

In[13]:= **Remove ["Global`*"]**

Using DSolve function to solve for the coupled differential equations, eq1 & eq2, of two identical masses connected by three identical springs with the four initial conditions.

Define $w_0 = 1$ for simplification.

In[14]:= **w0 = 1**

Out[14]= 1

In[15]:= **eq1 = x1''[t] + 2 w0^2 x1[t] - w0^2 x2[t] == 0;**

In[16]:= **eq2 = x2''[t] + 2 w0^2 x2[t] - w0^2 x1[t] == 0;**

Solving for x1 & x2

In[17]:= **sol = DSolve[{eq1, eq2, x1[0] == 1, x1'[0] == 0, x2[0] == 0, x2'[0] == 0}, {x1, x2}, t]**

Out[17]= $\left\{ \left\{ x1 \rightarrow \text{Function}\left[\{t\}, \frac{1}{2} (\cos[t] + \cos[\sqrt{3} t])\right], x2 \rightarrow \text{Function}\left[\{t\}, \frac{1}{2} (\cos[t] - \cos[\sqrt{3} t])\right] \right\} \right\}$

Simplifying the solutions for an easier expression to work with

In[18]:= **sol1 = Simplify[x1[t] /. sol[[1]]]**

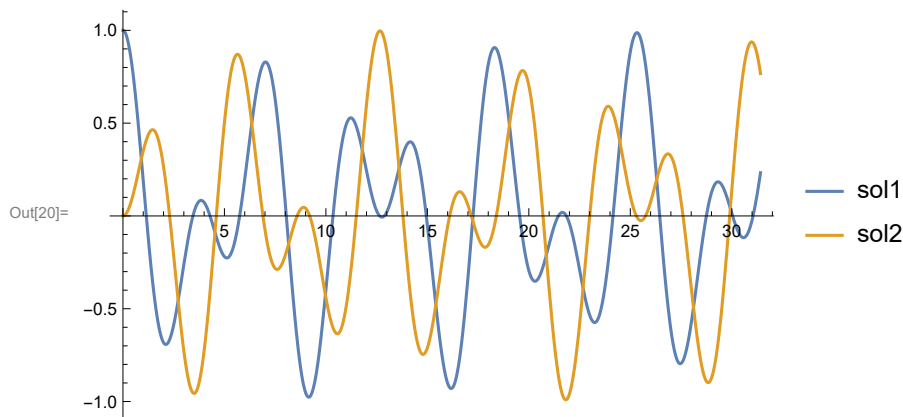
Out[18]= $\frac{1}{2} (\cos[t] + \cos[\sqrt{3} t])$

In[19]:= **sol2 = Simplify[x2[t] /. sol[[1]]]**

Out[19]= $\frac{1}{2} (\cos[t] - \cos[\sqrt{3} t])$

Graph of motion of x1 & x2 with respect to time

In[20]:= **p1 = Plot[{sol1, sol2}, {t, 0, 2 Pi * 5}, PlotLegends -> "Expressions"]**



Equations for x1 + x2 and x1 - x2

In[21]:= **xm = sol1 - sol2**

Out[21]= $\frac{1}{2} (-\cos[t] + \cos[\sqrt{3} t]) + \frac{1}{2} (\cos[t] + \cos[\sqrt{3} t])$

In[22]:= **xp = sol1 + sol2**

$$\text{Out[22]} = \frac{1}{2} (\cos[t] - \cos[\sqrt{3} t]) + \frac{1}{2} (\cos[t] + \cos[\sqrt{3} t])$$

Using ListLinePlot to make dashed lines indicating the expected periods corresponding to the eigenfrequencies

In[24]:= **Show[Plot[{xm, xp}, {t, 0, 5 * 2 Pi}, PlotLegends → "Expressions"],
ListLinePlot[{{5, 1}, {5, -1}, {12.5, 1}, {12.5, -1}}, PlotStyle → Dashed]]**

