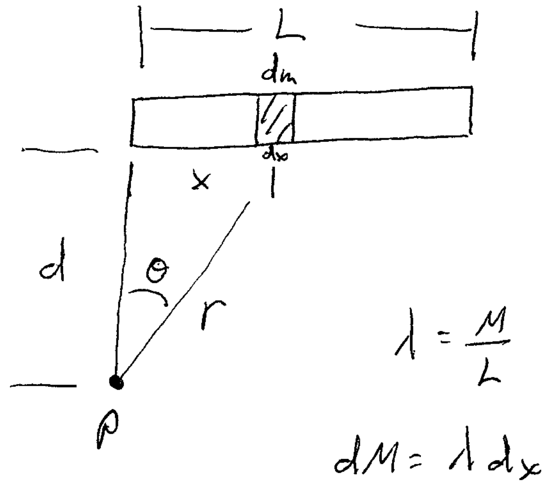
Determine the gravitational field strength at P. ①



$$\frac{F}{m} = \frac{GM}{r^2}$$

$$\lambda = \frac{M}{L}$$

$$dM = \lambda\, dx$$

$$r^2 = d^2 + x^2$$

$$\frac{dF}{m} = \frac{G\,dM}{r^2} = G\lambda \frac{dx}{d^2+x^2}$$

↑ Integration of this would involve arc tan.

Break the problem into x and y parts.

$$\frac{dF}{m}_x = G\lambda \frac{dx}{d^2+x^2} \sin\theta$$

$$\frac{dF}{m}_y = G\lambda \frac{dx}{d^2+x^2} \cos\theta$$

$$\sin\theta = \frac{opp}{hyp} = \frac{x}{\sqrt{x^2+d^2}}$$

$$\cos\theta = \frac{adj}{hyp} = \frac{d}{\sqrt{x^2+d^2}}$$

$$\frac{dF}{m_x} = G\lambda \frac{dx}{d^2+x^2}\,\frac{x}{\sqrt{x^2+d^2}} = G\lambda \frac{x\,dx}{(d^2+x^2)^{3/2}}$$

$$\frac{dF}{m_y} = G\lambda \frac{dx}{d^2+x^2}\,\frac{d}{\sqrt{x^2+d^2}} = G\lambda d \frac{dx}{(d^2+x^2)^{3/2}}$$

$$\frac{F}{m_x} = G\lambda \int_0^L \frac{x\,dx}{(d^2+x^2)^{3/2}} = G\lambda \left[\frac{-1}{(d^2+x^2)^{1/2}} \Bigg|_0^L \right]$$

$$\frac{F}{m_y} = G\lambda d \int_0^L \frac{dx}{(d^2+x^2)^{3/2}} = G\lambda d \left[\frac{x}{d^2(d^2+x^2)^{1/2}} \Bigg|_0^L \right]$$

$$\frac{F}{m_x} = G\lambda\left(\frac{-1}{\sqrt{d^2+L^2}} + \frac{1}{d}\right)$$

$$\frac{F}{m_y} = G\lambda\cancel{d}\,\frac{L}{d^{\cancel{2}}(d^2+L^2)^{\frac{1}{2}}} = \frac{G\lambda L}{d\sqrt{d^2+L^2}}$$

$$\boxed{\frac{F}{M_x} = \frac{GM}{L}\left(\frac{-1}{\sqrt{d^2+L^2}} + \frac{1}{d}\right)}$$

leave as components

$$\boxed{\frac{F}{m_y} = \frac{GM}{d\sqrt{d^2+L^2}}}$$