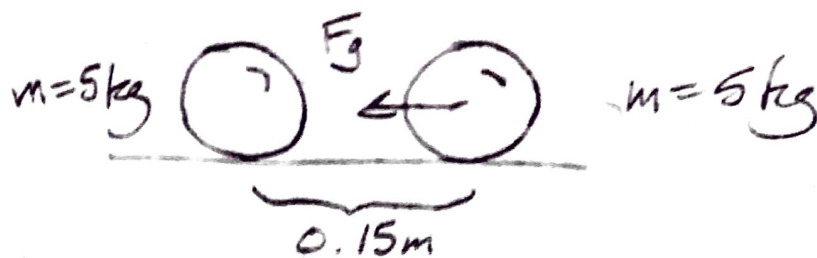


13.13



$$\begin{aligned} F_g &= G \frac{m_1 m_2}{r^2} \\ &= (6.672 \times 10^{-11} \frac{\text{Nm}^2}{\text{kg}^2}) \frac{(5 \text{ kg})(5 \text{ kg})}{(0.15 \text{ m})^2} \\ &= \boxed{7.41 \times 10^{-8} \text{ N}} \end{aligned}$$

⚡
No wonder it's so hard to measure!

13.15

 $F_{\text{planet on a baby?}}$

$$F = G \frac{m_1 m_2}{r^2}$$

$$\begin{aligned} a) \quad F_{\text{father}} &= \left(6.672 \times 10^{-11} \frac{\text{Nm}^2}{\text{kg}^2} \right) \frac{(4.2 \text{ kg})(100 \text{ kg})}{(0.20 \text{ m})^2} \\ &= \boxed{7.01 \times 10^{-7} \text{ N}} \end{aligned}$$

Looked up at
UNIVERSITYtoday.com

$$\begin{aligned} b) \quad F_{\text{Jupiter}} &= \left(6.672 \times 10^{-11} \right) \frac{(4.2 \times 1.9 \times 10^{27})}{(6.29 \times 10^8)^2} \\ &= \boxed{1.34 \times 10^{-6} \text{ N}} \end{aligned}$$

The father's force is about half that
of Jupiter:

$$\frac{7.01 \times 10^{-7}}{1.34 \times 10^{-6}} = \boxed{0.528}$$

13.20

Calculate Earth's mass using acceleration data?

$$F_g = ma_g = \frac{GMm}{r^2}$$

$$a_g = \frac{GM}{r^2}, \text{ so}$$

$$M = \frac{a_g r^2}{G}$$

$$M = \frac{(9.832 \text{ m/s}^2)(6356000 \text{ m})^2}{6.672 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2}$$

$$= \boxed{5.9532 \times 10^{24} \text{ kg}}$$

$$\% \text{ error} = \frac{5.9532 \times 10^{24} - 5.9726 \times 10^{24}}{5.9726 \times 10^{24}} \times 100$$

correct value \rightarrow

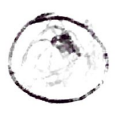
$$= 0.324 \% \text{ less than accepted value}$$



13.23

m of partridge = 15 kg

a) $F_g(\text{earth}) = mg$
 $= (15)(9.8) = \boxed{147\text{N}}$



b) $F_g(\text{moon}) = mg$ or $G \frac{Mm}{r^2}$

Need to find these?
 Appendix D in book!

$r = \frac{d}{2} = \frac{3476 \text{ km}}{2} = 1.738 \text{ e6 m}$

$M_{\text{moon}} = 7.36 \text{ e22 kg}$

$F_g = \frac{(6.672 \text{ e-11})(7.36 \text{ e22 kg})(15 \text{ kg})}{(1.738 \text{ e6})^2} = \boxed{24.4\text{N}}$

Approximately $\frac{1}{6}$ of Earth weight.

c) mass on the Moon is the same, of course!
 15 kg.

d) Weight far from any celestial body $\rightarrow \boxed{0\text{N}}$

e) Mass is the same, of course! $\boxed{15\text{kg}}$