# Thornton & Marion 5$^{th}$ Edition Problem 2 – 47

Consider a particle moving in the region $x > 0$ under the influence of a potential

$$U(x) = U_0\left(\frac{\alpha}{x} + \frac{x}{\alpha}\right)$$

where $U_0 = 1$ J and $\alpha = 2$ m. Plot the potential, find the equilibrium points and determine whether they are maxima or minima.

---

## Define the function:

```
Ux = Uzero * ((α/x) + (x/α))
```

$$Uzero\left(\frac{x}{\alpha} + \frac{\alpha}{x}\right)$$

```
Uzero = 1
α = 2
FindMaximum[Ux, {x, 2}]
```
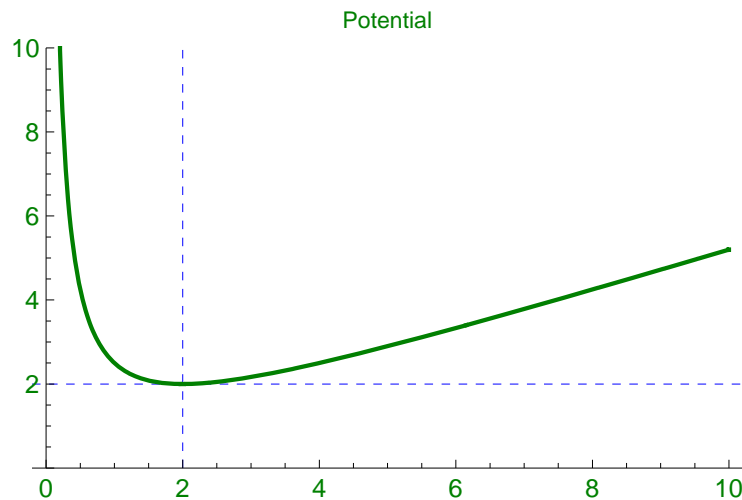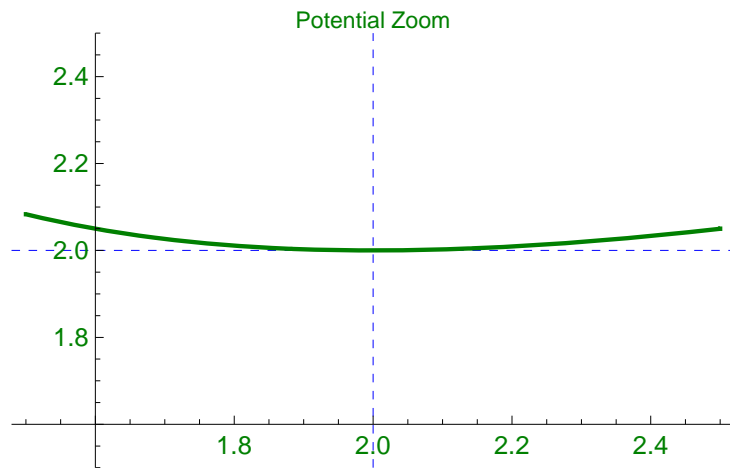
```
1
```

```
2
```

```
{2., {x → 2.}}
```

Plot the potential and include gridlines for the positions of the maxima and the values of the maxima

```
pPotential = Plot[Ux, {x, 0, 10}, TextStyle → {FontFamily → Helvetica, FontSize → 12, FontColor →
    GridLinesStyle → Directive[Blue, Dashed], PlotPoints → 500, PlotStyle → {RGBColor[0, 0.5, 0], T
```


Potential

Zoom in on the minimum to see the details.

```
pPotentialZoom = Plot[Ux, {x, 1.5, 2.5},
   TextStyle → {FontFamily → Helvetica, FontSize → 12, FontColor → RGBColor[0, 0.5, 0]},
   GridLines → {{2}, {2}}, GridLinesStyle → Directive[Blue, Dashed],
   PlotPoints → 500, PlotStyle → {RGBColor[0, 0.5, 0], Thickness[0.006]},
   PlotRange → {1.5, 2.5}, PlotLabel → "Potential Zoom"]
```



So there is one minimum at x = 2 and it is a point of stable equilibrium.