

Table of Contents

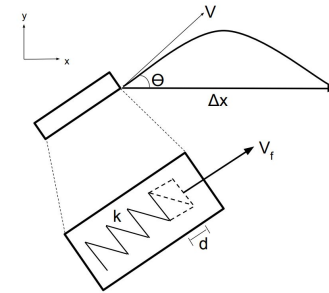
Feasibility Analysis P19046

1. [Launch Device Analysis](#)
2. [Energy Storage from Projectile Analysis](#)
3. [Cam Torque Analysis](#)

Launch Device Analysis

Assumptions

- No air resistance
- Mass of ball, $m=1.09\text{kg}$
- Acceleration due to gravity= 9.8m/s^2
- Horizontal displacement, $\Delta x= 30\text{ft} = 9.14\text{m}$
- Displacement due to compression/tension, $d=0.15\text{m}$
- Launch angle $\Theta=45^\circ$
- Initial $KE=PE=0$



Solving for Launch Velocity

$$\Delta x = \frac{v^2 \sin(2\theta)}{g} \rightarrow v = \sqrt{\frac{\Delta x * g}{\sin(2\theta)}} \rightarrow \sqrt{\frac{(9.14) * (9.8)}{\sin(2 * 45)}} = 9.47\text{m/s}$$

- Δx , horizontal displacement (m)
- v , Launch velocity (m/s)
- θ , Launch angle ($^\circ$)
- g , Gravitation acceleration (m/s^2)

Solving Conservation of Energy for K

$$KE_0 + PE_{S_0} = KE_f + PE_{S_f} \rightarrow 0 + \frac{1}{2}kd^2 = \frac{1}{2}mv_f^2 + 0 \rightarrow k = \frac{mv_f^2}{d^2} = \frac{(1.09) * (9.47)^2}{(0.15)^2} = 43.45 \text{ N/cm}$$

- KE_0 and KE_f , Initial and final kinetic energy (J or $\frac{\text{Kg} * \text{m}^2}{\text{s}^2}$)
- PE_{S_0} and PE_{S_f} , Initial and final spring potential energy (J or $\frac{\text{Kg} * \text{m}^2}{\text{s}^2}$)

Finding the Final Kinetic Energy

$$KE_f = \frac{1}{2}mv_f^2 \rightarrow \frac{1}{2}(1.09) * (9.47)^2 = 19.5\text{J}$$

- m , mass of projectile (Kg)

- v , velocity of projectile (m/s)

Energy Storage from Projectile Analysis

Assumptions

- No air resistance
- Acceleration due to gravity= 9.8m/s^2
- Initial KE=PE=0
- Mass of 9" incrediball: $m=0.100\text{kg}$
- Maximum net displacement for ball to not hit child: $x=1\text{ft}= 0.3048\text{m}$
- Maximum distance ball is being thrown from: $d=30\text{ft} = 9.14\text{m}$

Determining the incoming velocity using the projectile range formula:

$$\Delta d = \frac{v^2 * \sin(2\theta)}{g} \rightarrow v = \sqrt{\frac{\Delta d * g}{\sin(2\theta)}} \rightarrow \sqrt{\frac{(9.14) * (9.8)}{\sin(2 * 45)}} = 9.47\text{m/s}$$

** 9.47m/s is found if children are both using overcomer. Adding velocity for scenario the child is playing with able bodied individual, **$v=15\text{m/s}$**

Determining the incoming kinetic energy of 9" incrediball:

