clear

$$clear \tag{1}$$

R R_0

$$R_0 \tag{2}$$

$$\sigma(q, r) := \frac{q}{4 \cdot \pi \cdot r^2}$$

$$(q, r) \to \frac{1}{4} \ \frac{q}{\pi\, r^2} \tag{3}$$

$$\frac{\mathrm{d}}{\mathrm{d}\,\theta} S := 2 \cdot \pi \cdot r^2 \cdot \sin(\theta)$$

$$\varphi_R(q, R, R_0) := \int_0^{\pi} \frac{2 \cdot \pi \cdot r^2 \cdot \sin(\theta) \cdot \sigma(q, r)}{\sqrt{(R_0)^2 - 2 \cdot R_0 \cdot r \cdot \cos(\theta) + (r)^2}}\, \mathrm{d}\theta$$

$$(q, R, R_0) \to \int_0^{\pi} \frac{2\, \pi\, r^2 \sin(\theta)\ \sigma(q, r)}{\sqrt{R_0^{\,2} - 2\, R_0\, r \cos(\theta) + r^2}}\, \mathrm{d}\theta \tag{4}$$

$\varphi_R(q, R, R_0)$

$$\int_0^{\pi} \frac{1}{2} \ \frac{\sin(\theta)\ q}{\sqrt{R_0^{\,2} - 2\, R_0\, r \cos(\theta) + r^2}}\, \mathrm{d}\theta \tag{5}$$

$\varphi_R(q, 1, R_0) - \varphi_R(q, 2, R_0)$

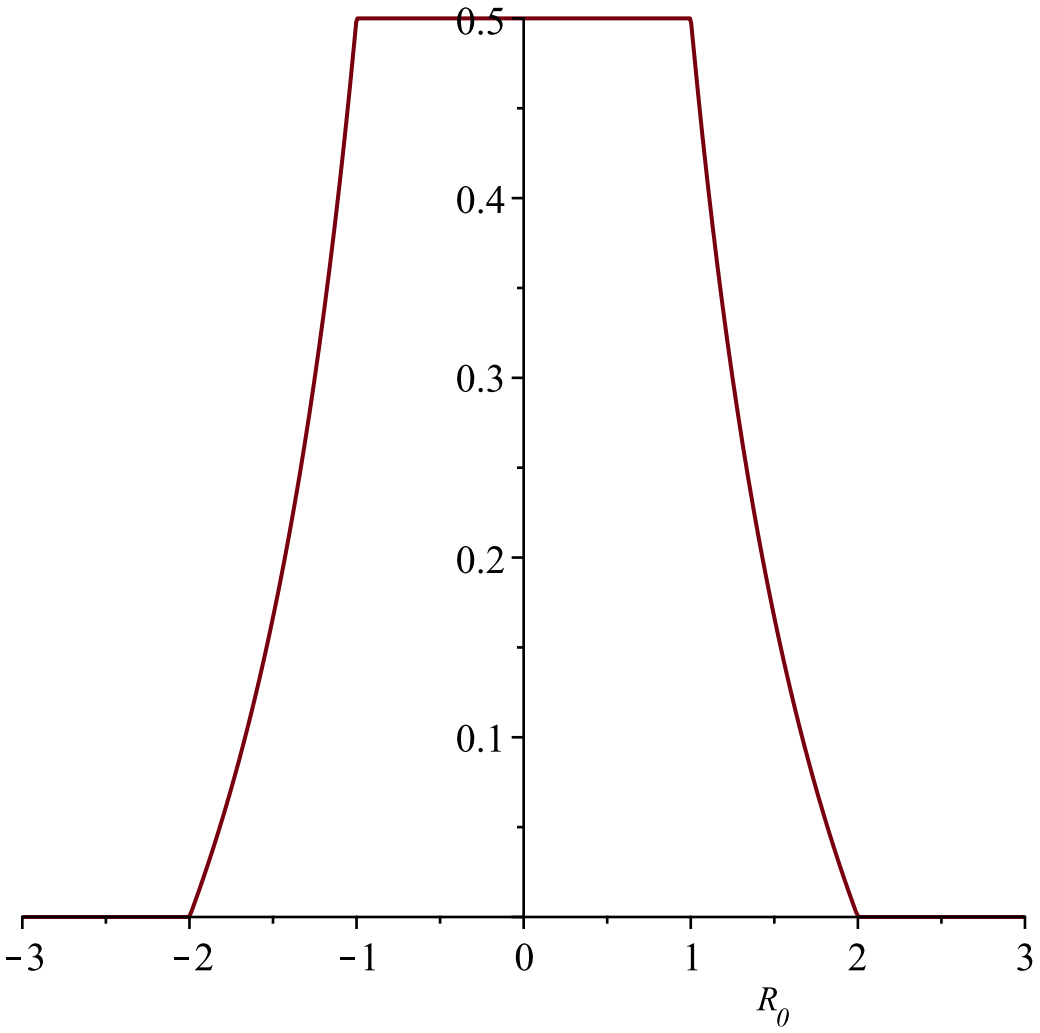
$$\frac{1}{4} \ \frac{\int_0^{2\pi} \int_0^{\pi} \frac{q \sin(\theta)}{\sqrt{R_0^{\,2} - 2\, R_0 \cos(\theta) + 1}}\, \mathrm{d}\theta\, \mathrm{d}\varphi}{\pi} - \frac{1}{4} \ \frac{\int_0^{2\pi} \int_0^{\pi} \frac{q \sin(\theta)}{\sqrt{R_0^{\,2} - 4\, R_0 \cos(\theta) + 4}}\, \mathrm{d}\theta\, \mathrm{d}\varphi}{\pi} \tag{6}$$

