

Answer on Question #41163, Physics, Mechanics | Kinematics | Dynamics

Question:

two masses $m_1=2\text{kg}$ and $m_2=8\text{kg}$ infinite distance apart are initially at rest . under their mutual grav attraction they start moving. When separation becomes 1m , velocity of m_2 will be???

ans in terms of G ?

Answer:

The law of conservation of momentum:

$$m_1 \vec{v}_1 + m_2 \vec{v}_2 = 0$$

Therefore:

$$v_1 = \frac{m_2}{m_1} v_2$$

The law of conservation of energy:

$$T + U = \text{const}$$

where $T = \frac{mv^2}{2}$ is kinetic energy, m - mass, v – speed, $U = -\frac{Gm_1m_2}{r}$ is potential energy.

Therefore:

$$\begin{aligned} 0 &= \frac{m_1 v_1^2}{2} + \frac{m_2 v_2^2}{2} - G \frac{m_1 m_2}{r} \\ \frac{m_1 \left(\frac{m_2}{m_1} v_2 \right)^2}{2} + \frac{m_2 v_2^2}{2} &= G \frac{m_1 m_2}{r} \\ v_2^2 &= \frac{2Gm_1}{r \left(1 + \frac{m_2}{m_1} \right)} \\ v_2 &= \sqrt{\frac{2Gm_1}{r \left(1 + \frac{m_2}{m_1} \right)}} = 7.3 \cdot 10^{-6} \frac{\text{m}}{\text{s}} \end{aligned}$$

Answer: $7.3 \cdot 10^{-6} \frac{\text{m}}{\text{s}}$