 = Plot[{Re[ξ2[r]]}, {r, 1, 2}];
Show[a1, a2, a3, a4, a5, a6, Frame → True,
 FrameLabel → {"R", "Re[ξ]"}, PlotRange → All]
```

Out[13]=



In[184]:=
```
σ1[R_] = -2 R + 3/2 - Sqrt[R - 3/4]
σ2[R_] = -2 R + 3/2 + Sqrt[R - 3/4]
σ3[R_] = R - 1
σ10 = σ1[0.8]
σ20 = σ2[0.8]
σ30 = σ3[0.8]
```

Out[184]= $\frac{3}{2} - \sqrt{-\frac{3}{4} + R} - 2R$

Out[185]= $\frac{3}{2} + \sqrt{-\frac{3}{4} + R} - 2R$

Out[186]= $-1 + R$

Out[187]= -0.323607

Out[188]= 0.123607

Out[189]= -0.2

Ic

In[15]:=
```
f1[tfix_] := ξ[tfix] /.
  NDSolve[{ξ'[t] == (0.8 - 1) * ξ[t] + ξ[t]^2 - ξ[t]^3, ξ[0] == 0.2764}, ξ, {t, 0, 100}]
f2[tfix_] := ξ[tfix] /. NDSolve[
   {ξ'[t] == (0.8 - 1) * ξ[t] + ξ[t]^2 - ξ[t]^3, ξ[0] == 0.2763}, ξ, {t, 0, 100}]
f3[tfix_] := ξ[tfix] /. NDSolve[{ξ'[t] == (0.8 - 1) * ξ[t] + ξ[t]^2 - ξ[t]^3, ξ[0] == 0.72},
   ξ, {t, 0, 100}]
f4[tfix_] := ξ[tfix] /. NDSolve[{ξ'[t] == (0.8 - 1) * ξ[t] + ξ[t]^2 - ξ[t]^3, ξ[0] == 0.74},
   ξ, {t, 0, 100}]
```

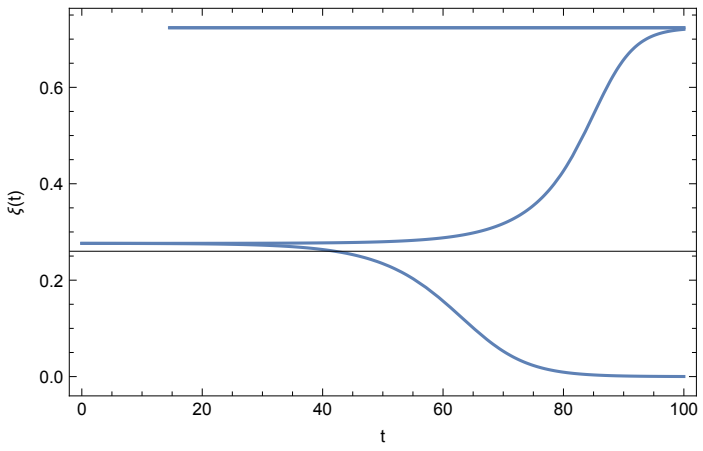
In[19]:=
```
f4[0]
```

Out[19]=
```
{0.74}
```

In[20]:=
```
b1 = Plot[Evaluate[f1[t], {t, 0, 100}]];
b2 = Plot[Evaluate[f2[t], {t, 0, 100}]];
b3 = Plot[Evaluate[f3[t], {t, 0, 100}]];
b4 = Plot[Evaluate[f4[t], {t, 0, 100}]];

Show[b1, b2, b3, b4, Frame → True, FrameLabel → {"t", "ξ(t)"}, PlotRange → All]
```

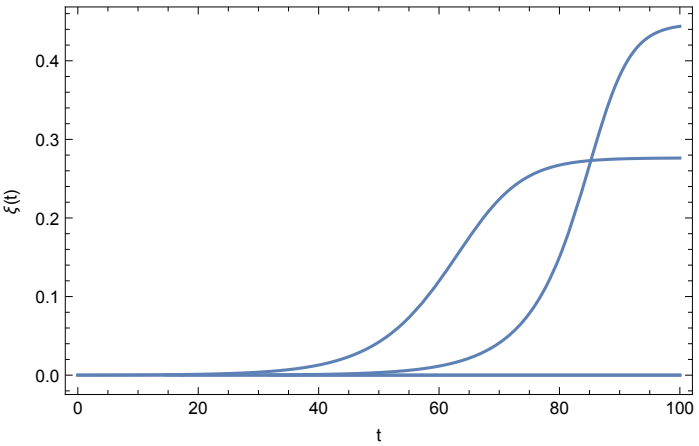
Out[24]=



In[25]:=
```
c1 = Plot[Evaluate[Abs[f1[t] - 0.2764], {t, 0, 100}]];
c2 = Plot[Evaluate[Abs[f2[t] - 0.2764], {t, 0, 100}]];
c3 = Plot[Evaluate[Abs[f3[t] - 0.7236], {t, 0, 100}]];
c4 = Plot[Evaluate[Abs[f4[t] - 0.7236], {t, 0, 100}]];

Show[c1, c2, c3, c4, Frame → True, FrameLabel → {"t", "ξ(t)"}, PlotRange → All]
```

Out[29]=



In[30]:=

In[130]:=
```
f11[td2_] :=
 D[Log[PiecewiseExpand[Abs[f1[t] - 0.2763], f1[t] - 0.2763 ∈ Reals]], t] /. t → td2
f22[td2_] :=
 D[Log[PiecewiseExpand[Abs[f2[t] - 0.2764], f2[t] - 0.2764 ∈ Reals]], t] /. t → td2
f33[td3_] :=
 D[Log[PiecewiseExpand[Abs[f3[t] - 0.7237], f3[t] - 0.7237 ∈ Reals]], t] /. t → td3
f44[td4_] :=
 D[Log[PiecewiseExpand[Abs[f4[t] - 0.7236], f4[t] - 0.7236 ∈ Reals]], t] /. t → td4
```

In[190]:=
```
Plot[{f11[tplt], f22[tplt], f33[tplt], f44[tplt]},
 {tplt, 0, 100}, PlotRange → Full, Frame → True,
 FrameLabel → {"t", "σ"}, GridLines → {{}, {σ10, σ20}}]
```

Out[190]=