$$q_n(\varphi) := \text{if } \varphi \le \frac{\pi}{2} \wedge \varphi \ge \frac{3\pi}{2} \;\; \| \text{return } \boxed{q_0} \;\; \text{else} \;\; \| 0$$

$$q_n(\varphi) := q_0 \rightarrow q_0$$

$$q_t(\varphi) := \frac{q_0}{\pi} \cdot (4 \sin(\varphi) + 1) \rightarrow \frac{q_0 \cdot (4 \cdot \sin(\varphi) + 1)}{\pi}$$

$$a'_n(n) := \frac{1}{\pi} \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} q_n(\varphi) \cdot \cos(n \cdot \varphi) \, d\varphi \rightarrow \frac{2 \cdot q_0 \cdot \sin\left(\frac{n \cdot \pi}{2}\right)}{n \cdot \pi}$$

$$a''_n(n) := \frac{1}{\pi} \int_{0}^{2\pi} q_t(\varphi) \cdot \cos(n \cdot \varphi) \, d\varphi \rightarrow \frac{q_0 \cdot \left(\left(n^2 - 1\right) \cdot \sin(2 \cdot n \cdot \pi) + \left(8 \cdot n \cdot \cos(n \cdot \pi)^2 - 8 \cdot n\right)\right)}{n \cdot \pi^2 \cdot (n-1) \cdot (n+1)}$$

$$b'_n(n) := \frac{1}{\pi} \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} q_n(\varphi) \cdot \sin(n \cdot \varphi) \, d\varphi \rightarrow 0$$

$$b''_n(n) := \frac{1}{\pi} \int_{0}^{2\pi} q_t(\varphi) \cdot \sin(n \cdot \varphi) \, d\varphi \rightarrow \frac{2 \cdot q_0 \cdot \left(2 \cdot n \cdot \sin(2 \cdot n \cdot \pi) + \left(n^2 - 1\right) \cdot \sin(n \cdot \pi)^2\right)}{n \cdot \pi^2 \cdot (n-1) \cdot (n+1)}$$

$$A_n(n) := \frac{R^4}{E \cdot J \cdot n^2 \cdot \left(n^2 - 1\right)^2} \cdot \left(a''_n(n) + n \cdot b'_n(n)\right) \rightarrow \frac{q_0 \cdot R^4 \cdot \left(\left(n^2 - 1\right) \cdot \sin(2 \cdot n \cdot \pi) + \left(8 \cdot n \cdot \cos(n \cdot \pi\right.\right.}{E \cdot J \cdot n^3 \cdot \pi^2 \cdot (n-1) \cdot (n+1) \cdot \left(n^2 - 1\right.}$$

$$B_n(n) := \frac{R^4}{E \cdot J \cdot n^2 \cdot \left(n^2 - 1\right)^2} \cdot \left(b''_n(n) - n \cdot a'_n(n)\right) \rightarrow \frac{R^4 \cdot \left(\frac{2 \cdot q_0 \cdot \left(2 \cdot n \cdot \sin(2 \cdot n \cdot \pi) + \left(n^2 - 1\right) \cdot \sin(n\right.\right.}{n \cdot \pi^2 \cdot (n-1) \cdot (n+1)}}{E \cdot J \cdot n^2 \cdot \left(n^2 - 1\right)^2}$$

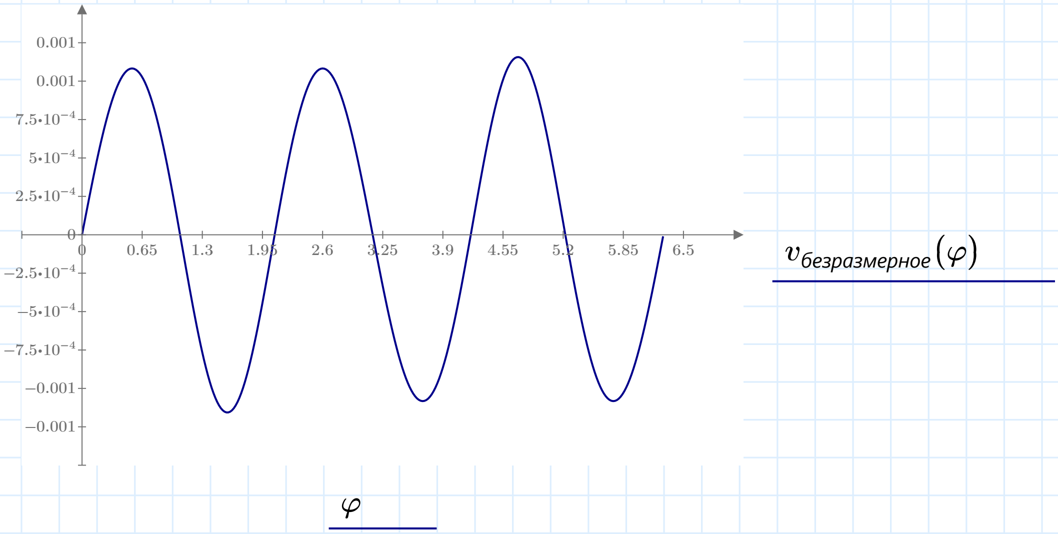
$$N := 20$$

$$v(\varphi) := \sum_{n=2}^{N} \left(A_n(n) \cdot \cos(n \cdot \varphi) + B_n(n) \cdot \sin(n \cdot \varphi)\right) \rightarrow \frac{4633252624 \cdot q_0 \cdot R^4 \cdot \sin(19 \cdot \varphi) + \left(19200813489\right.}{}$$

$$v_{безразмерное}(\varphi) := \frac{v(\varphi)}{q_0 \cdot R^4} \rightarrow \frac{4633252624 \cdot q_0 \cdot R^4 \cdot \sin(19 \cdot \varphi) + \left(19200813489 \cdot q_0 \cdot R^4 \cdot \sin(15 \cdot \varphi) + \left(\right.\right.}{}$$

