- worksheet: `positron.hep.upenn.edu/p8/files/ws20.pdf`
- 5 problems + 2 XC. Several closely follow video examples.
- A short **actual skimming assignment** is due this Friday. (**Onouye/Kane** ch1+2, see Canvas, mainly look at the illustrations.)
- The next video lecture (on trusses, which are in O/K ch3) is due Monday.
- In the next few weeks, we will **skim** 7 or 8 chapters of a beautifully illustrated [see `onouye_ch01.pdf`] book by Onouye & Kane, "Statics & Strength of Materials for Architecture & Building Construction. You can find your own copy (any edition will do), or you can venmo me $10 for one of my used copies. At the end of the term, you can either keep it or return it to me for a full $10 refund.
- Email **in advance** & file a CAR if you need to miss class.

torque (lever arm $\times$ force): $\tau = r_{\mathrm{perp}}\ F$

$\tau = I\,\alpha$

For equilibrium: $\sum F_x = 0 \quad \sum F_y = 0 \quad \sum_{\circlearrowleft P}\ \tau = 0.$

Usual torque convention: CCW minus CW. In choosing pivot P, note forces whose lines-of-action pass through P drop out of $\sum \tau$.

rod about its end: $I = \frac{1}{3} m\ell^2$

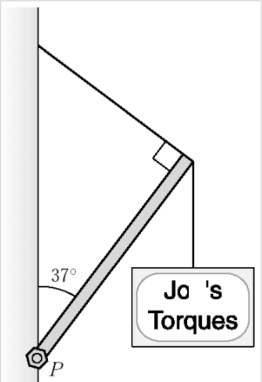
solid sphere: $I = \frac{2}{5} mR^2$

$F^K = \mu_k F^N$

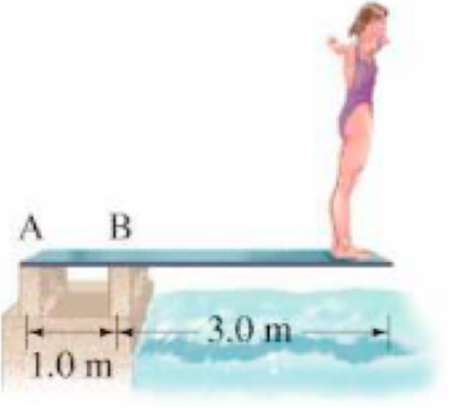
1*. Draw an extended free-body diagram for a stepladder resting on the floor, which you are standing on after having climbed halfway to the top. Try to make the relative lengths of the force lines seem roughly plausible (eg the different normal forces by the floor on the two sides of the ladder). Don't spend too much time — just enough to help strengthen your intuition.

2*. A 20 kg ladder of length 8.0 m leans against a smooth wall and makes an angle of 53.1° with the ground. An 80 kg person starts to climb the ladder. (a) Draw an EFBD for the ladder, when the person has climbed about one-quarter of the way up the ladder. (b) If the coefficient of static friction between the ground and the ladder is 0.40, what distance along the ladder can he or she climb before the ladder starts to slip?

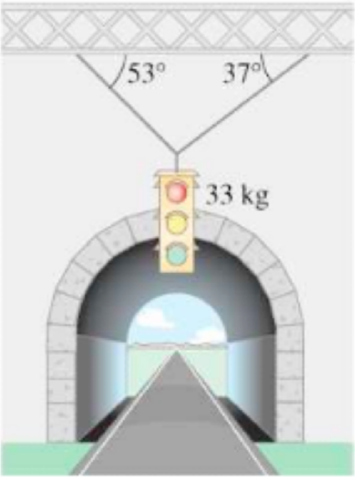
3*. You want to hang a 20 kg sign (shown at right) that advertises your new business. To do this, you attach a 10.0 kg beam of length 1.0 m to a wall at its base by a pivot P. You then attach a thin cable to the beam and to the wall in such a way that the cable and beam are perpendicular to each other. The beam makes an angle of 36.9° with the vertical. You hang the sign from the end of the beam to which the cable is attached. (a) Draw an EFBD for the beam. (b) What is the tension in the cable? (c) Determine the horizontal and vertical components of the force the pivot exerts on the beam.



4*. Calculate the forces (magnitudes and directions) F_A and F_B that the supports exert on the diving board in the figure when a 50 kg person stands at its tip. (a) Ignore the weight of the board. (b) Take into account the board's mass of 25 kg. Assume the board's CoM is at its center. (c) For the scenario of part (b), annotate the provided diagram to turn it into a rough EFBD for the beam.



5*. Find the tension in the two wires supporting the traffic light shown in the figure. As part of your solution, either annotate the figure or separately draw a FBD for the point P where the three wires (the two long wires and the little stub above the traffic light) meet.



6XC*. A mass $m = 5.0\,\mathrm{kg}$ bowling ball is thrown down the alley with a speed of $v_i = 10.0\,\mathrm{m/s}$. At first the ball slides with no rotation. The coefficient of kinetic friction between the ball and the alley surface is $\mu_k = 0.10$. (a) How much time does it take for the ball to achieve pure rolling motion? (b) What is its translational speed at this time? [I think this is a fun problem!]

7XC*. A large steel bar of length $\ell = 1.0\ \mathrm{m}$ is hinged at one end to a wall. A mechanic holds the far end so that the bar is parallel to the ground and places a penny on the bar right at the end she is holding. (a) What is the rotational acceleration of the bar at the instant after she lets go? (b) What is the magnitude of the downward linear acceleration of the far end of the bar at the instant after she lets go? (c) Does the penny remain in contact with the bar after the far end of the bar is released? (Hint: this idea is the basis for the so-called "faster than g" classroom demonstration that we may or may not do at some point.)