```
(* Here, we denote the BH potential as V=
 -GMm/r and take the parameter α=GMm to give the strength of BH *)

sol = ParametricNDSolve [{(1 / 2) * ϕ''[r] + (1 / r) ϕ'[r] - 2 ϕ[r] / r ^ 2 + (α / r) * ϕ[r] == ψ[r] * ϕ[r],
    ψ''[r] + (2 / r) ψ'[r] == (1 / 2) ϕ[r] ^ 2, ψ[0.01] == p, ϕ[0.01] == 0,
    ϕ'[0.01] == 1, ψ'[0.01] == 0}, {ϕ, ψ}, {r, 0.01, 6}, {p, α}]
```

Out[393]=

$\{\phi \to$ ParametricFunction [Expression : ϕ Parameters : {p, α}],

$\psi \to$ ParametricFunction [Expression : ψ Parameters : {p, α}]$\}$

In[394]:=

```
Plot[Evaluate[{ϕ[-2.33463, 0][r], ϕ[-1.81523, 0.5][r], ϕ[-1.31995, 1][r],
    ϕ[-0.850292, 1.5][r], ϕ[-0.407773, 2][r], ϕ[0.00667873, 2.5][r]} /. sol],
 {r, 0.01, 7}, PlotLegends → {"α=0", "α=0.5", "α=1", "α=1.5", "α=2", "α=2.5"}]
```

Out[394]=