ME 274 – Spring 2025
Sample Problems for Exam 1

Included here is a set of problems covering topics of Exam 1. These problems are provided to you for your review in preparing for the exam this semester. Most/all of these problems will likely be covered during the exam review session prior to the exam.

Please note the following.

- Please do not view the problems provided here as being a strict guide for the exact topics that will appear on this semester's exam. Although the topics here are from the official list of exam topics announced, the presence or absence of a particular topic in this set of sample problems do not imply the same presence or absence of that topic on your exam this semester.
- We will not be providing solutions or answers for these problems. Weekly Joys has a large number of sample exam questions from past semesters for which detailed solutions are provided that you can use. Attempt solutions for the sample questions provided here on your own under the more realistic exam conditions of not having the answers. If you get stuck on any problem, attend the exam review session, discuss the problem with your colleagues in the course, and/or ask your instructor/TAs for help. This process will be more helpful to you in your exam preparation than working backwards from known answers to learn how to work problems.

ME 274 – Summer 2022 ***Name*** *(Print)*_____

(Last) *(First)*

Examination No. 1

PROBLEM No. 1 (20 pts.) ***Instructor***_____

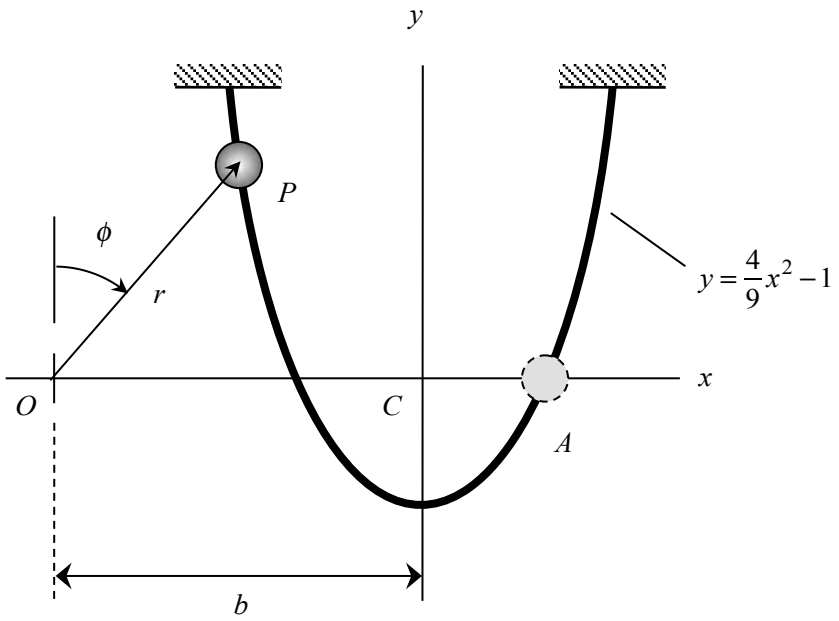
Given: Particle P moves along a guide in the xy-plane, with the equation of the guide being given by: $y = 4x^2/9 - 1$, where x and y are given in *mm* and the origin for the xy coordinate system is at C. The particle moves in way such that its horizontal component of velocity is a constant, $\dot{x}$. An observer at point O is tracking the particle through the radial distance r and the angle ϕ.

Find: For the position of P when $y = 0$ (shown as position A below):

a) Determine the velocity and acceleration in terms of their Cartesian components. Write your answers as vectors.

b) Determine values for $\dot{r}$ and $\dot{\phi}$. Clearly indicate the polar unit vectors in the drawing below.

Use the following parameters in your analysis: $\dot{x} = 30 mm/s$ and $b = 6.5\ mm$.