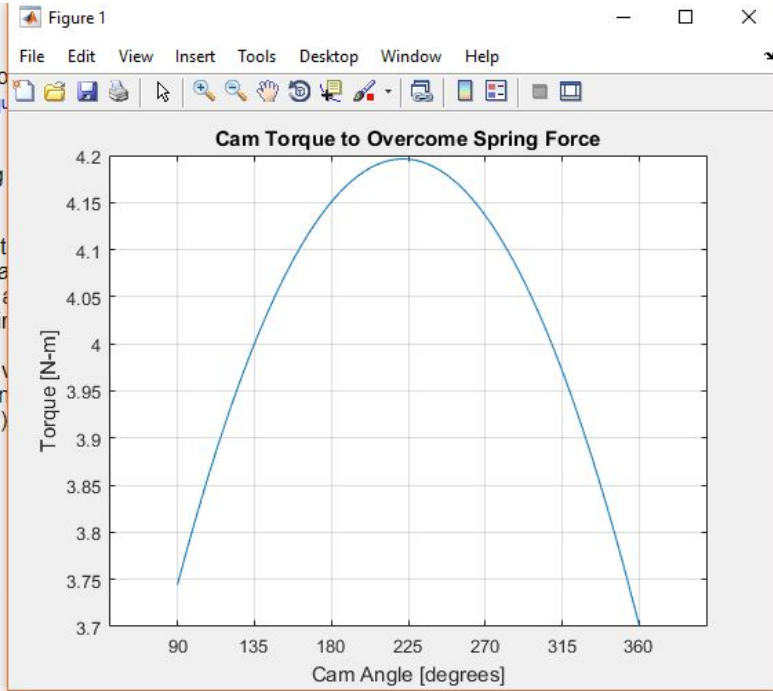
$$KE = \frac{1}{2} * m * v^2 \rightarrow \frac{1}{2} * 0.1 * 15^2 = 11.25\text{J}$$

Determining the K the net needs to be to not displace more than 1ft:

$$PE_{Net} = KE_{Ball} \rightarrow \frac{1}{2}kx^2 = \frac{1}{2}mv^2 \rightarrow k = \frac{mv^2}{x^2} = \frac{0.1 * (15)^2}{0.3048^2} = 242.188 \text{ N/m}$$

Cam Torque Analysis

$$r_{\text{applied}} = 0.050\text{m} \quad \Delta_{\text{cam}} = 0.026\text{m} \quad r_{\text{min}} = 0.01\text{m} \quad r_{\text{max}} = 0.036\text{m}$$



This calculator finds the equation of a parabola. Also [Find Equation Solver](#).

This calculator is based on solving

How to use the calculator 1 - Enter the coefficients and press "enter". Two equations are entered in fractional form and the number of decimal places is entered.

When at least two points are on a parabola (A and B for example), no equation is found. Enter the equation in decimal form (example: 1.02).

A = (,)

B = (,)

C = (,)

Decimal Places =

$$y = -\frac{7366395493590971}{18589026837400977000}x^2 + \frac{1391404306563213}{161234106252011870}x - \frac{119039067756222}{4617894869853432}$$

$$y = -0.0003963x^2 + 0.008630x - 0.002578$$

$$r_{\text{applied}} = 0.100\text{m} \quad \Delta_{\text{cam}} = 0.052\text{m} \quad r_{\text{min}} = 0.01\text{m} \quad r_{\text{max}} = 0.062\text{m}$$

This calculator finds the equation of the graph of the parabola. Also [Find Equation Solver](#).

This calculator is based on solving

How to use the calculator 1 - Enter and press "enter". Two equations and coefficients are in fractional forms and number of decimal number of decimal

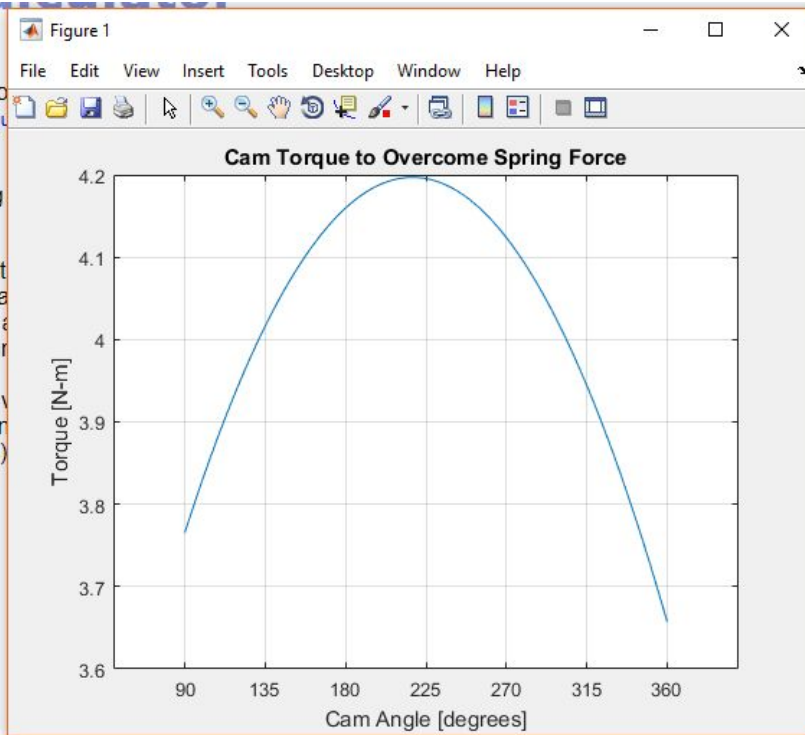
When at least two points are on a vertical line (for example, no equation is four entered in decimal (example: 1.02)

