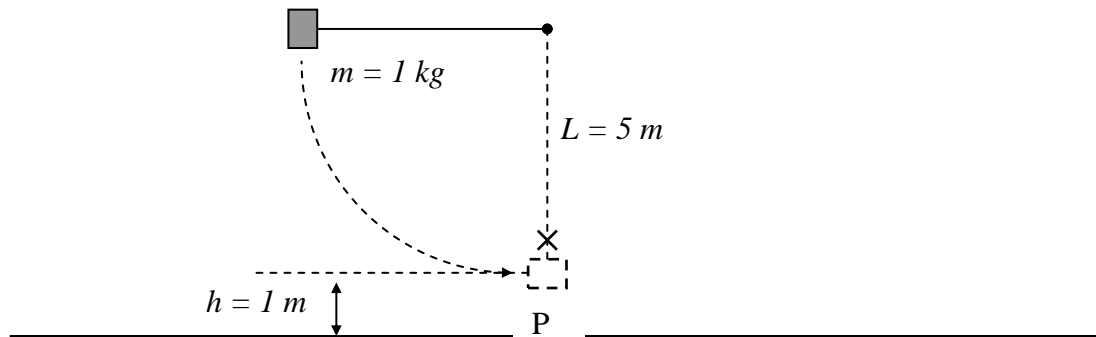


Practice on the final examination for show-work problems.

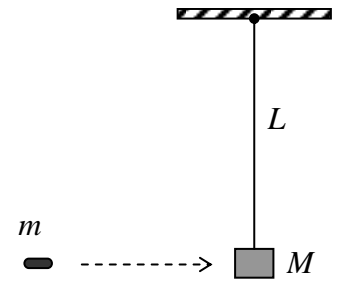
(You might need to finish it in 70-80 minutes).

III. [total 30 points] A block ($m=1\text{ kg}$) is originally at rest and swings down as shown in the diagram below. At the lowest point marked with P, the string suddenly breaks (take $g=10\text{ m/s}^2$ if needed).



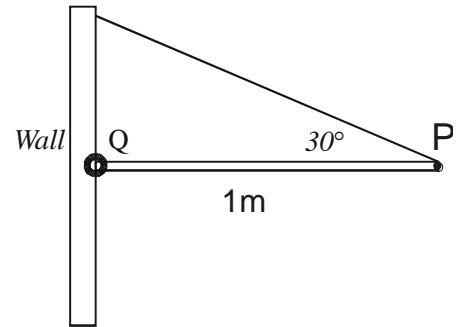
1. **[10 points]** What is the magnitude and direction of the velocity of the block at point P?
2. **[20 points]** How far will the block travel horizontally (from the point P) before it hits the ground?

IV. [30 points] A bullet with mass $m=10$ g and traveling at 100 m/s hits and stays in a wood block with $M=0.99$ kg. The wood block is originally at rest and it is tied to a string with $L=1$ m. See the figure on the right. Find the largest angle that the wood block can swing to after the collision (take $g=10$ m/s² if needed).



V. [total 40 points] See the diagram on the right. A 1-kg mass rod has a length of 1 m and is attached to a vertical wall at point Q. The rod is free to rotate around Q. The other end of the rod (P) is tied with a string fixed to the wall. The system is at rest. Take $g=10 \text{ m/s}^2$ if needed.

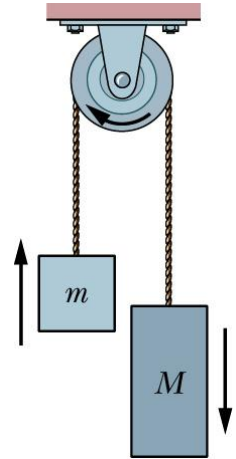
(1) **[10 points]** Find the tension force exerted by the string on the rod.



(2) **[15 points]** Find the force exerted by the wall (at the point Q) on the rod.

(3) **[15 points]** If you suddenly cut the string, the rod will swing down. Find the linear velocity (V) of the point P just before the rod hits the wall (the momentum-of-inertia $I=(1/3)ML^2$ if the rod rotates about the end point Q. L is the rod length and M is the rod mass).

VI. [total 40 points] In the figure on the right, one block has mass $M=540$ g, the other has mass $m=460$ g, and the pulley, which is mounted in horizontal frictionless bearings, has a radius of 10 cm and a mass of 1000 g. The moment of inertia (I_{com}) of the pulley is $\frac{1}{2}MR^2$ (M and R are the mass and the radius of the pulley, respectively). (take $g=10$ m/s² if needed).



1. **[20 points]** When the system is released from the rest, what is the magnitude of the blocks' acceleration?

2. **[14 points]** What are the tensions in the part of the cord that supports the heavier block and the lighter block, respectively?

3. **[6 points]** What is the magnitude of the pulley's angular acceleration?