$MEr := 9 \quad MCo := 5 \quad \lambda := 10$

$E(B,\alpha,\phi) := MEr \cdot MCo \cdot \lambda \cdot \cos(\alpha) - (B \cdot MEr \cdot \sin(\alpha + \phi)) - B \cdot MCo \cdot \sin(\phi)$

Given

$\frac{\partial}{\partial\alpha}E(B,\alpha,\phi) = 0 \qquad \frac{\partial}{\partial\phi}E(B,\alpha,\phi) = 0$

$0 < \alpha < \pi \qquad -\frac{\pi}{2} < \phi < \frac{\pi}{2}$

$Angles1(B,\alpha,\phi) := Find(\alpha,\phi)$

Given

$0 < \alpha < \pi \qquad -\frac{\pi}{2} < \phi < \frac{\pi}{2}$

$Angles2(B,\alpha,\phi) := Minimize(E,\alpha,\phi)$

$Angles1(7,1,1) = \begin{pmatrix} 2.13 \times 10^{-8} \\ 1.571 \end{pmatrix} \qquad Angles2(7,1,1) = \begin{pmatrix} 3.142 \\ 1.571 \end{pmatrix}$

$E\left(7, 2.13 \times 10^{-8}, \frac{\pi}{2}\right) = 352 \qquad E\left(7,\pi,\frac{\pi}{2}\right) = -422$

Solutions also may be dependent on the guess values (first 2 args) for the angles.

$Angles1(7,0,0) = \begin{pmatrix} 0 \\ -1.571 \end{pmatrix} \qquad Angles1(7,1,1) = \begin{pmatrix} 2.13 \times 10^{-8} \\ 1.571 \end{pmatrix} \qquad Angles1(7,2,2) = \begin{pmatrix} 3.142 \\ 1.571 \end{pmatrix}$

$Angles2(7,0,0) = \begin{pmatrix} 3.142 \\ 1.571 \end{pmatrix} \qquad Angles2(7,1,1) = \begin{pmatrix} 3.142 \\ 1.571 \end{pmatrix} \qquad Angles2(7,2,2) = \begin{pmatrix} 3.142 \\ 1.571 \end{pmatrix}$

$Angles1\left(7,\pi,\frac{\pi}{2}\right) = \begin{pmatrix} 3.142 \\ 1.571 \end{pmatrix} \qquad Angles1\left(28,\pi,\frac{\pi}{2}\right) = \begin{pmatrix} 3.142 \\ 1.571 \end{pmatrix} \qquad Angles1(28,0,0) = \begin{pmatrix} 0 \\ -1.571 \end{pmatrix}$

$Angles2\left(27,\pi,\frac{\pi}{2}\right) = \begin{pmatrix} 3.142 \\ 1.571 \end{pmatrix} \qquad Angles2\left(28,\pi,\frac{\pi}{2}\right) = \begin{pmatrix} 0 \\ 1.571 \end{pmatrix} \qquad Angles2(28,0,0) = \begin{pmatrix} 3.142 \\ -1.571 \end{pmatrix}$

$E\left(28,0,\frac{\pi}{2}\right) = 58 \qquad E\left(28,\pi,\frac{\pi}{2}\right) = -338$

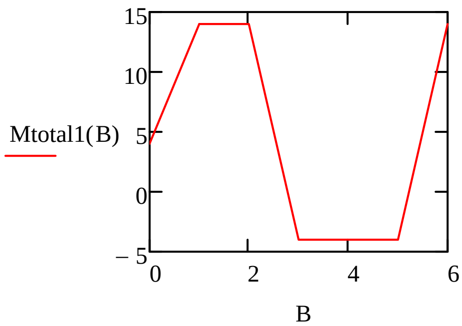
The guess values are hardcoded in the routines below. You may chose to change them and you will see the effect this has on Mtotal.
You may also chose to calculate appropriate guess values in those routines dependent on the value of B, if that seems appropprioate.

