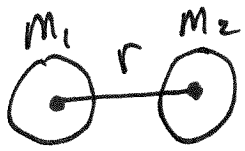
Chapter 13 Problem 32

a) Find the gravitational potential energy between 2 masses



$m_1 = m_2 = 5.00\,kg$

$r = 15\,cm = 0.15\,m$

Potential Energy is

$$U_0 = -\frac{GMm}{r} = -\frac{Gm_1m_2}{r}$$

$$= -\frac{(6.67\times10^{-11}\,N\,m^2/kg^2)(5.00\,kg)(5.00\,kg)}{(0.15\,m)^2}$$

$$= \boxed{-7.41\times10^{-8}\,J} = 74.1\,J$$

b) Beginning at rest, how fast are they going when they impact each other.

$$U_0 + K_0 = U_f + K_f$$

When they make contact, $r_f = 2(5.10\,cm) = 10.2\,cm$

$$U_f = -\frac{(6.67\times10^{-11}\,N\,m^2/kg^2)(5.00\,kg)(5.00\,kg)}{(0.102\,m)^2}$$

$$= -1.60\times10^{-7}\,J$$

$K_0 = 0$

$K_f = 2\left(\frac{1}{2}m_1v^2\right) = m_1v^2$ ← There are 2 masses being accelerated

Then $U_0 + 0 = U_f + m_1v^2 \rightarrow m_1v^2 = U_0 - U_f$

$$v = \sqrt{\frac{U_0 - U_f}{m_1}} = \sqrt{\frac{(-7.41\times10^{-8}) - (-1.60\times10^{-7})\,J}{(5.00\,kg)}} = \boxed{1.3\times10^{-4}\,\frac{m}{s}}$$