$evalf\left(\varphi_R(1, 1, R_0) - \varphi_R(1, 2, R_0)\right)$

$$0.07957747152\left(\int_{0.}^{6.283185308}\int_{0.}^{3.141592654}\frac{\sin(\theta)}{\sqrt{R_0^{\,2}-2.\,R_0\cos(\theta)+1.}}\,d\theta\,d\varphi\right)-0.07957747152\left(\int_{0.}^{6.283185308}\int_{0.}^{3.141592654}\frac{\sin(\theta)}{\sqrt{R_0^{\,2}-4.\,R_0\cos(\theta)+4.}}\,d\theta\,d\varphi\right) \tag{7}$$

2 - 1

$with(plots):plot(\varphi_R(1,1,R_0)+\varphi_R(-1,2,R_0),R_0=-3..3)$



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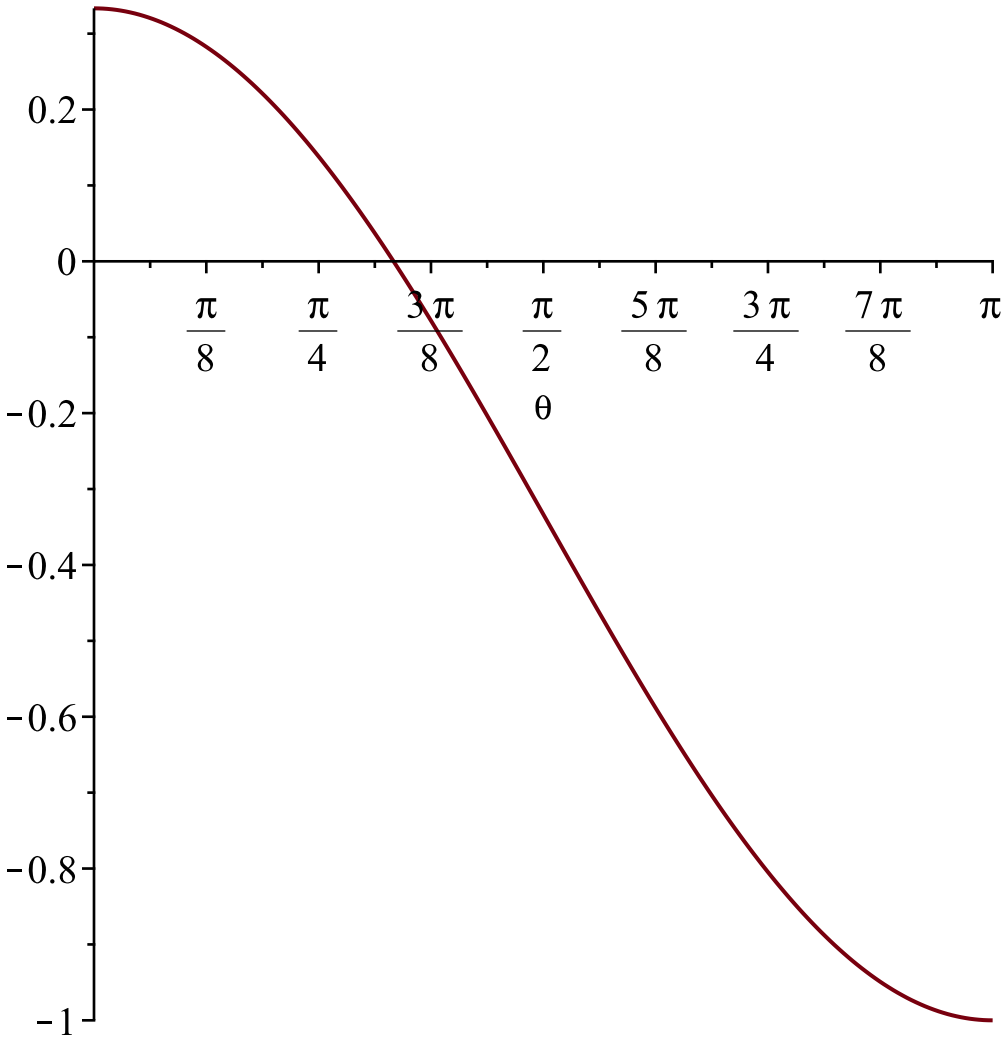
$$vr(v, c, R, R_0, \theta) := \frac{v}{c} \cdot (R_0 \cdot \cos(\theta) - R)$$

