In[1051]:=

```
Clear[radius, t, h, w, g, theta, delta, tsol, xrange, x0, dist, vboat, xboat, variation]
radius = 10;
h = 80;
w = 0.8; g = 9.81; theta[0] = 0;
delta = 0.01;
dist = 150; vboat = 10;
theta[n_] := theta[n] = theta[n - 1] + delta



x0[n_] := x0[n] = radius Sin[theta[n]]


tsol[n_] :=
 tsol[n] = t /. Solve[h + radius Cos[theta[n]] - w radius Sin[theta[n]] t - g t^2 / 2 == 0, t][[2]]



xrange[n_] := xrange[n] = x0[n] + w radius Cos[theta[n]] tsol[n]
xboat[n_] := xboat[n] = dist - vboat (tsol[n] + theta[n] / w)
variation[n_] := variation[n] = xboat[n] - xrange[n]



variationsolution = Catch[Do[If[Sign[variation[n] / variation[n - 1]] < 0,
     Throw[{n, theta[n], xrange[n], xboat[n], (theta[n] / w) + tsol[n]}]], {n, 1, 4000}]];
Print["The variation solution finds that the beginning of the successful
   launch window occurs when theta = ", variationsolution[[2]],
 " radians = ", 180 variationsolution[[2]] / π, " degrees"]

Print["  "]


firstsol = Catch[Do[If[xrange[p] > xboat[p],
     Throw[{p, theta[p], xboat[p], xrange[p], theta[p] / w + tsol[p]}]], {p, 4000}]];
Print["The beginning of the successful launch window occurs when theta =  ",
 180 firstsol[[2]] / π, " degrees."]
Print["The person steps off the wheel at t = ", firstsol[[2]] / w,
 "   seconds and hits the water at t =  ", firstsol[[5]], "  seconds."]
Print["  When the person hits the water, the front edge of the boat is at x = ",
 firstsol[[3]], "  meters."]
lastsol = Catch[Do[If[(xrange[m] - xboat[m]) > 1, Throw[{m - 1, theta[m - 1], xboat[m - 1],
       xrange[m - 1], theta[m - 1] / w + tsol[m - 1], w radius Cos[theta[m - 1]]}]], {m, 4000}]];
Print["   "]
Print["The successful launch window ends when theta = ",
 (180 / π) lastsol[[2]], " degrees."]
Print["The person steps off the wheel at ", lastsol[[2]] / w,
 " seconds and hits the water at ", lastsol[[5]], " seconds."]
Print["When the person hits the water, the front edge of the boat is at x = ",
 lastsol[[3]], " meters."]
```

```
g1 = ListPlot[Table[{tsol[n] + theta[n] / w, xboat[n]}, {n, 0, 1500}], PlotStyle → Red];
g2 = ListPlot[Table[{tsol[n] + theta[n] / w, xrange[n]}, {n, 1500}], PlotStyle → Cyan];

Show[g1, g2, PlotRange → All, AxesLabel → {Time, Distance},
 LabelStyle → Directive[Blue, 14, Bold]]
```

The variation solution finds that the beginning of the successful
launch window occurs when theta = 5.91 radians = 338.618 degrees

The beginning of the successful launch window occurs when theta = 338.618 degrees.

The person steps off the wheel at t = 7.3875
seconds and hits the water at t = 11.9623 seconds.

When the person hits the water, the front edge of the boat is at x = 30.3772 meters.

The successful launch window ends when theta = 340.91 degrees.

The person steps off the wheel at 7.4375 seconds and hits the water at 11.983 seconds.

When the person hits the water, the front edge of the boat is at x = 30.1705 meters.

Out[1077]=