Physics 216 Final Exam

April 20, 2015

- Read all questions carefully first, and budget your time accordingly.
- Write in the booklet provided, clearly label the problem and section you are doing.
- No books or notes, no computers or wireless internet devices. You are allowed to bring one sheet of formulas. In addition some formulas will be provided upon request.
- In case something is unclear, please ask!

Good Luck!!!

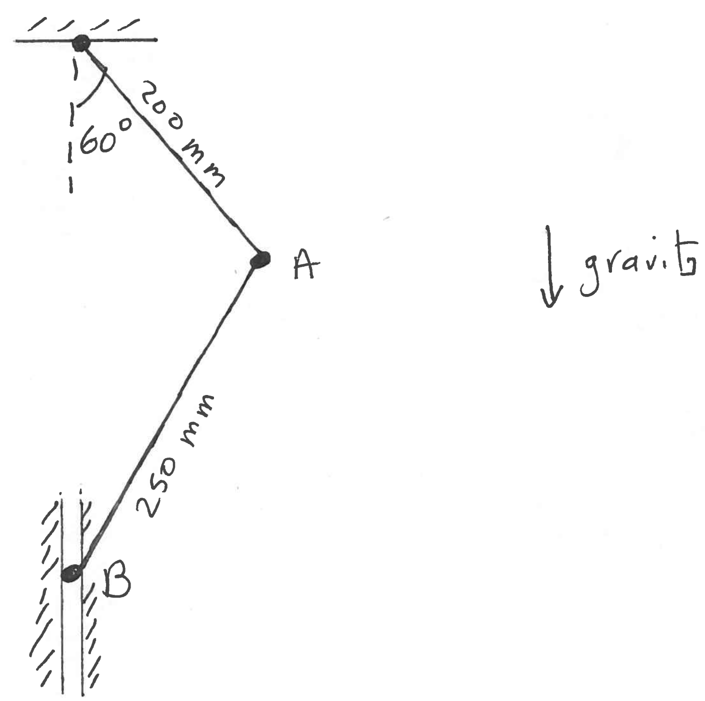
Problem 1 (25 points)

- Using Newton's second law ($\vec{F} = m\vec{a}$) and integarting between the initial and final positions, show the work-energy relation holds:

$$T_1 + W = T_2 \tag{1}$$

  where T_1, T_2 are the initial and final kinetic energies, and $W = \int_1^2 \vec{F} \cdot \vec{dx}$ is the work done by the force

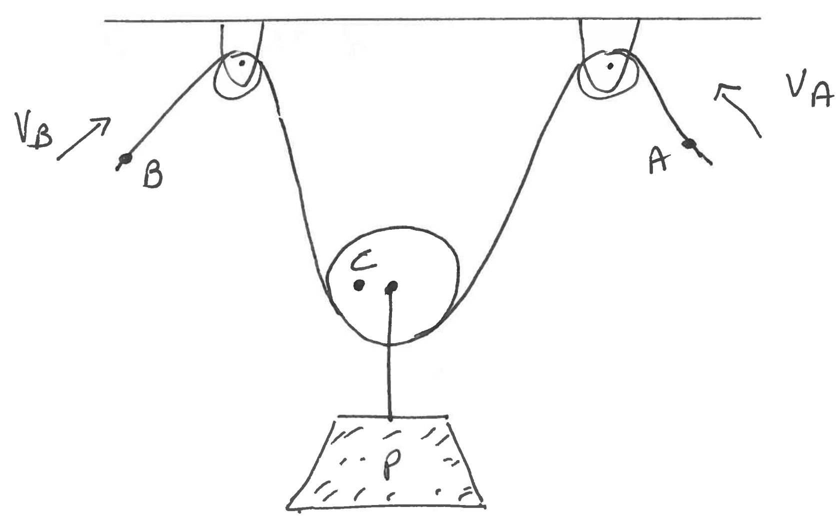
- Two small bodies of mass m are connected as drawn, where B is constrained by a guide to only move vertically. The configuration is initially at rest, and the only force is that of gravity. Using work and energy, find the velocity of A as it crosses the vertical line.



Problem 2 (25 points)

For the arrangements of pulleys drawn, neglect all friction and assume the two upper pulleys are of negligible size, whereas the central pulley has radius of 200mm. The velocities of the points A,B are $0.4\frac{m}{sec}$ and $0.2\frac{m}{sec}$.

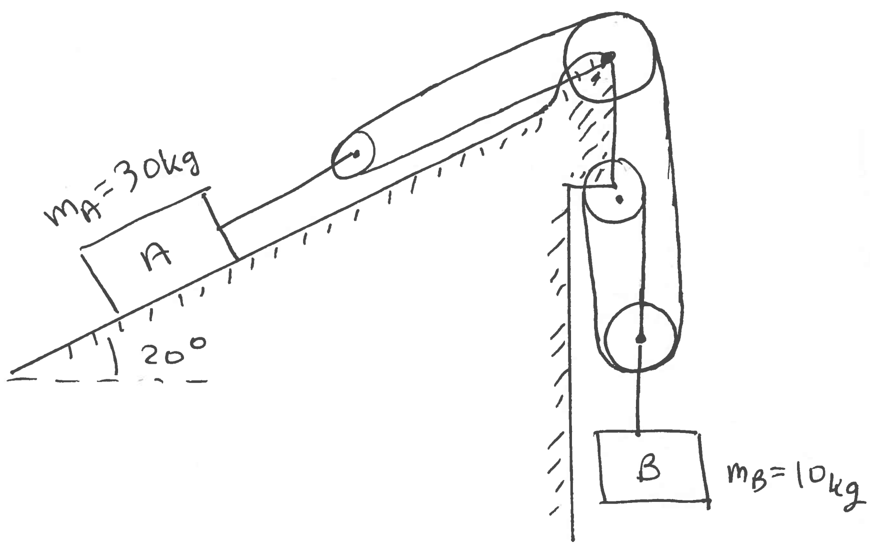
- Find the velocity of the load P.
- Find the angular velocity of the central pulley.
- Find the velocity of the point C half-way inside the central pulley (i.e. distance 100mm from the center).



Problem 3 (25 points)

In the configuration drawn below, neglect friction and the mass of the pulleys. The initial configuration is at rest.

- Draw the free body diagrams for both masses and determine the balance of forces on them.
- For your choice of coordinates describing the motion, write the constraint resulting from the cable connecting both masses being of fixed length.
- Using Newton's second law and the constraint above, determine the accelerations of both masses in terms of the masses (m_A, m_B) and the gravitational constant g.



Problem 4 (25 points)

A projectile is launched at angle θ above the horizon, with initial speed v_0.

- Determine the height and horizontal distance travelled as function of time.
- What is the range of the projectile (i.e. the distance when it reaches the ground level again)?
- When fixing v_0, what is the optimal angle to choose in order to maximize the range of the projectile? What is that maximal range?