$$(v, c, R, R_0, \theta) \rightarrow \frac{v\,(R_0 \cos(\theta) - R)}{c} \qquad \textbf{(8)}$$

$$plot(vr(1, 3, 1, 2, \theta), \theta = 0..\pi)$$



R_0 ,

R v .

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$$\varphi_{lw}(q, v, c, r, R_0) := \int_0^{\pi} \frac{2 \cdot \pi \cdot r^2 \cdot \sin(\theta) \cdot \sigma(q, r)}{\sqrt{(R_0)^2 - 2 \cdot R_0 \cdot r \cdot \cos(\theta) + (r)^2} - \frac{v}{c} \cdot (R_0 \cdot \cos(\theta) - r)}\, d\theta$$

$$\varphi_{lw}(q, v, c, R, R_0) := \frac{1}{4\cdot\pi}\int_0^{2\pi}\int_0^{\pi} \frac{q\cdot\sin(\theta)}{\sqrt{(R_0)^2 - 2\cdot R_0\cdot R\cdot\cos(\theta) + (R)^2} - \frac{v}{c}\cdot(R_0\cdot\cos(\theta) - R)}\, d\theta\, d\varphi$$

$$(q, v, c, R, R_0) \to \frac{1}{4}\,\frac{\int_0^{2\pi}\int_0^{\pi} \frac{q\sin(\theta)}{\sqrt{R_0^2 - 2R_0R\cos(\theta) + R^2} - \frac{v(R_0\cos(\theta) - R)}{c}}\, d\theta d\varphi}{\pi} \qquad \textbf{(9)}$$