ME 274 – Summer 2022 **Name** *(Print)*_____

(Last) *(First)*

Examination No. 1

PROBLEM No. 2 (20 pts.) **Instructor**_____

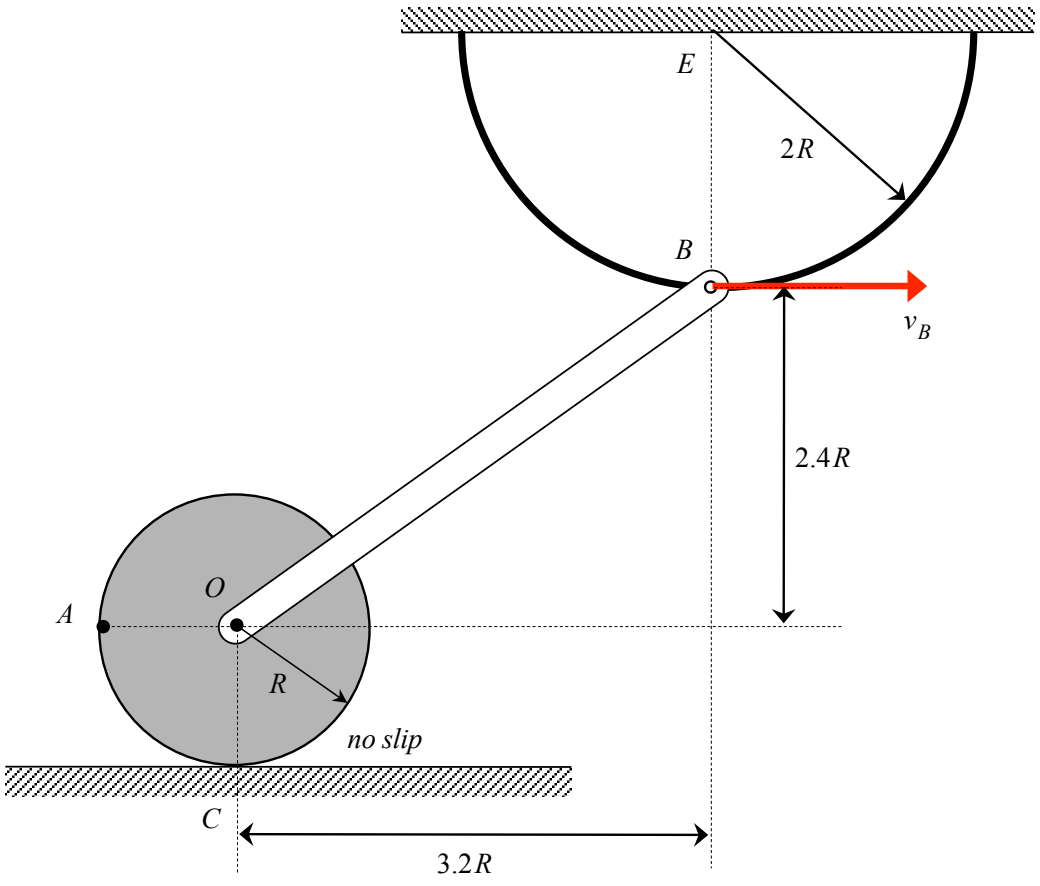
Given: End B of rigid link OB is constrained to move with a *constant* speed v_B along a semi-circular guide having a radius of 2R. End O of the link is pinned to the center of a circular disk, with the disk being allowed to roll without slipping along a straight horizontal surface. At the instant shown, B is directly below the center E of the circular guide, and point A on the perimeter of the disk is directly to the left of O.

Find: For the instant shown:

a) Determine the angular velocity and angular acceleration of link OB.

b) Determine the acceleration of point A on the disk.

Write your answers as vectors and in terms of the parameters of R and v_B only.



PLEASE START YOUR WORK ON THE NEXT PAGE.

ME 274 – Summer 2022 **Name** *(Print)*_____

(Last) *(First)*

Examination No. 1

PROBLEM No. 3 (20 pts.) **Instructor**_____

YOU ARE NOT ASKED TO PROVIDE JUSTIFICATION FOR YOUR ANSWERS IN ANY PART OF THIS PROBLEM.

The mechanism shown is made up of links OD, BD and AB. Link AB is rotating in the CCW sense with an angular speed of ω_{AB}. Assume that the figure shown has been drawn to scale. Consider using the *INSTANT CENTER* approach in answering the following three questions.

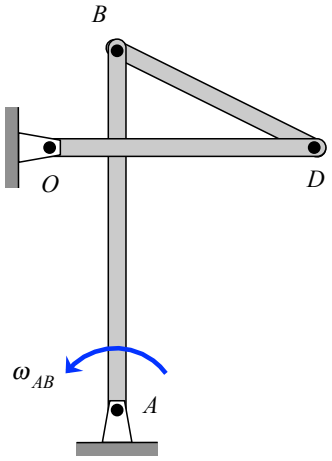
PART A – 3 points

Circle the response below that most accurately describes the sense of rotation for ***link BD***:

a) ω_{BD} *is CCW*

b) $\omega_{BD} = 0$

c) ω_{BD} *is CW*



PART B – 3 points

Circle the response below that most accurately describes the sense of rotation for ***link OD***:

