

Lista 1 - Primeiro Ano

① A justificativa para as duas afirmações é a mesma: sempre entre dois corpos haverá uma força de atração gravitacional.

$$\textcircled{2} \text{ a) } F = \frac{G m M}{d^2} = \frac{6,67 \cdot 10^{-11} \cdot 1 \cdot 1}{1^2} = \boxed{6,67 \cdot 10^{-11} \text{ N}}$$

$$\text{b) } F = \frac{6,67 \cdot 10^{-11} \cdot 5 \cdot 15}{12^2} = \frac{500,25 \cdot 10^{-11}}{144} = \boxed{3,47 \cdot 10^{-11} \text{ N}}$$

$$\text{c) } F = \frac{6,67 \cdot 10^{-11} \cdot 2 \cdot 10^5 \cdot 1 \cdot 10^6}{3^2} = \frac{13,34 \cdot 10^0}{9} = \boxed{1,48 \text{ N}}$$

$$\text{d) } F = \frac{6,67 \cdot 10^{-11} \cdot 3 \cdot 10^{-6} \cdot 1 \cdot 10^{-3}}{(2 \cdot 10^{-4})^2} = \frac{20,01 \cdot 10^{-20}}{4 \cdot 10^{-8}} = \boxed{5 \cdot 10^{-12} \text{ N}}$$

$$\text{e) } 500 \text{ g} = 0,5 \text{ Kg} \quad 1500 \text{ g} = 1,5 \text{ Kg} \quad 2 \text{ cm} = 0,02 \text{ m} = 2 \cdot 10^{-2} \text{ m}$$

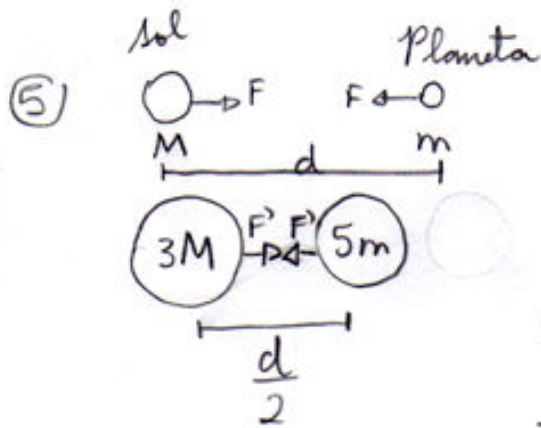
$$F = \frac{6,67 \cdot 10^{-11} \cdot 0,5 \cdot 1,5}{(2 \cdot 10^{-2})^2} = \frac{5 \cdot 10^{-11}}{4 \cdot 10^{-4}} = \boxed{1,25 \cdot 10^{-7} \text{ N}}$$

$$\textcircled{3} F = \frac{6,67 \cdot 10^{-11} \cdot 2 \cdot 10^{30} \cdot 6 \cdot 10^{24}}{(1,5 \cdot 10^{11})^2} = \frac{80,04 \cdot 10^{43}}{2,25 \cdot 10^{22}} = 35,5 \cdot 10^{21}$$

$$\boxed{F = 3,55 \cdot 10^{22} \text{ N}}$$

$$\textcircled{4} F = \frac{6,67 \cdot 10^{-11} \cdot 1 \cdot 10^{23} \cdot 6 \cdot 10^{24}}{(4 \cdot 10^8)^2} = \frac{40,02 \cdot 10^{36}}{16 \cdot 10^{16}} = \boxed{1,11 \cdot 10^{20} \text{ N}}$$

$$\text{OBS: } 4 \cdot 10^5 \text{ Km} = 4 \cdot 10^8 \text{ m}$$

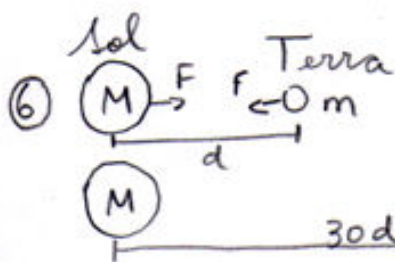


→ A força aumenta 15 x pelo aumento das massas. (3 x 5)

→ A força aumenta 4 x pela redução da distância (2^2)

→ O aumento total da força é $15 \times 4 = \boxed{60F}$

①



Netuno ← 18m

$$\frac{18}{30^2} = \frac{18}{900} = \boxed{0,02F}$$

①

Lista 2

① A intensidade do campo gravitacional depende da massa do corpo e da distância ao seu centro.

② Como a Terra tem a forma de uma esfera achatada, o campo gravitacional na superfície terrestre será menor na linha do Equador do que nos polos, já que na linha do Equador, o raio da Terra é maior (e consequentemente mais distante do centro da Terra).