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$R_+ := 1:$ $R_- := 2:$

$c := 3:$

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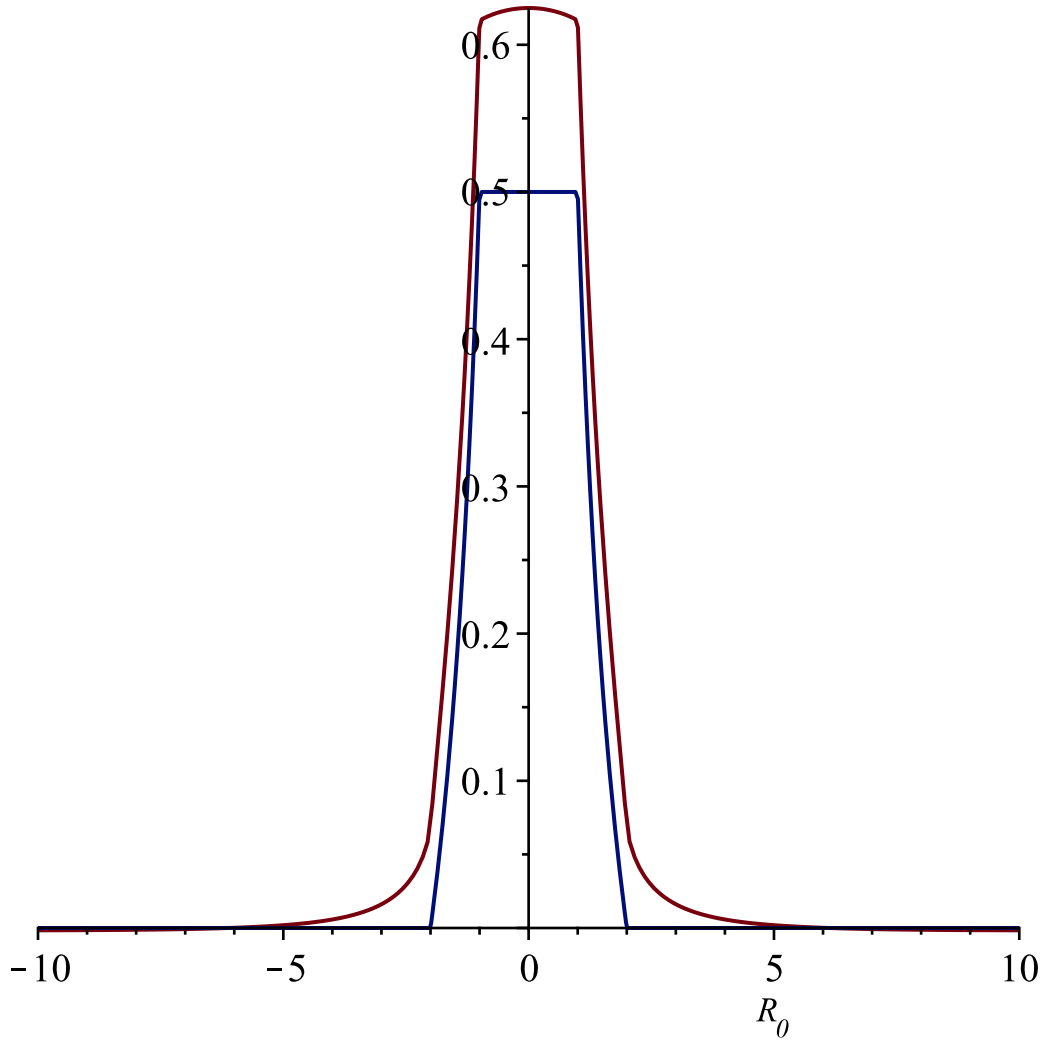
$with(plots): plot\left(\left[\varphi_R(1, R_+, R_0) + \varphi_{lw}(-1, 1, c, R_-, R_0), \varphi_R(1, R_+, R_0) + \varphi_R(-1, R_-, R_0)\right], R_0 = -10..10\right)$



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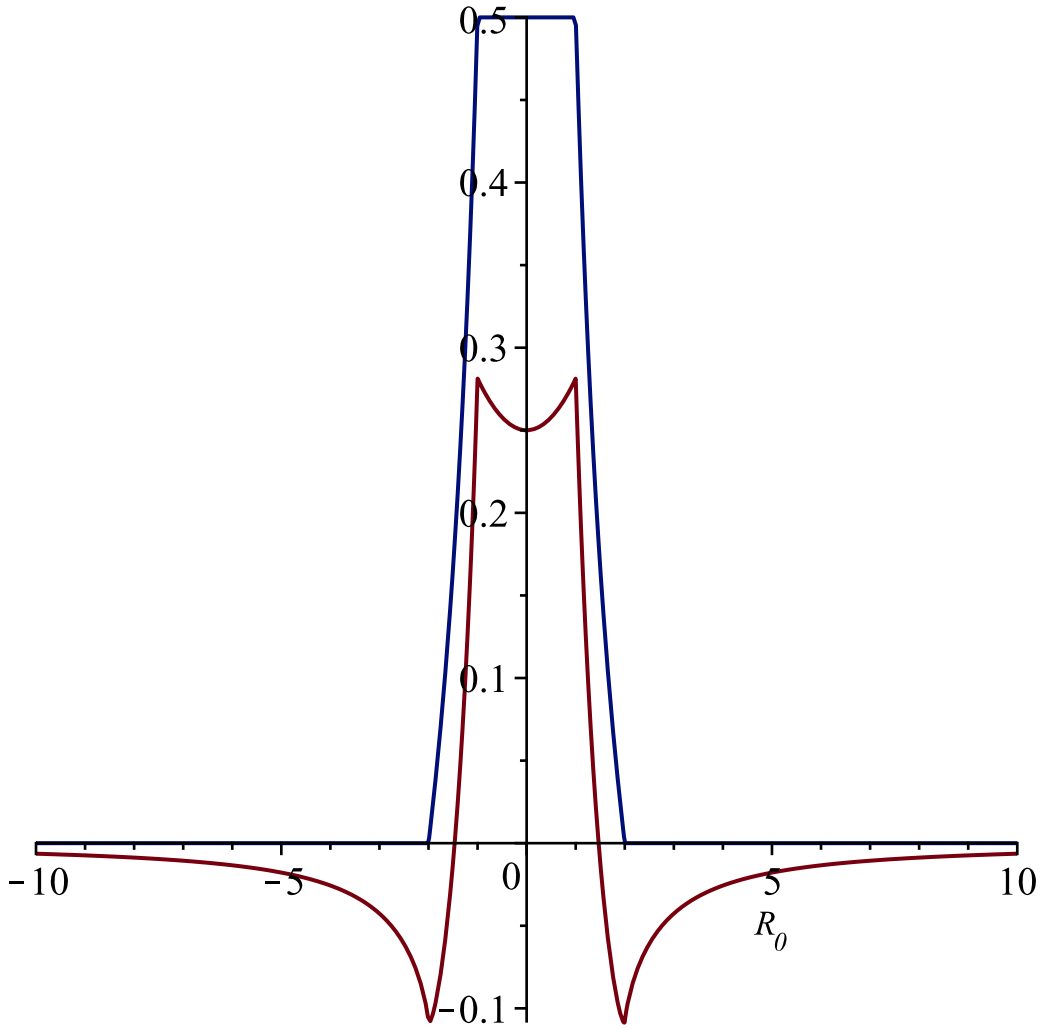
$with(plots) : plot\left(\left[\varphi_R(1, R_+, R_0) + \varphi_{lw}(-1, -1, c, R_-, R_0), \varphi_R(1, R_+, R_0) + \varphi_R(-1, R_-, R_0) \right], R_0 = -10..10 \right)$



