

Homework - Oct 11, 2007

①  $g = GM/R^2$

(a) Moon:  $g = \frac{(6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2)(7.36 \times 10^{22} \text{ kg})}{(1.74 \times 10^6 \text{ m})^2} = 1.62 \text{ N/kg}$

(b) Mars:  $g = \frac{(6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2)(6.40 \times 10^{23} \text{ kg})}{(3.40 \times 10^6 \text{ m})^2} = 3.69 \text{ N/kg}$

(c) Jupiter:  $g = \frac{(6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2)(1.90 \times 10^{27} \text{ kg})}{(7.15 \times 10^7 \text{ m})^2} = 24.8 \text{ N/kg}$

(d) Sun:  $g = \frac{(6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2)(1.99 \times 10^{30} \text{ kg})}{(6.96 \times 10^8 \text{ m})^2} = 274 \text{ N/kg}$

②  $q = +1.6 \times 10^{-19} \text{ C}$       avg. separation =  $2 \times 10^{-15} \text{ m}$   
(radius of proton =  $1 \times 10^{-15} \text{ m}$ )

$$F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2} = \left(9 \times 10^9 \frac{\text{N}\cdot\text{m}^2}{\text{C}^2}\right) \frac{(1.6 \times 10^{-19} \text{ C})^2}{(2 \times 10^{-15} \text{ m})^2} = 58 \text{ N}$$

③ NaCl ionic separation =  $0.236 \text{ nm} = 0.236 \times 10^{-9} \text{ m}$

$\text{Na}^+ \quad q = +1.6 \times 10^{-19} \text{ C}$

$\text{Cl}^- \quad q = -1.6 \times 10^{-19} \text{ C}$

$$F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2} = \left(9 \times 10^9 \frac{\text{N}\cdot\text{m}^2}{\text{C}^2}\right) \frac{(1.6 \times 10^{-19} \text{ C})^2}{(0.236 \times 10^{-9} \text{ m})^2} = 4.1 \times 10^{-9} \text{ N}$$