A = (1.5708, .01)

B = (3.9270, .0405)

C = (6.2832, .062)

Decimal Places = 4



$$y = -\frac{6027050858392613}{7435610734960390000}x^2 + \frac{3591191705332987}{206379656002575200}x - \frac{362535533249293}{23643621733649574}$$

$$y = -0.0008106x^2 + 0.01740x - 0.01533$$

$$r_{\text{applied}} = 0.125\text{m}$$

$$\Delta_{\text{cam}} = 0.065\text{m}$$

$$r_{\text{min}} = 0.01\text{m}$$

$$r_{\text{max}} = 0.075\text{m}$$

This calculator finds the equation of the graph of the parabola. Also [Find Equation Solver](#).

This calculator is based on solving a

How to use the calculator 1 - Enter and press "enter". Two equations are coefficients are in fractional forms a number of decimal number of decimal

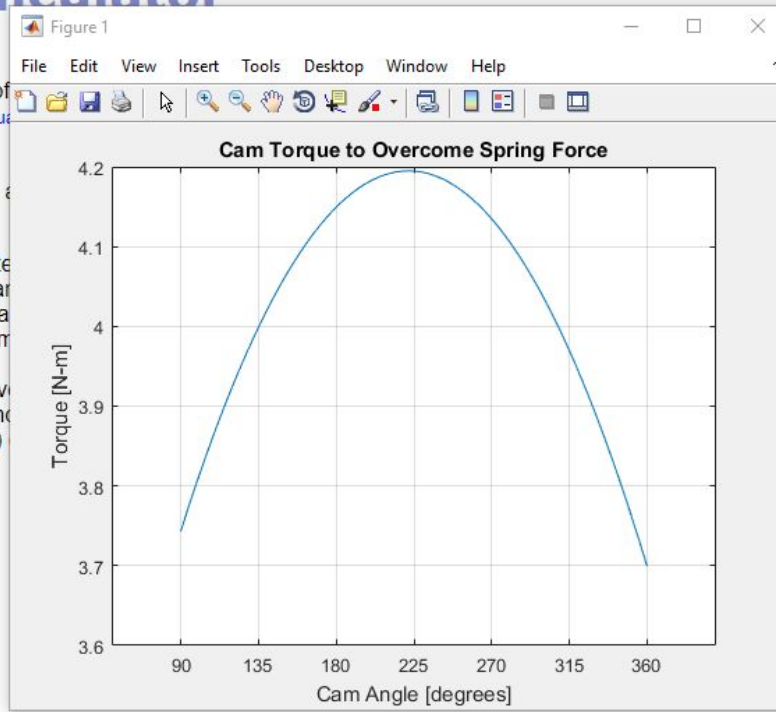
When at least two points are on a vertical line (for example, no equation is found entered in decimal (example: 1.02)

A = (,)

B = (,)

C = (,)

Decimal Places =



$$y = -\frac{7366395493590971}{7435610734960390000}x^2 + \frac{4452493781002281}{206379656002575200}x - \frac{2535121663663539}{11821810866824781}$$

$$y = -0.0009907x^2 + 0.02157x - 0.02144$$

$$r_{\text{applied}} = 0.150\text{m}$$

$$\Delta_{\text{cam}} = 0.077\text{m}$$

$$r_{\text{min}} = 0.01\text{m}$$

$$r_{\text{max}} = 0.087\text{m}$$

This calculator finds the equation of a parabola from a graph of the parabola. Also [Find Equation Solver](#).

This calculator is based on solving

How to use the calculator 1 - Enter the equation and press "enter". Two equations are entered. The coefficients are in fractional forms and the number of decimal number of decimal places.