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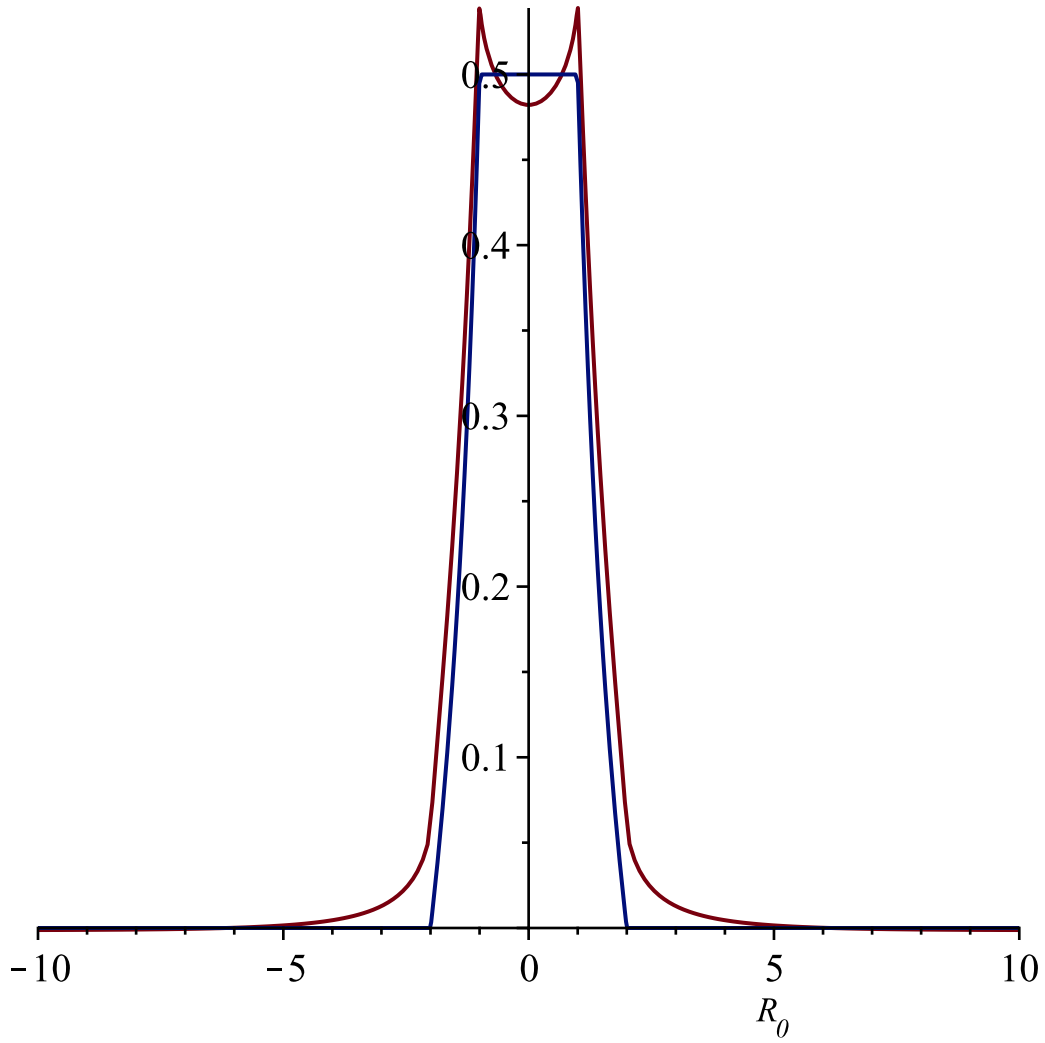
$with(plots) : plot\left(\left[\varphi_{lw}(1, 0.5, c, R_+, R_0) + \varphi_{lw}(-1, 1, c, R_-, R_0), \varphi_R(1, R_+, R_0) + \varphi_R(-1, R_-, R_0) \right], R_0 = -10..10 \right)$