③

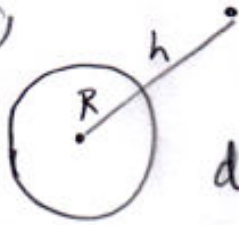


$$d = R + h = 6,4 \cdot 10^6 + 9 \cdot 10^3$$

$$d = 6,4 \cdot 10^6 = 0,009 \cdot 10^6 = 6,409 \cdot 10^6 \text{ m}$$

$$g = \frac{GM}{d^2} = \frac{6,67 \cdot 10^{-11} \cdot 6,0 \cdot 10^{24}}{(6,409 \cdot 10^6)^2} = \frac{42,02 \cdot 10^{13}}{41,07 \cdot 10^{12}}$$

$$g = 0,97 \cdot 10^1 = \boxed{9,7 \text{ m/s}^2}$$

④  $h = 3,57 \cdot 10^4 \text{ Km} = 3,57 \cdot 10^7 \text{ m}$

$$d = R + h = 6,4 \cdot 10^6 + 3,57 \cdot 10^7 = 0,64 \cdot 10^7 + 35,7 \cdot 10^7$$

$$d = 4,21 \cdot 10^7 \text{ m} \quad g = \frac{6,67 \cdot 10^{-11} \cdot 6 \cdot 10^{24}}{(4,21 \cdot 10^7)^2} = \frac{40,02 \cdot 10^{13}}{17,7 \cdot 10^{14}}$$

$$g = 2,25 \cdot 10^{-1} \text{ m/s}^2$$

⑤ Mercúrio:

$$g = \frac{6,67 \cdot 10^{-11} \cdot 3,6 \cdot 10^{23}}{(2,4 \cdot 10^6)^2} = \frac{24,0 \cdot 10^{12}}{5,76 \cdot 10^{12}} = 4,16 \text{ m/s}^2$$

Vênus:

$$g = \frac{6,67 \cdot 10^{-11} \cdot 5,0 \cdot 10^{24}}{(6,0 \cdot 10^6)^2} = \frac{33,35 \cdot 10^{13}}{36 \cdot 10^{12}} = 0,92 \cdot 10^1 = 9,2 \text{ m/s}^2$$

Terra:

$$g = \frac{6,67 \cdot 10^{-11} \cdot 6,0 \cdot 10^{24}}{(6,4 \cdot 10^6)^2} = \frac{40,02 \cdot 10^{13}}{40,96 \cdot 10^{12}} = 0,97 \cdot 10^1 = 9,7 \text{ m/s}^2$$

Marte

$$g = \frac{6,67 \cdot 10^{-11} \cdot 6,6 \cdot 10^{23}}{(3,4 \cdot 10^6)^2} = \frac{44,022 \cdot 10^{12}}{11,56 \cdot 10^{12}} = 3,8 \text{ m/s}^2$$

Júpiter

$$g = \frac{6,67 \cdot 10^{-11} \cdot 1,9 \cdot 10^{27}}{(7,1 \cdot 10^7)^2} = \frac{12,673 \cdot 10^{16}}{50,41 \cdot 10^{14}} = 0,25 \cdot 10^2 = 25 \text{ m/s}^2$$

Saturno

$$g = \frac{6,67 \cdot 10^{-11} \cdot 5,7 \cdot 10^{26}}{(6,0 \cdot 10^7)^2} = \frac{38,019 \cdot 10^{15}}{36 \cdot 10^{14}} = 1,0 \cdot 10 = 10 \text{ m/s}^2$$

(4)

$$g = \frac{6,67 \cdot 10^{-11} \cdot 8,8 \cdot 10^{25}}{(2,5 \cdot 10^7)^2} = \frac{58,696 \cdot 10^{14}}{6,25 \cdot 10^{14}} = \boxed{9,4 \text{ m/s}^2}$$

Netuno

$$g = \frac{6,67 \cdot 10^{-11} \cdot 1,0 \cdot 10^{26}}{(2,4 \cdot 10^7)^2} = \frac{6,67 \cdot 10^{15}}{5,76 \cdot 10^{14}} = 1,1 \cdot 10 = \boxed{11 \text{ m/s}^2}$$

Plutão

$$g = \frac{6,67 \cdot 10^{-11} \cdot 1,2 \cdot 10^{22}}{(1,2 \cdot 10^6)^2} = \frac{8,0 \cdot 10^{11}}{1,44 \cdot 10^{12}} = 5,5 \cdot 10^{-1} = \boxed{0,55 \text{ m/s}^2}$$

Sol

$$g = \frac{6,67 \cdot 10^{-11} \cdot 2,0 \cdot 10^{30}}{(7,0 \cdot 10^8)^2} = \frac{13,34 \cdot 10^{19}}{4,9 \cdot 10^{16}} = 0,27 \cdot 10^3 = \boxed{270 \text{ m/s}^2}$$