a) ω_{OD} *is CCW*

b) $\omega_{OD} = 0$

c) ω_{OD} *is CW*

PART C – 3 points

Circle the response below that most accurately describes the relative sizes of the speeds v_B and v_D for joints B and D, respectively, in the mechanism:

a) $v_B > v_D$

b) $v_B = v_D$

c) $v_B < v_D$

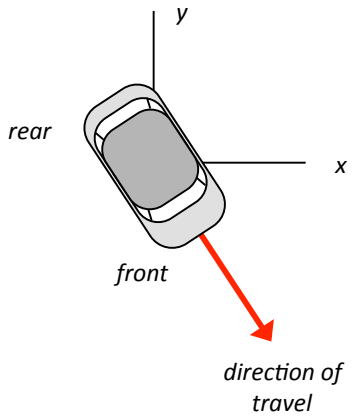
PART D – 3 points

The velocity and acceleration of an automobile P *moving in the forward direction* on a horizontal road are known in terms of their Cartesian components as:

$$\vec{v}_P = \left(15\hat{i} - 20\hat{j}\right) m/s$$

$$\vec{a}_P = \left(-6\hat{i} - 5\hat{j}\right) m/s^2$$

respectively. Circle the response below that most accurately describes the change in speed for P:



a) The speed of the automobile is *increasing*.

b) The speed of the automobile is *constant*.

c) The speed of the automobile is *decreasing*.

PART E – 2 points

Consider, again, the travel of the automobile described above. Circle the response below that most accurately describes the path of P:

a) The driver of the automobile is *turning left*.

b) The driver of the automobile is *not turning*.

c) The driver of the automobile is *turning right*.

<u>*HINT*</u>: Make sketches of the velocity and acceleration vectors to assist you in answering this question.

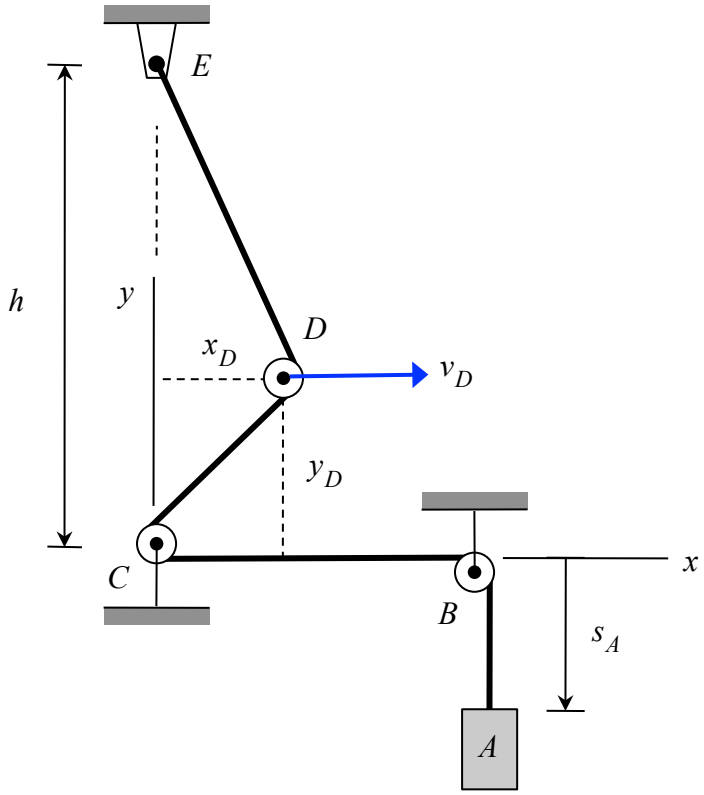
ME 274 – Summer 2022 ***Name*** _____

Examination No. 1 - makeup

PROBLEM NO. 3

PART A – 6 points

An inextensible cable connects block A to ground at E, with the cable being wrapped around two fixed pulleys at B and C, and a moveable pulley at D. When pulley D is at the location $(x_D, y_D) = (0.3, 0.4)\ m$, the center of pulley D is known to have a velocity of $\vec{v}_D = (2\hat{i})\ m/s$. Determine the speed of block A at that instant. Use $h = 0.8\ m$. Assume the pulleys to have small radii.



PART G – 3 points

A disk rolls without slipping up an incline with the speed of its center O being *constant*. In the figure below, show sketches for:

a) the acceleration of point C.

b) the velocity of point A.

c) the acceleration of point A.