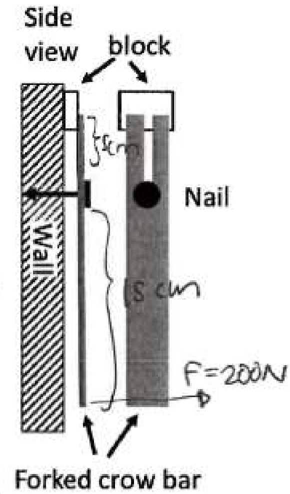
Assessment #7 121 Schwartz

1. I use the device at right to pry a nail out of a wall. At right is what you see looking directly at the wall. At left is a side view, looking along the wall. The distance between the nail and the block is 5 cm. I pull with a force of 200 N on the bottom end of the crow bar, which is 15 cm below the nail. How much force did this put on the nail?



I'm going to use an angular dynamics lens because the force applied perpendicularly to the crow bar is a torque that will cause the crow bar to spin, and torques cause angular acceleration. When the sum of the torques equals zero & the sum of the forces equal zero, the system is static.

$\tau_B + \tau_N + \tau_{Me} = 0$

$F_B r_B + \underbrace{\cancel{F_N r_N}}_{0} + F_M r_M = 0$

$F_B(0.05 m) + (200 N)(0.15 m) = 0$

$F_B(0.05 m) = -30 Nm$

$F_B = 600 N$

$600 N + 200 N = -F_N$

$F_N = -800 N$

A

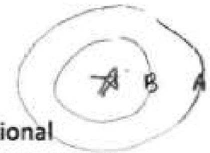
This person (below) did everything right but switched A and B, so all the numbers inserted should be inverses… that is "4" should be "¼" and root 2 should be one over root 2.

2 Two identical planets orbit the same star in a circular path. But planet B is twice as far as planet A.

That is: $m_A = m_B$

$R_B = \underline{2}R_A$

Please find the following ratios:



a) Which planet has greater gravitational attraction to the sun, or are they the same?

or, $F_B = \underline{4}\, F_A$

??

$$F_g = \frac{mMG}{r^2} \qquad F_A = \frac{mMG}{(2r)^2} = \frac{1}{4}\frac{mMG}{r}$$

$$F_A = \frac{1}{4} F_B \qquad F_A = \frac{mMG}{r}$$

b) Which planet has a greater acceleration or are they the same?

or, $a_B = \underline{4}\, a_A$

$$F_B = m a_B$$
$$4F_A = m\,4a_A$$

$$F = ma$$
$$F_B = m a_B$$
$$F_A = \frac{1}{4}F_B = \frac{1}{4}(m a_B)$$
$$a_A = \frac{1}{4} a_B$$

c) Which planet has a greater speed, or are they the same?

or, $v_B = \underline{\sqrt{2}}\, v_A$

$$a_c = \frac{v^2}{r} \longrightarrow v = \sqrt{a_c r}$$

$$V_A = \sqrt{\tfrac{1}{4}a \cdot 2r} = \sqrt{\tfrac{1}{2}ar} = \frac{1}{\sqrt{2}}\sqrt{ar} = \sqrt{2}\, V_A$$

$$V_B = \sqrt{a_c r} = \sqrt{ar} \qquad V_B$$

This person (below) needed to write that alpha = 0, and thus the sum of the torques = 0:

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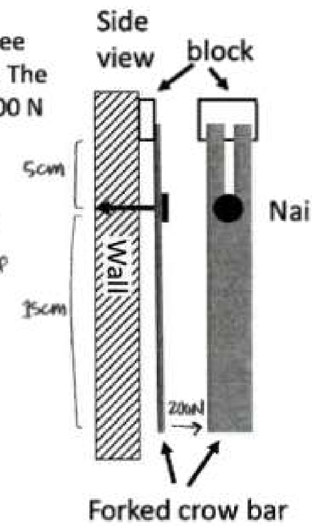
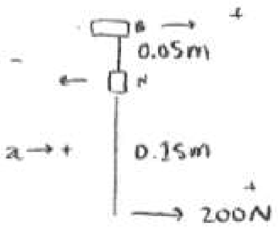


$\Sigma \vec{F} = m\vec{a}$

I am using a dynamics lens because the applied force on the bar is accelerating the nail

$\vec{F}_{app} \Rightarrow \vec{a}_{nail}$

side view :



$\Sigma \vec{\tau} = I\vec{\alpha}$

$\alpha = ?$

$\tau_N = \tau_B^{\,0} + \tau_{app}$

$F_N \cdot 0.05m = 200N \cdot 0.20m$

$0.05 F_N = 40 Nm$

$F_N = \frac{40Nm}{0.05m} = 800N$

$F_N = F_B + F_{app}$

$800N = 600N + 200N$

800N on the nail

this makes sense because since $\tau = F_\perp r$, putting a smaller force on a larger radius gives the similar torque as a larger force on a smaller radius

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