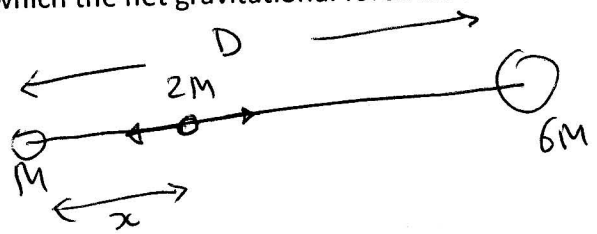
PHYS101
QUIZ#11 - CHAPTER 13
DATE: 16/12/12

Name: Key Id#: Sect#

Two stars of masses M and 6M are separated by a distance D = 3000 km. Calculate the distance (measured from M) to a point at which the net gravitational force on a third star of mass 2 M would be zero.



$$\frac{G\,M(2M)}{x^2} = \frac{G\,(6M)(2M)}{(D-x)^2}$$

$$\frac{2}{x^2} = \frac{12}{(D-x)^2}$$

$$2(D-x)^2 = 12x^2$$

$$\sqrt{2}\sqrt{(D-x)^2} = \sqrt{12}\sqrt{x^2}$$

$$\sqrt{2}(D-x) = \sqrt{12}\,x$$

$$\sqrt{2}D - \sqrt{2}x = \sqrt{12}\,x$$

$$x = \frac{\sqrt{2}\,D}{\sqrt{12}+\sqrt{2}} = \boxed{870\ \text{Km}}$$

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Calculate the work done to move an Earth satellite of mass 1000 kg from an altitude of 3Re to an altitude of 4Re.
(Re = 6370 km, Me = 5.98×10^{24} kg, and G = 6.67×10^{-11} N m^2/kg^2)

$$E = -\frac{GMm}{2r}$$

$$W = \Delta E = E_f - E_i$$

$$= -\frac{GM_e m}{10R_e} + \frac{GMem}{8R_e} = \frac{GM_e m}{40R_e}$$

$$W = \frac{6.67\times10^{-7} \times 5.98\times10^{24} \times 1000}{40 \times 6370\times10^{3}} = \boxed{1.57\times10^{13}\ J}$$

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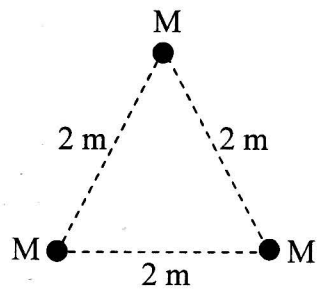
Three identical particles each of mass M = 2 kg are placed as shown in the figure. What is the work done to remove one of the particle to a point at infinity?



$$U = -\frac{G m_1 m_2}{r}$$

$$W = \Delta U = U_f - U_i$$

$$= -\frac{GM^2}{d} + \frac{3GM^2}{d}$$

$$= \frac{2GM^2}{d} = \frac{2 \times 6.67 \times 10^{-17} \times 4}{2}$$

$$= \boxed{2.67 \times 10^{-10}\ \text{J}}$$