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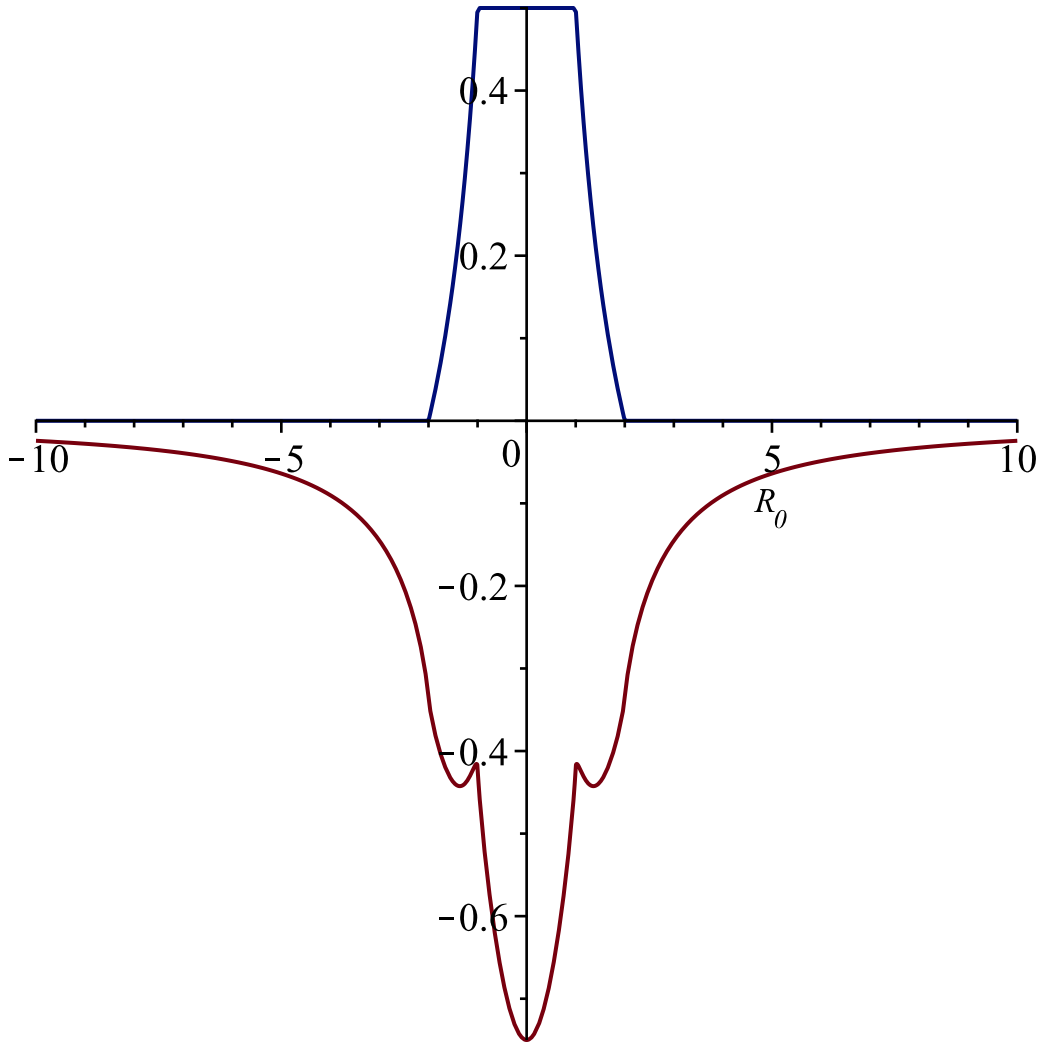
$with(plots) : plot\left(\left[\varphi_{lw}(1, 1, c, R_+, R_0) + \varphi_{lw}(-1, -2, c, R_-, R_0), \varphi_R(1, R_+, R_0) + \varphi_R(-1, R_-, R_0) \right], R_0 = -10..10 \right)$



