

STEP III, 2004, Q11

- 11 Particles P , of mass 2, and Q , of mass 1, move along a line. Their distances from a fixed point are x_1 and x_2 , respectively where $x_2 > x_1$. Each particle is subject to a repulsive force from the other of magnitude $\frac{2}{z^3}$, where $z = x_2 - x_1$.

Initially, $x_1 = 0$, $x_2 = 1$, Q is at rest and P moves towards Q with speed 1. Show that z obeys the equation $\frac{d^2z}{dt^2} = \frac{3}{z^3}$.

By first writing $\frac{d^2z}{dt^2} = v \frac{dv}{dz}$, where $v = \frac{dz}{dt}$, show that $z = \sqrt{4t^2 - 2t + 1}$.

By considering the equation satisfied by $2x_1 + x_2$, find x_1 and x_2 in terms of t .



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