Physics: Modeling Nature

Errata

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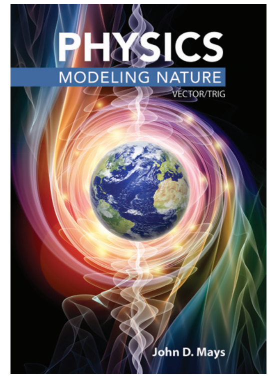

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Physics: Modeling Nature (2021)

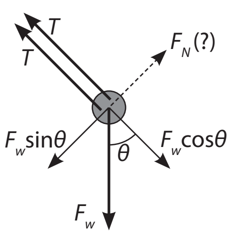
Chapter 1 Answers

p. 35: Item 4b: The answer given in the Solutions Manual has a typo. The correct answer is 76,991 μL. (The correct answer is given in the back of the text.)

Chapter 3 Answers

27.b. The calculation of acceleration is fine as is. The corrected calculation of the tensions is as follows:

Finally, we draw the free-body diagram and solve for the tension.



$$2T - F_w\cos\theta = ma$$
$$2T - mg\cos\theta = ma$$
$$T = \frac{m(a + g\cos\theta)}{2} = \frac{110\text{ kg}\cdot\left(54.2\ \frac{\text{m}}{\text{s}^2} + 9.80\ \frac{\text{m}}{\text{s}^2}\cdot\cos 45°\right)}{2} = 3362\text{ N}$$
$$\boxed{T = 3400\text{ N}}$$

(Note the question about the normal force in the FBD. As the problem is stated, the perpendicular weight component, $F_w\sin\theta$, is not cancelled out by anything in the machine. If the machine pulled only at 45° during the acceleration, as the problem describes, there would have to be a normal force from the throwing mechanism cancelling out $F_w\sin\theta$, such as a track or chute for the stone to slide on while it is being accelerated. Apparently there is no motion in the direction of $F_w\sin\theta$ and no mention of friction either, so F_N is merely suggested. In other words, F_N has to be there, the problem simply doesn't mention it. The motion in an actual trebuchet is more complex—roughly circular—but the problem does not supply the information for a more sophisticated solution, and we haven't addressed circular motion yet anyway!)

Chapter 8 Answers

28. $m_1/m_2 = (5 + 2\sqrt{10})/3$

The corrected version of the last part of the solution follows:

$$\tfrac{1}{2}m_2v_2^2 = 2m_2gr + \tfrac{1}{2}m_2v_3^2$$
$$v_2^2 = 4gr + gr = 5gr$$
$$v_2^2 = 5gr$$
$$\left(\frac{2m_1m_2\sqrt{2gr}}{m_2^2 + m_1m_2}\right)^2 = 5gr$$
$$8m_1^2m_2^2gr = 5gr\left(m_2^2 + m_1m_2\right)^2$$
$$8m_1^2m_2^2 = 5\left(m_2^4 + 2m_1m_2^3 + m_1^2m_2^2\right) = 5m_2^4 + 10m_1m_2^3 + 5m_1^2m_2^2$$
$$3m_1^2m_2^2 = 5m_2^4 + 10m_1m_2^3$$
$$3m_1^2 = 5m_2^2 + 10m_1m_2$$
$$3m_1^2 - 10m_1m_2 - 5m_2^2 = 0$$

Divide by m_2^2 to make this a quadratic in m_1/m_2:

$$3\left(\frac{m_1}{m_2}\right)^2 - 10\frac{m_1}{m_2} - 5 = 0$$
$$\frac{m_1}{m_2} = \frac{10 \pm \sqrt{100+60}}{6} = \frac{10 \pm \sqrt{160}}{6} = \frac{5 \pm 2\sqrt{10}}{3}$$

Since $m_1 > m_2$,

$$\frac{m_1}{m_2} = \frac{5 + 2\sqrt{10}}{3}$$

Appendix C

p. Appendix C, 533. The conversion equation for watts to horsepower should read 746 W = 1 hp.