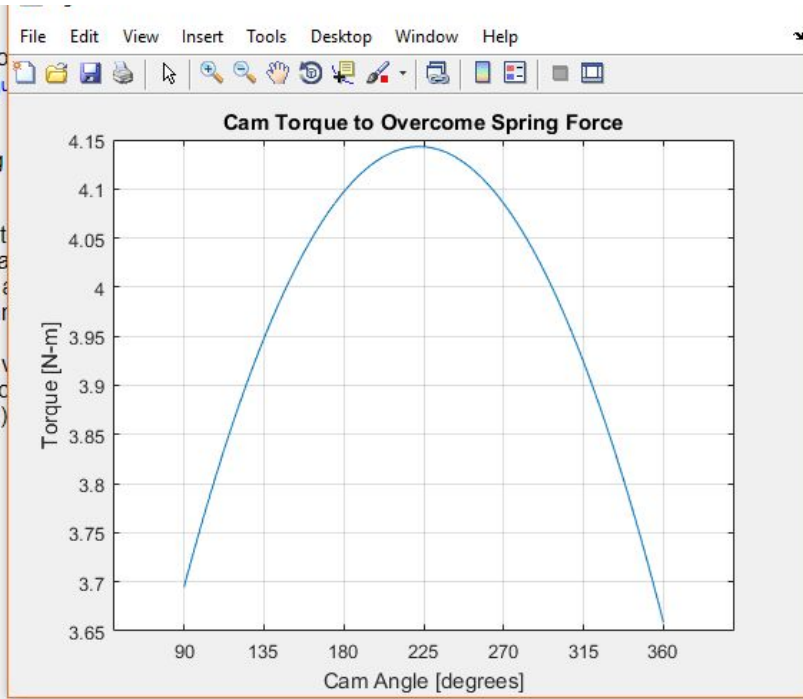
When at least two points are on a vertical line (example: of B for example), no equation is found. The equation is entered in decimal (example: 1.02).

A = ,

B = ,

C = ,

Decimal Places =



$$y = -\frac{4352870064394665}{3717805367480195000}x^2 + \frac{843200133739973}{33020744960412030}x - \frac{6590790911708897}{242110686552571650}$$

$$y = -0.001171x^2 + 0.02554x - 0.02722$$

$$r_{\text{applied}} = 0.175\text{m}$$

$$\Delta_{\text{cam}} = 0.090\text{m}$$

$$r_{\text{min}} = 0.01\text{m}$$

$$r_{\text{max}} = 0.10\text{m}$$

This calculator finds the equation and graph of the parabola. Also [Find Equation Solver](#).

This calculator is based on solving

How to use the calculator 1 - Enter and press "enter". Two equations coefficients are in fractional forms number of decimal number of deci

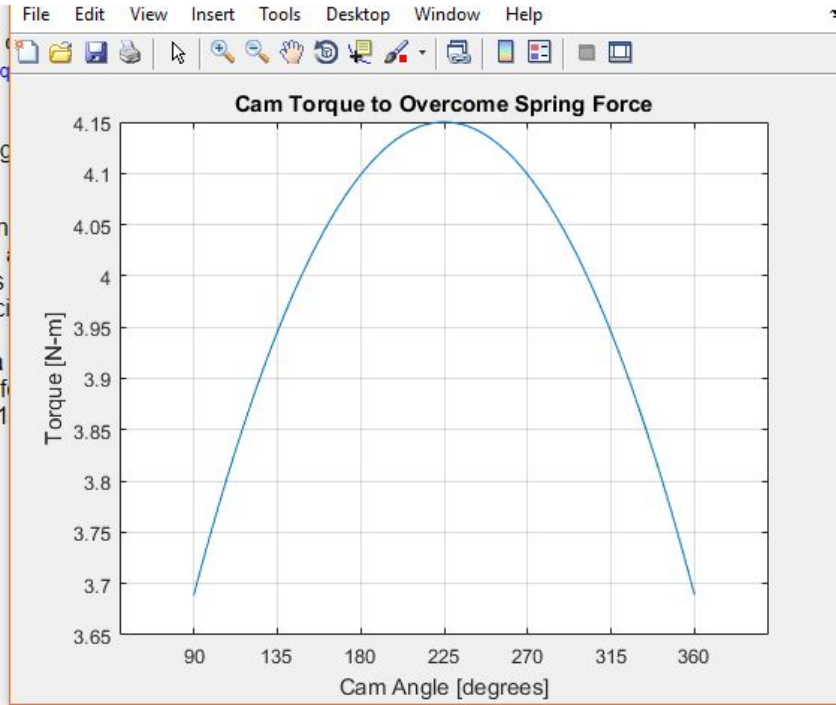
When at least two points are on a of B for example), no equation is f be entered in decimal (example: 1