Lua

$$g = \frac{6,67 \cdot 10^{-11} \cdot 7,4 \cdot 10^{22}}{(1,7 \cdot 10^6)^2} = \frac{49,358 \cdot 10^{11}}{2,89 \cdot 10^{12}} = 17 \cdot 10^{-1} = \boxed{1,7 \text{ m/s}^2}$$

$$\textcircled{6} \text{ Mercúrio: } P = m \cdot g \Rightarrow P = 70 \cdot 4,16 = \boxed{291,2 \text{ N}}$$

$$\text{Vênus: } P = 70 \cdot 9,2 = \boxed{644 \text{ N}}$$

$$\text{Terra: } P = 70 \cdot 9,7 = \boxed{679 \text{ N}}$$

$$\text{Marte: } P = 70 \cdot 3,8 = \boxed{266 \text{ N}}$$

$$\text{Júpiter: } P = 70 \cdot 25 = \boxed{1750 \text{ N}}$$

$$\text{Saturno: } P = 70 \cdot 10 = \boxed{700 \text{ N}}$$

$$\text{Urano: } P = 70 \cdot 9,4 = \boxed{658 \text{ N}}$$

$$\text{Netuno: } P = 70 \cdot 11 = \boxed{770 \text{ N}}$$

$$\text{Plutão: } P = 70 \cdot 0,55 = \boxed{38,5 \text{ N}}$$

$$\text{Sol: } P = 70 \cdot 270 = \boxed{18900 \text{ N}}$$

$$\text{Lua: } P = 70 \cdot 1,7 = \boxed{119 \text{ N}}$$

$$\text{Merkúrio: } \textcircled{7} F = \frac{6,67 \cdot 10^{-11} \cdot 2,0 \cdot 10^{30} \cdot 3,6 \cdot 10^{23}}{(5,8 \cdot 10^{10})^2} = \frac{48,024 \cdot 10^{42}}{33,64 \cdot 10^{20}}$$

$$\boxed{F = 1,42 \cdot 10^{22} \text{ N}}$$

$$\text{Vênus: } F = \frac{6,67 \cdot 10^{-11} \cdot 2,0 \cdot 10^{30} \cdot 5,0 \cdot 10^{24}}{(1,1 \cdot 10^{11})^2} = \frac{66,7 \cdot 10^{43}}{1,21 \cdot 10^{22}} = 55,1 \cdot 10^{21}$$

$$\boxed{F = 5,51 \cdot 10^{22} \text{ N}}$$

$$\text{Terra: } F = \frac{6,67 \cdot 10^{-11} \cdot 2,0 \cdot 10^{30} \cdot 6,0 \cdot 10^{24}}{(1,5 \cdot 10^{11})^2} = \frac{80,04 \cdot 10^{43}}{2,25 \cdot 10^{22}} = 35,5 \cdot 10^{21}$$

$$\boxed{F = 3,55 \cdot 10^{22} \text{ N}}$$

$$\text{Marte: } F = \frac{6,67 \cdot 10^{-11} \cdot 2,0 \cdot 10^{30} \cdot 6,6 \cdot 10^{23}}{(2,3 \cdot 10^{11})^2} = \frac{88,044 \cdot 10^{42}}{5,29 \cdot 10^{22}}$$

$$F = 16,6 \cdot 10^{20} \quad \boxed{F = 1,66 \cdot 10^{21} \text{ N}}$$

$$\text{Júpiter: } F = \frac{6,67 \cdot 10^{-11} \cdot 2,0 \cdot 10^{30} \cdot 1,9 \cdot 10^{27}}{(7,8 \cdot 10^{11})^2} = \frac{25,346 \cdot 10^{46}}{60,84 \cdot 10^{22}}$$

$$F = 0,416 \cdot 10^{24} \quad \boxed{F = 4,16 \cdot 10^{23} \text{ N}}$$

(6)

$$\text{Saturno: } F = \frac{6,67 \cdot 10^{-11} \cdot 2,0 \cdot 10^{30} \cdot 5,7 \cdot 10^{26}}{(1,4 \cdot 10^{12})^2} = \frac{76,038 \cdot 10^{45}}{1,96 \cdot 10^{24}}$$

$$F = 38,7 \cdot 10^{21} \quad \boxed{F = 3,87 \cdot 10^{22} \text{ N}}$$

$$\text{Urano: } F = \frac{6,67 \cdot 10^{-11} \cdot 2,0 \cdot 10^{30} \cdot 8,8 \cdot 10^{25}}{(2,9 \cdot 10^{12})^2} = \frac{117,39 \cdot 10^{44}}{8,41 \cdot 10^{24}}$$

$$F = 13,9 \cdot 10^{20} \quad \boxed{F = 1,39 \cdot 10^{21} \text{ N}}$$

$$\text{Netuno: } F = \frac{6,67 \cdot 10^{-11} \cdot 2,0 \cdot 10^{30} \cdot 1,0 \cdot 10^{26}}{(4,5 \cdot 10^{12})^2} = \frac{13,34 \cdot 10^{45}}{20,25 \cdot 10^{24}}$$

$$F = 0,658 \cdot 10^{21} \quad \boxed{F = 6,58 \cdot 10^{22} \text{ N}}$$