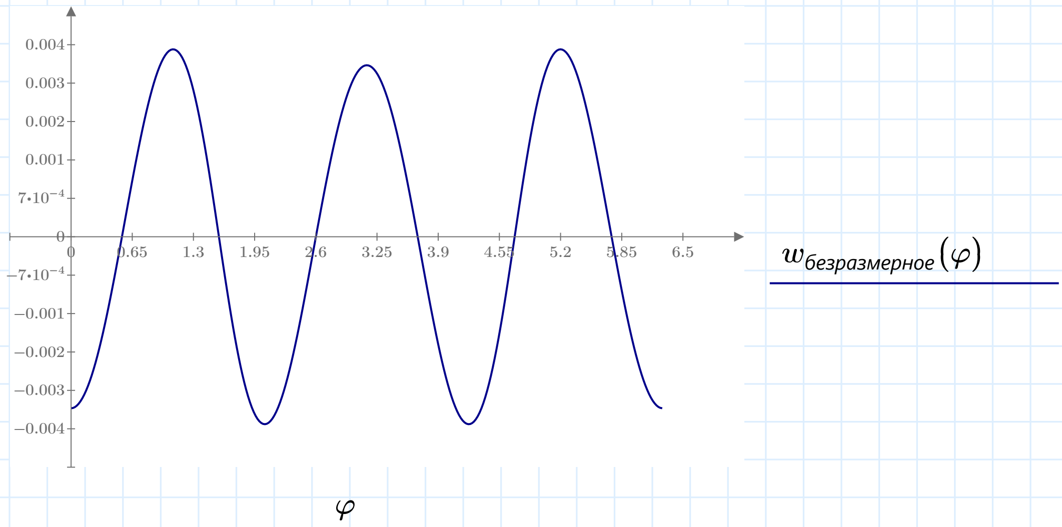
$$\overline{E \cdot J}$$

$$\varphi := 0, 0.02 .. 2\,\pi$$



$$w(\varphi) := -\left(\frac{d}{d\varphi} v(\varphi)\right) \rightarrow \frac{-\left(1905904 \cdot q_0 \cdot R^4 \cdot \cos(19 \cdot \varphi)\right) + 3328325 \cdot q_0 \cdot R^4 \cdot \cos(17 \cdot \varphi) + (1279 ...}{...}$$

$$w_{безразмерное}(\varphi) := -\left(\frac{d}{d\varphi} v_{безразмерное}(\varphi)\right) \rightarrow \frac{-\left(1905904 \cdot \cos(19 \cdot \varphi)\right) + 3328325 \cdot \cos(17 \cdot \varphi) + (12790 ...}{...}$$



$$M(\varphi) := \frac{E \cdot J}{R^2} \cdot \left(\frac{d^2}{d\varphi^2} w(\varphi) + w(\varphi)\right) \rightarrow \frac{68068 \cdot q_0 \cdot R^4 \cdot \cos(19 \cdot \varphi) + \left(138567 \cdot q_0 \cdot R^4 \cdot \cos(15 \cdot \varphi) + (35 ...}{...}$$

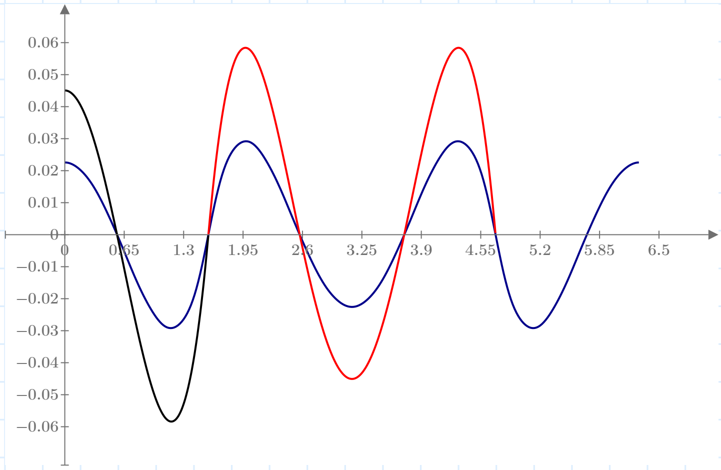
$$M_{безразмерный}(\varphi) := \frac{M(\varphi)}{...} \rightarrow \frac{68068 \cdot \cos(19 \cdot \varphi) + \left(138567 \cdot \cos(15 \cdot \varphi) + \left(352716 \cdot \cos(11 \cdot \varphi) + (1385 ...}{...}$$

$_{безразмерный}(\varphi)$

$$q_0 \cdot R^2$$

$$M_1(\varphi) := 1 - \frac{3}{\pi}\cos(\varphi) - \frac{2}{\pi}\varphi \cdot \sin(\varphi) \qquad \varphi_1 := 0, 0.01 .. \frac{\pi}{2}$$

$$M_2(\varphi) := 2\sin(\varphi) - \frac{3}{\pi}\cos(\varphi) - \frac{2}{\pi}\varphi \cdot \sin(\varphi) - 1 \qquad \varphi_2 := \frac{\pi}{2}, \frac{\pi}{2} + 0.01 .. \frac{3\pi}{2}$$



$M_{безразмерный}(\varphi)$

$M_1(\varphi_1)$

$M_2(\varphi_2)$

φ

φ_1

φ_2

$$\frac{M_1\left(\frac{\pi}{6}\right)}{M_{безразмерный}\left(\frac{\pi}{6}\right)} = 2.012$$