PhD Qualifying Exam

Fall 2013

DYNAMICS

1. There are a total of 4 problems.

2. Duration: 2.5 hours

3. Closed book, closed notes (one sheet of formulas is allowed).

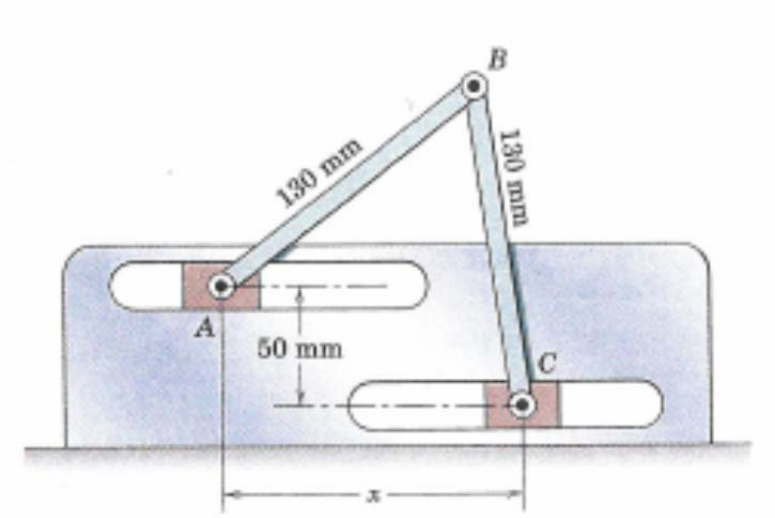
4. Show your work on these exam sheets. (Add additional sheets, if needed.)

5. You may use a calculator.

6. Laptops and cell phones are not allowed.

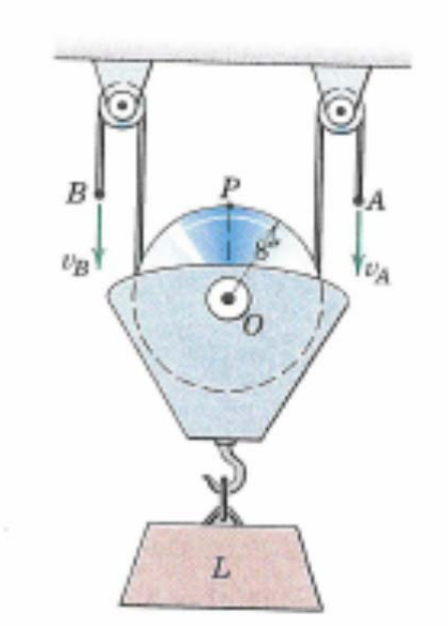
Problem 1

Each of the sliding blocks has a constant velocity 0.6 m/s, *A* to the right and *C* to the left. Determine the magnitude of the velocity of pin *B* at the instant when $x = 120$ mm.



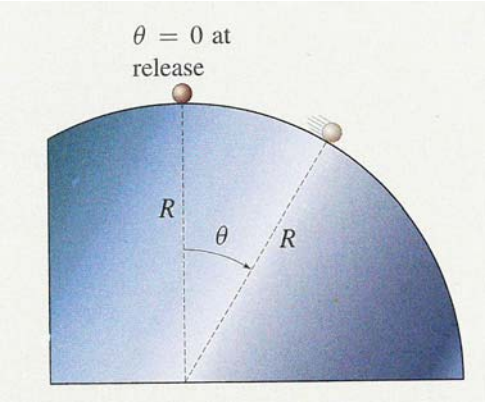
Problem 2

The load L is being elevated by the downward velocities of ends *A* and *B* of the cable. Determine the acceleration of point *P* on the top of the sheave for the instant when $v_A = 2$ ft/sec, $\dot{v}_A = 0.5$ ft/sec^2, $v_B = 3$ ft/sec, $\dot{v}_B = -0.5$ ft/ sec^2.



Problem 3

A small sphere of mass *m* is at rest on top of a frictionless semi-cylindrical surface. The sphere is given a slight nudge to the right so that it slides along the surface. Determine the angle at which the sphere separates from the surface.



Problem4

A stick of length *L* and mass *m* is in equilibrium while standing on its end A when end B is gently nudged to the right, causing the stick to fall. Model the stick as a uniform slender bar with $I_G = \frac{1}{12} m L^2$ and assume that there is friction between the stick and the ground. If the static coefficient of friction is μ_S . Find the value of the angle θ at which the stick starts to slide.

(Hint: Find the normal and frictional forces and use dynamic equilibrium to find the forces as a function of $\theta, \dot{\theta} \text{ and } \ddot{\theta}$. Then use work-energy to find $\dot{\theta}(\theta) \text{ and } \ddot{\theta}(\theta)$ and hence the forces as a function of θ).