APL100 Problem Set 3 (Part A)

1. In the system shown (Figure 1), disk A is free to rotate about the horizontal rod OA. Assuming that shaft OC and disk B rotate with constant angular velocities ω_1 and ω_2, respectively, both counterclockwise. Determine:

   (a) The angular velocity of disk A

   (b) The angular acceleration of disk A

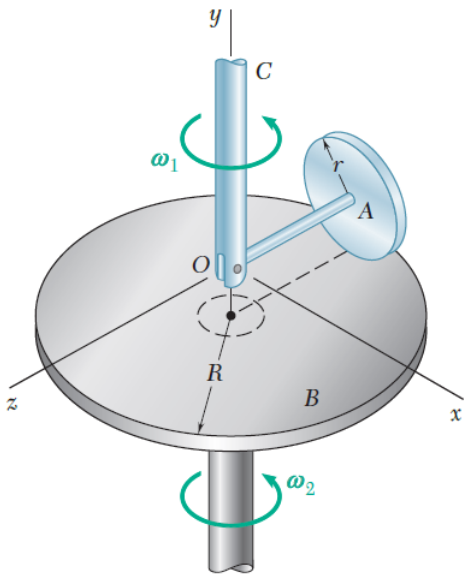

Figure 1: Disk rotating on another rotating disk.

Reference: Problem 15.192, *Vector Mechanics for Engineers*, 11th Edition, by Beer and Johnston. Published by McGraw-Hill Education.

2. A wheel rolls without slipping on a fixed cylinder. Knowing that at the instant shown (Figure 2) the angular velocity of the wheel is 10 rad/s clockwise and its angular acceleration is 30 rad/s^2 counterclockwise, determine the acceleration of:

   (a) Point A,

   (b) Point B,

   (c) Point C.

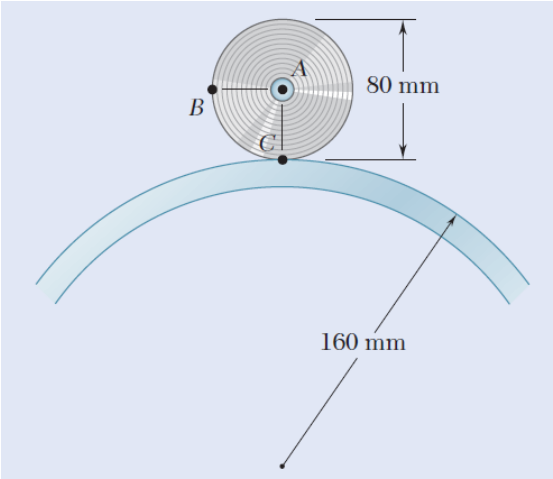

Figure 2: Wheel rolling without slipping on a fixed cylinder.

Reference: Problem 15.116, *Vector Mechanics for Engineers*, 11th Edition, by Beer and Johnston. Published by McGraw-Hill Education.

Problem Set 3 (Part B)

1. The 100mm radius drum rolls without slipping on a portion of a belt which moves downward to the left with a constant velocity of 120 mm/s. Knowing that at a given instant the velocity and acceleration of the center A of the drum are as shown, determine the acceleration of Point D.

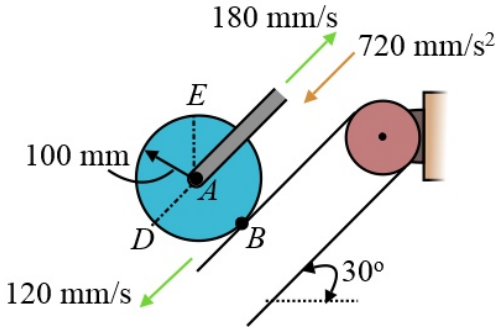

Figure 3: Drum rolls on a belt.

Answer: $0.18\mathbf{i} - 0.720\mathbf{j}\ \text{m/s}^2$, where $\mathbf{i}$ and $\mathbf{j}$ are unit vectors as shown in the Figure 3 ($\mathbf{i}$ is along the belt, $\mathbf{j}$ is perpendicular to the belt).

Reference: Problem 15.117, *Vector Mechanics for Engineers*, 11th Edition, by Beer and Johnston. Published by McGraw-Hill Education.

2. A 30 mm radius wheel is mounted on an axle OB of length 100 mm. The wheel rolls without sliding on the horizontal floor, and the axle is perpendicular to the plane of the wheel. Knowing that the system rotates about the $y-$axis at a constant rate $\omega_1 = 2.4$ rad/s, determine:

   (a) the angular velocity of the wheel,

   (b) the angular acceleration of the wheel,

   (c) the acceleration of Point C located at the highest point on the rim of the wheel.

   (Assume that the wheel is free to rotate w.r.t. axle BO)

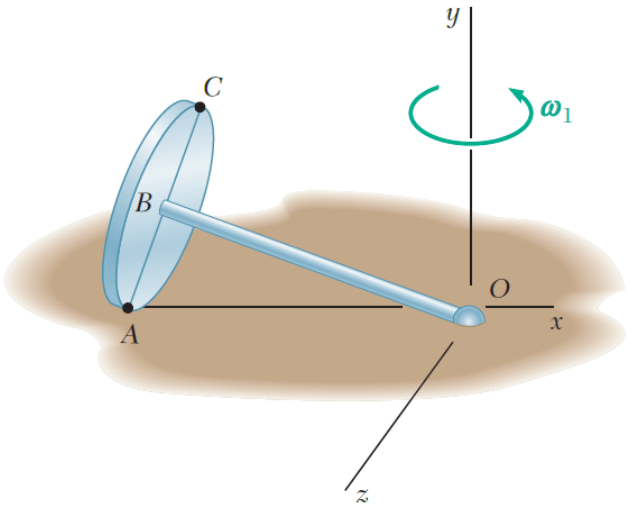

Figure 4: Wheel with axle rolls on the floor.

Answer: $8i$ rad/s, $-19.2k$ rad/s^2, $1.103i - 2.005j$ m/s^2

Reference: Problem 15.198, *Vector Mechanics for Engineers*, 9th Edition, by Beer and Johnston. Published by McGraw-Hill Education.