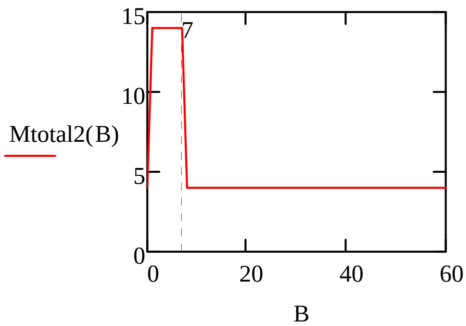
Guess values: $\alpha_g := \pi$ $\phi_g := \frac{\pi}{2}$

$$Mtotal1(B) := \left| \begin{array}{l} \begin{pmatrix}\alpha \\ \phi\end{pmatrix} \leftarrow Angles1\left(\alpha_g, \phi_g, B\right) \\ MEr \cdot \sin(\alpha + \phi) + MCo \cdot \sin(\phi) \end{array}\right.$$

$$Mtotal2(B) := \left| \begin{array}{l} \begin{pmatrix}\alpha \\ \phi\end{pmatrix} \leftarrow Angles2\left(\alpha_g, \phi_g, B\right) \\ MEr \cdot \sin(\alpha + \phi) + MCo \cdot \sin(\phi) \end{array}\right.$$

$B := 0 .. 60$




I don't think that either of the two is what you expected.

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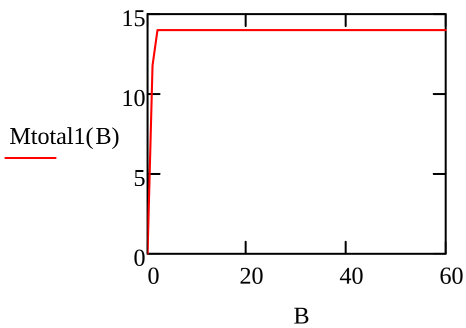
Here the same with different guess values

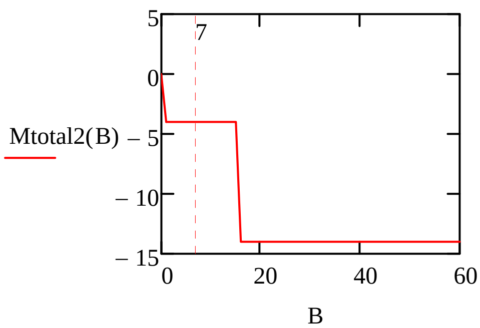
Guess values: $\alpha_g := 0$ $\phi_g := 0$

$$Mtotal1(B) := \left| \begin{array}{l} \begin{pmatrix}\alpha \\ \phi\end{pmatrix} \leftarrow Angles1\left(\alpha_g, \phi_g, B\right) \\ MEr \cdot \sin(\alpha + \phi) + MCo \cdot \sin(\phi) \end{array}\right.$$

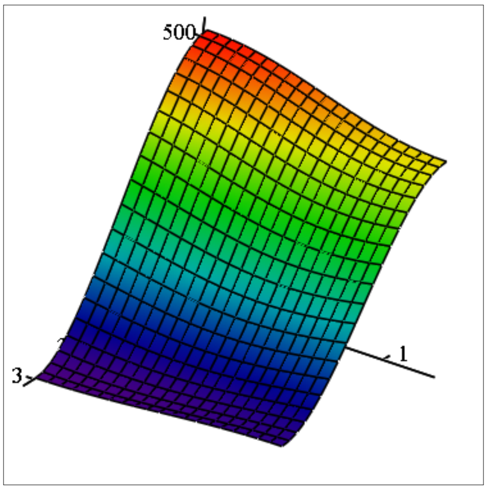
$$Mtotal2(B) := \left| \begin{array}{l} \begin{pmatrix}\alpha \\ \phi\end{pmatrix} \leftarrow Angles2\left(\alpha_g, \phi_g, B\right) \\ MEr \cdot \sin(\alpha + \phi) + MCo \cdot \sin(\phi) \end{array}\right.$$

$B := 0 .. 60$



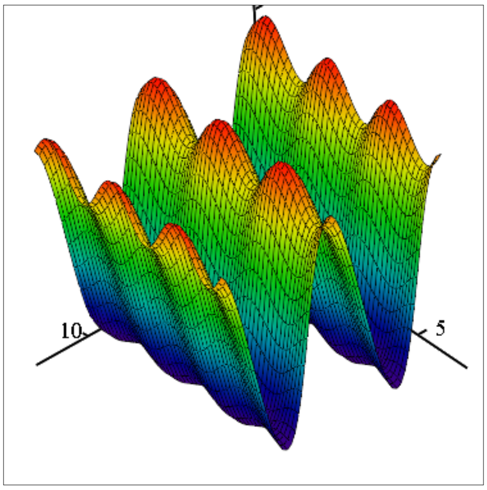



$f(\alpha,\phi) := E(7,\alpha,\phi)$




f

Here is the surface for B=7 for the range of the angles you gave in your range variables. Minumum obviously in the bottom left corner for α=π and φ=π/2




f

Here is the same surface for a wider range of the angles.