A = (1.5708, .01)

B = (3.9270, .0625)

C = (6.2832, .100)

Decimal Places = 4



$$y = -\frac{8036067811190151}{5948488587968312000}x^2 + \frac{842679855582451}{28364603938905300}x - \frac{433273950314751}{12998218509442528}$$

$$y = -0.001351x^2 + 0.02971x - 0.03333$$

$$r_{\text{applied}} = 0.200\text{m}$$

$$\Delta_{\text{cam}} = 0.103\text{m}$$

$$r_{\text{min}} = 0.01\text{m}$$

$$r_{\text{max}} = 0.113\text{m}$$

This calculator finds the equation of the graph of the parabola. Also Find Step Solver.

This calculator is based on solving

How to use the calculator 1 - Enter C and press "enter". Two equation coefficients are in fractional forms. number of decimal number of deci

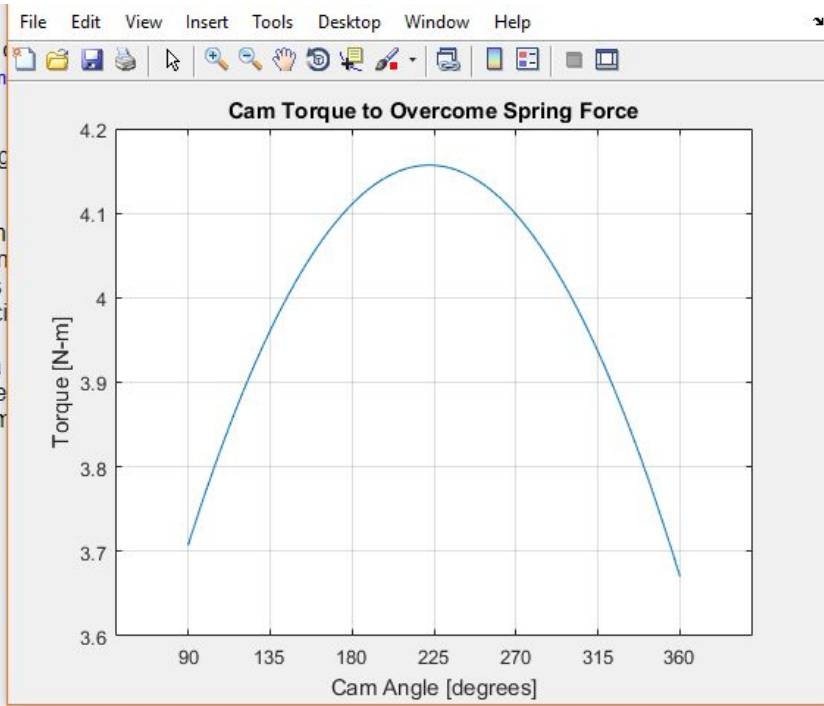
When at least two points are on a coordinate of B for example), no e Numbers may be entered in decim

A = (1.5708 /), (.01 /)

B = (3.9270 /), (.0702 /)

C = (6.2832 /), (.113 /)

Decimal Places = 4 /



$$y = -\frac{3641343226945537}{2323628354675122000}x^2 + \frac{242135932289689}{7087213461626896}x - \frac{646302297389597}{16238751190693390}$$

$$y = -0.001567x^2 + 0.03417x - 0.03980$$

$$r_{\text{applied}} = 0.160\text{m}$$

$$\Delta_{\text{cam}} = 0.083\text{m}$$

$$r_{\text{min}} = 0.01\text{m}$$

$$r_{\text{max}} = 0.93\text{m}$$

This calculator finds the equation and graph of the parabola. Also Find Equation Solver.