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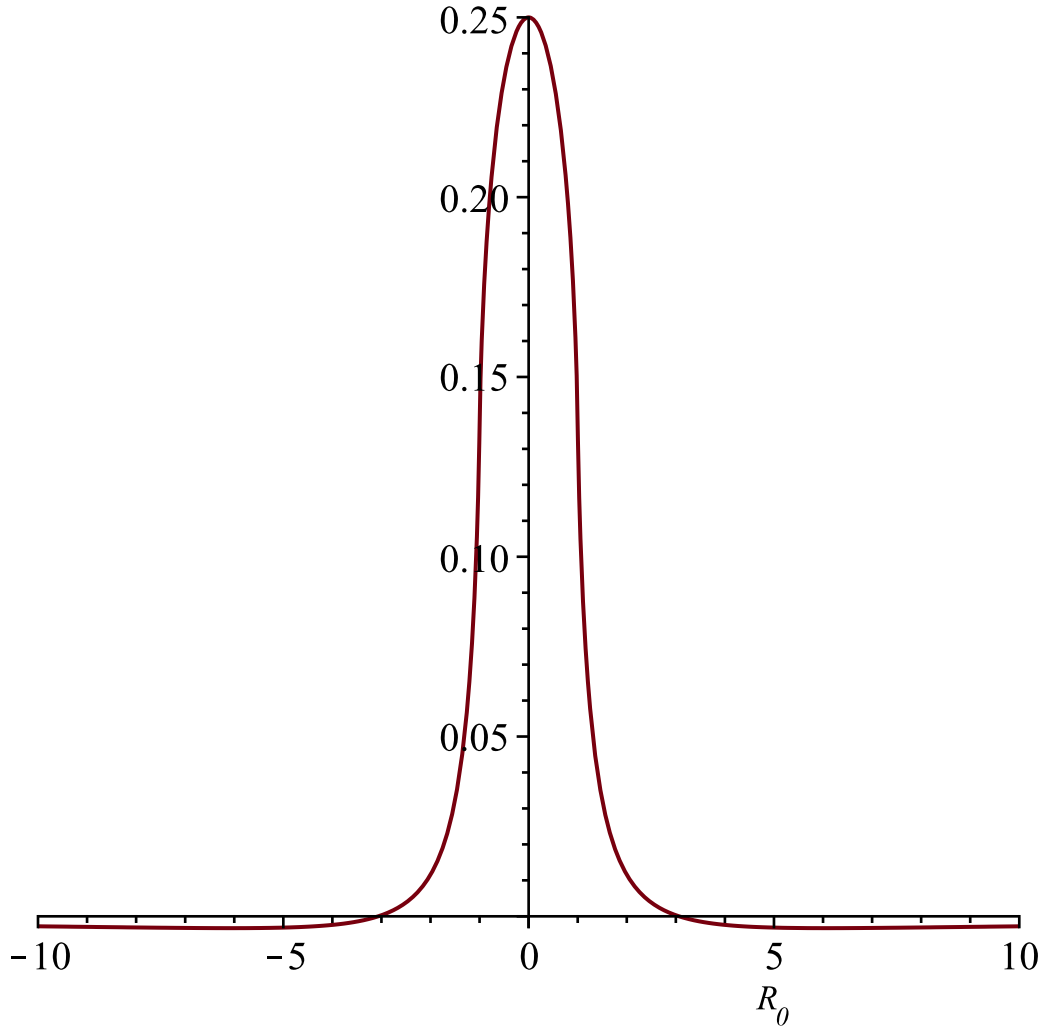
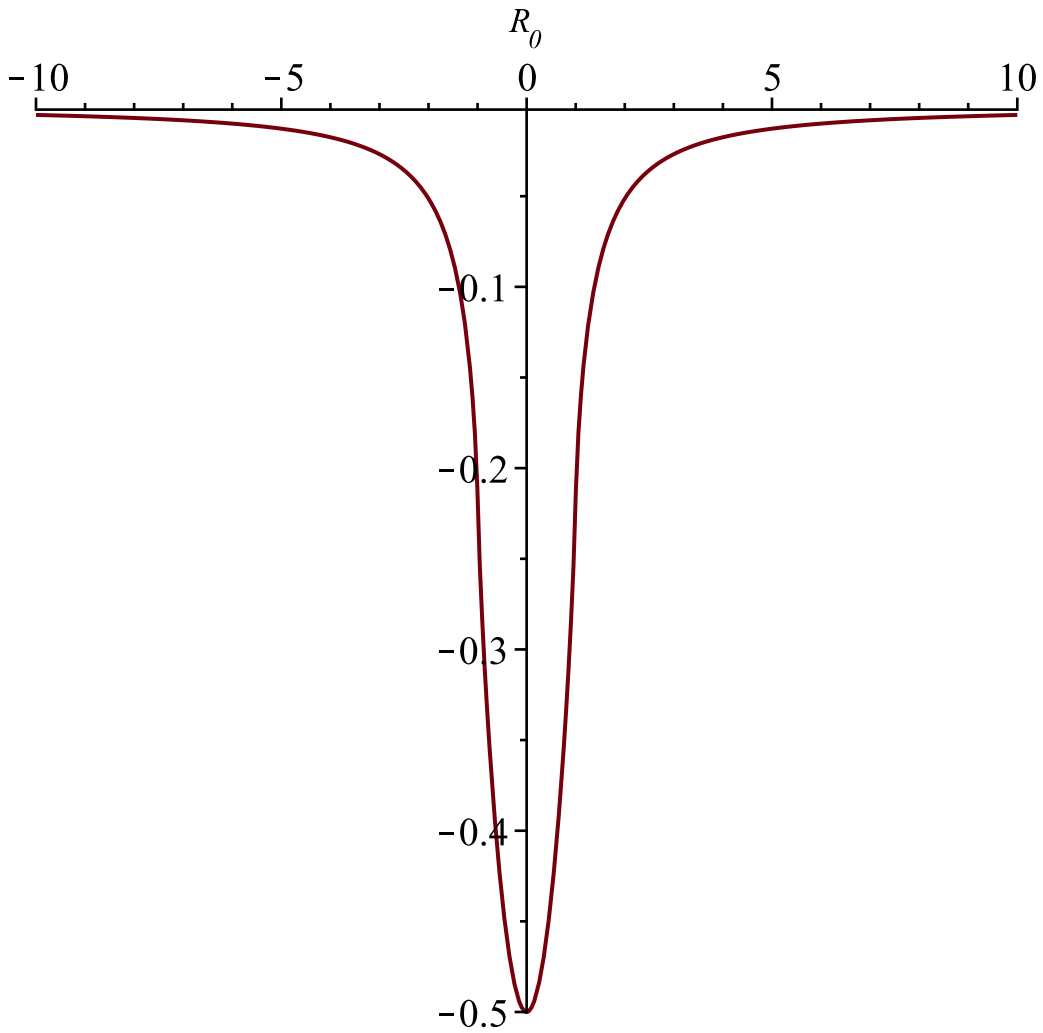
$$d\varphi_{lw}(q, v, c, R, R_0) := \varphi_{lw}(q, v, c, R, R_0) + \varphi_{lw}(-q, 0, c, R, R_0)$$

$$(q, v, c, R, R_0) \rightarrow \varphi_{lw}(q, v, c, R, R_0) + \varphi_{lw}(-q, 0, c, R, R_0) \quad \textbf{(10)}$$

$$with(plots) : plot([d\varphi_{lw}(-1, 1, c, R_+, R_0)], R_0 = -10..10)$$



$with(plots) : plot([d\varphi_{lw}(-1, -1, c, R_+, R_0)], R_0 = -10..10)$


R_0
−10
−5
0
5
10
−0.1
−0.2
−0.3
−0.4
−0.5