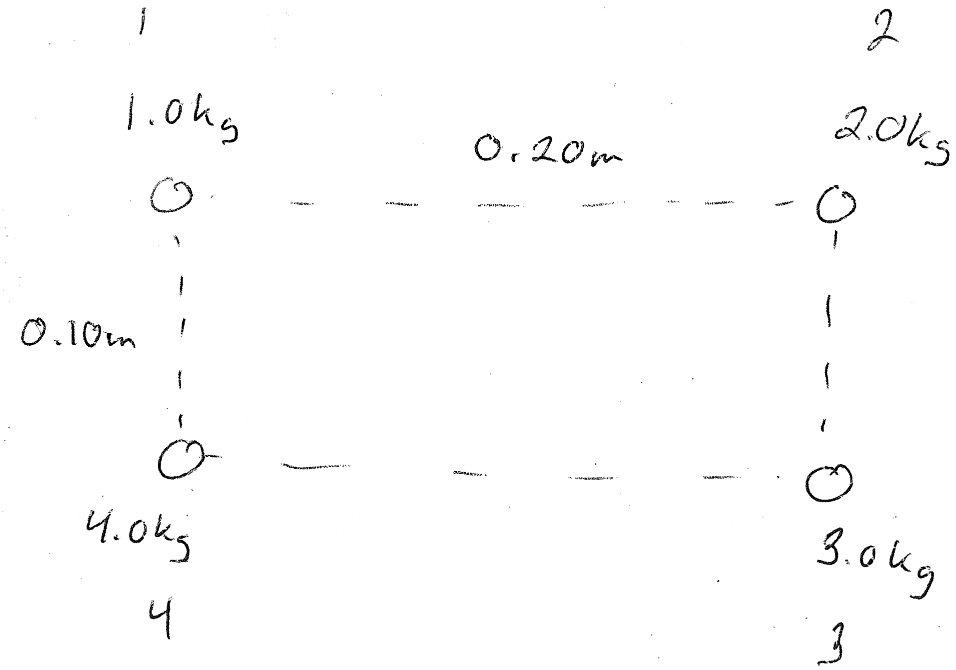
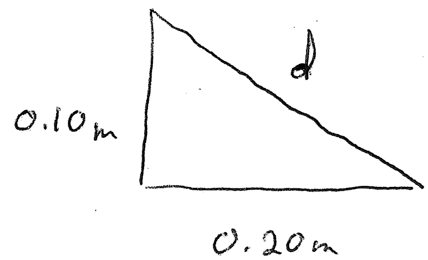


1) Determine the total gravitational potential energy

2) If masses are all doubled, how does the energy change?

3) If all distances are halved, how does the energy change?

1) $E_{g_{Total}} = E_{g_{1-2}} + E_{g_{1-3}} + E_{g_{1-4}} + E_{g_{2-3}} + E_{g_{2-4}} + E_{g_{3-4}}$



$d = \sqrt{(0.10m)^2 + (0.20m)^2}$

$= 2.24E-1\,m$

$\underline{0.224\,m}$

$E_{g_{1-2}} = \dfrac{G m_1 m_2}{r_{1-2}} = \dfrac{(6.67E-11\ \frac{Nm^2}{kg^2})(1.0kg)(2.0kg)}{0.20m} = 6.6E-10$

$E_{g_{1-3}} = \dfrac{G m_1 m_3}{r_{1-3}} = \dfrac{(6.67E-11\ \frac{Nm^2}{kg^2})(1.0kg)(3.0kg)}{0.224m} = 8.84E-10J$

$$E_{g_{1-4}} = \frac{G m_1 m_4}{r_{1-4}} = \frac{\left(6.67E\text{-}11 \frac{Nm^2}{kg^2}\right)(1.0kg)(4.0kg)}{0.10m} = 2.64E\text{-}9J$$

$$E_{g_{2-3}} = \frac{G m_2 m_3}{r_{2-3}} = \frac{\left(6.67E\text{-}11 \frac{Nm^2}{kg^2}\right)(2.0kg)(3.0kg)}{0.10m} = 3.96E\text{-}9J$$

$$E_{g_{2-4}} = \frac{G m_2 m_4}{r_{2-4}} = \frac{\left(6.67E\text{-}11 \frac{Nm^2}{kg^2}\right)(2.0kg)(4.0kg)}{0.224m} = 2.36E\text{-}9J$$

$$E_{g_{3-4}} = \frac{G m_3 m_4}{r_{3-4}} = \frac{\left(6.67E\text{-}11 \frac{Nm^2}{kg^2}\right)(3.0kg)(4.0kg)}{0.20m} = 3.96E\text{-}9J$$

$$\Sigma E_g = 1.45E\text{-}8J$$

$$\boxed{1.5E\text{-}8J}$$

2 $E_g = \frac{G\, 2m_1\, 2m_2}{r} = 4\left(\frac{G m_1 m_2}{r}\right)$

Each value is multiplied by 4 with 6 value

$= 4x_1 + 4x_2 + \cdots + 4x_6$

$= 4(x_1 + \cdots + x_6)$

before

4 times

3) $E_g = \frac{G m_1 m_2}{\frac{1}{2} r} = 2\left(\frac{G m_1 m_2}{r}\right)$

Each value is multiplied by 2

$= 2(x_1 + \cdots + x_c)$

2 times