This calculator is based on solving

How to use the calculator 1 - Enter and press "enter". Two equations coefficients are in fractional forms number of decimal number of dec

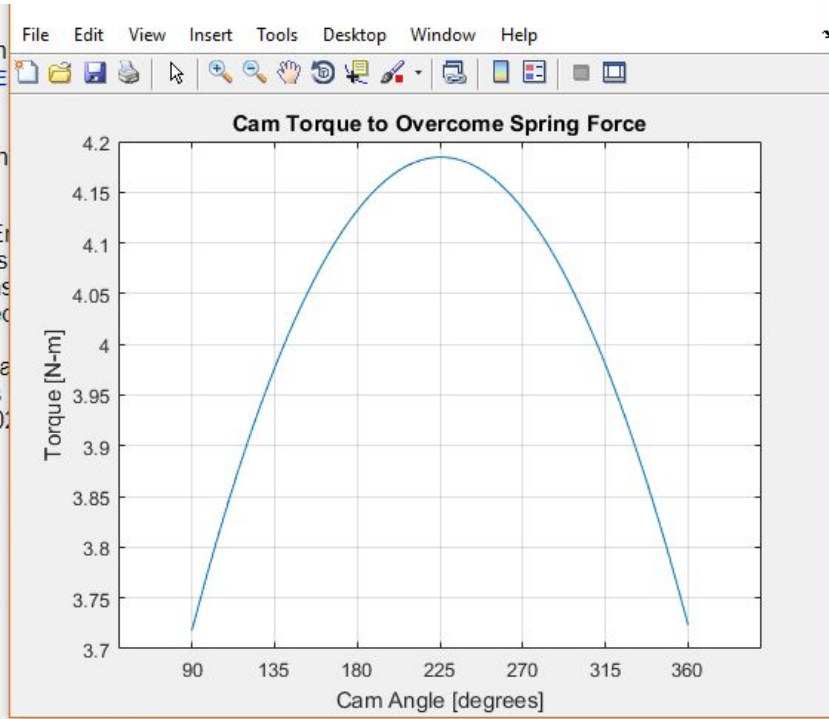
When at least two points are on a of B for example), no equation is entered in decimal (example: 1.0)

A = (1.5708 /), (.01 /)

B = (3.9270 /), (.0584 /)

C = (6.2832 /), (.093 /)

Decimal Places = 4 /



$$y = -\frac{5775923739292921}{4647256709350244000}x^2 + \frac{5884955919562441}{214978808336015840}x - \frac{2303816440626879}{76964914497557220}$$

$$y = -0.001243x^2 + 0.02737x - 0.02993$$

$$r_{\text{applied}} = 0.140\text{m}$$

$$\Delta_{\text{cam}} = 0.072\text{m}$$

$$r_{\text{min}} = 0.01\text{m}$$

$$r_{\text{max}} = 0.082\text{m}$$

This calculator finds the equation of the parabola. Also find the graph of the parabola. Also find the Step Solver.

This calculator is based on solving

How to use the calculator 1 - Enter C and press "enter". Two equation coefficients are in fractional forms number of decimal number of dec

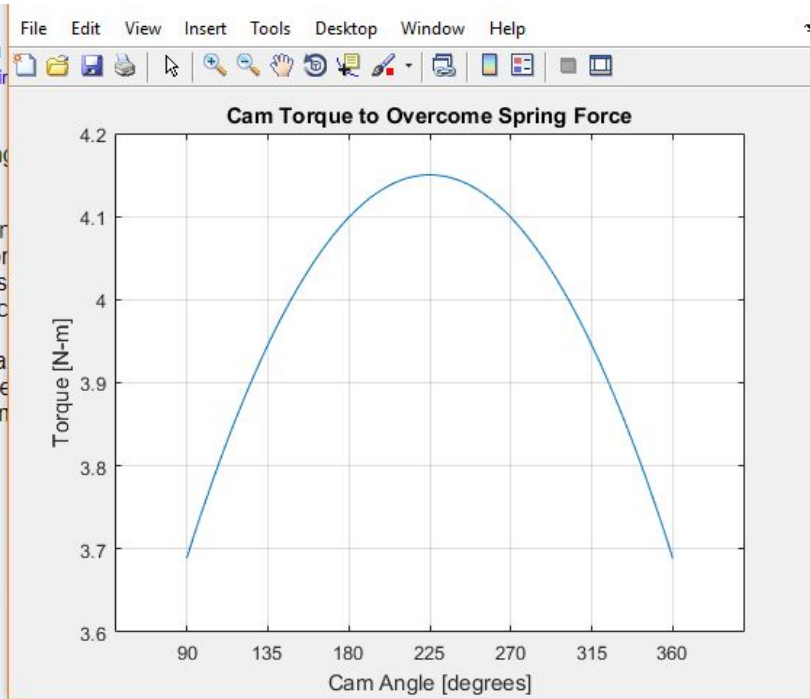
When at least two points are on a coordinate of B for example), no e Numbers may be entered in decim

A = (1.5708 /), (.01 /)

B = (3.9270 /), (.052 /)

C = (6.2832 /), (.082 /)

Decimal Places = 4



$$-\frac{8036067811190151}{7435610734960390000}x^2 + \frac{49050423292353}{2063796560025752}x - \frac{746507950203763}{30263835819071456}$$

$$y = -0.001081x^2 + 0.02377x - 0.02467$$

STARTING AT PI/2

$r_{\text{applied}} = 0.150\text{m}$

$\Delta_{\text{cam}} = 0.077\text{m}$

$r_{\text{min}} = 0.01\text{m}$

$r_{\text{max}} = 0.087\text{m}$

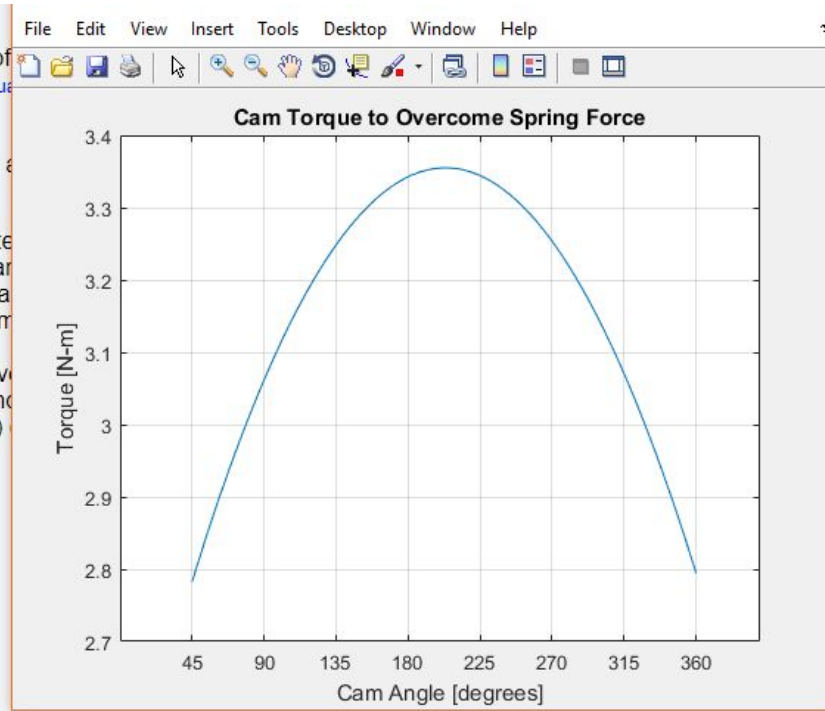
This calculator finds the equation of graph of the parabola. Also [Find Equation Solver](#).

This calculator is based on solving a

How to use the calculator 1 - Enter and press "enter". Two equations are coefficients are in fractional forms a number of decimal number of decimal

When at least two points are on a vertical line (for example, no equation is found entered in decimal (example: 1.02)

A = (,)
 B = (,)
 C = (,)
 Decimal Places =



$$y = -\frac{1645905740588205}{1574329927216922600}x^2 + \frac{4487568726547051}{209742880026320900}x - \frac{835613290128031}{1356694871314563}$$

$$y = -0.001045x^2 + 0.02140x - 0.006159$$

$$\text{Inches: } r = -0.04114\theta^2 + 0.84252\theta - 0.24248$$

$$\text{Inches, degrees: } r = -0.000718058\theta^2 + 0.0147047\theta - 0.00423208$$

