TAM 212. Midterm 2. Spring 2015

Discussion 'Quiz'

- There are 20 questions, each worth 5 points. (Quiz has just 5 questions.)
- You must not communicate with other students during this test.
- No electronic devices allowed.
- This is a 2 hour exam.
- Do not turn this page until instructed to do so.
- There are several different versions of this exam.

1. Fill in your information:

Full Name: _____

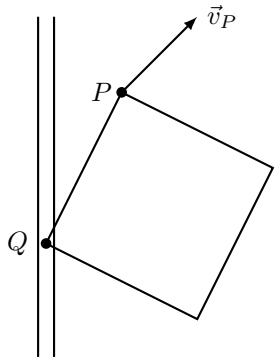
UIN (Student Number): _____

NetID: _____

2. Fill in the following answers on the Scantron form:

91. A
92. A
93. A
94. A
95. D
96. C

1. (1 point) A rigid body is moving in 2D as shown below with angular velocity $\vec{\omega} = \omega\hat{k}$. A pin at point Q constrains that point to move in a vertical slot.



Point P on the body has:

$$\vec{r}_{PQ} = -\hat{\imath} - 2\hat{\jmath}\ \text{m}$$
$$\vec{v}_P = \hat{\imath} + \hat{\jmath}\ \text{m/s}.$$

What is ω?

(A) $-1\ \text{rad/s} \leq \omega < 0\ \text{rad/s}$

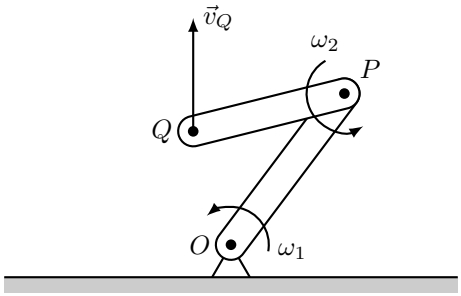
(B) $0\ \text{rad/s} < \omega < 1\ \text{rad/s}$

(C) $\omega = 0\ \text{rad/s}$

(D) $1\ \text{rad/s} \leq \omega$

(E) $\omega < -1\ \text{rad/s}$

2. (1 point) Two rods are connected with pin joints at O, P, and Q as shown. Rod OP has angular velocity $\vec{\omega}_1 = -\hat{k}$ rad/s and rod PQ has angular velocity $\vec{\omega}_2 = \omega_2\hat{k}$.



The velocity $\vec{v}_Q$ of point Q is directly upwards and the positions of the rods are:

$$\vec{r}_{OP} = 3\hat{\imath} + 4\hat{\jmath} \text{ m}$$
$$\vec{r}_{PQ} = -4\hat{\imath} - \hat{\jmath} \text{ m}$$

What is the speed v_Q of point Q?

(A) $9 \text{ m/s} \leq v_Q < 12 \text{ m/s}$

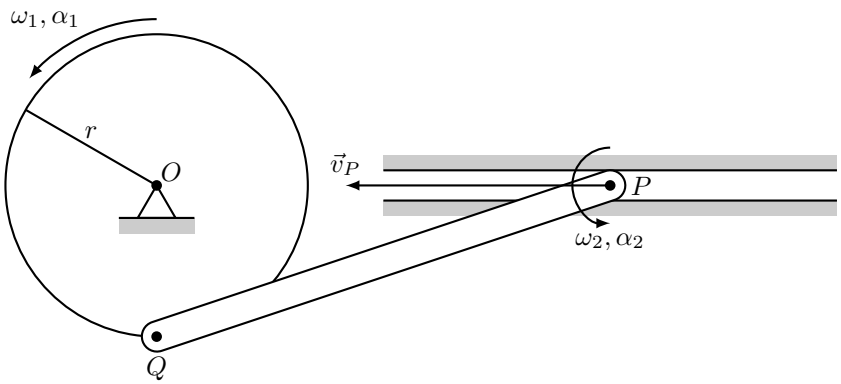
(B) $0 \text{ m/s} \leq v_Q < 3 \text{ m/s}$

(C) $6 \text{ m/s} \leq v_Q < 9 \text{ m/s}$

(D) $3 \text{ m/s} \leq v_Q < 6 \text{ m/s}$

(E) $12 \text{ m/s} \leq v_Q$

3. (1 point) A circular rigid body with radius $r = 2$ m rotates about the fixed center O as shown. A rigid rod connects pins P and Q, and point P is constrained to only move horizontally. Point P has velocity $\vec{v}_P = -4\hat{\imath}$ m/s and acceleration $\vec{a}_P = 0$. The angular velocity and angular acceleration of the circular body are $\vec{\omega}_1 = \omega_1\hat{k}$ and $\vec{\alpha}_1 = \alpha_1\hat{k}$, while those of the rod are $\vec{\omega}_2 = \omega_2\hat{k}$ and $\vec{\alpha}_2 = \alpha_2\hat{k}$.



The position vectors are:

$$\vec{r}_{OQ} = -2\hat{\jmath} \text{ m}$$
$$\vec{r}_{PQ} = -6\hat{\imath} - 2\hat{\jmath} \text{ m}.$$

What is α_1?

(A) $1 \text{ rad/s}^2 \leq \alpha_1$

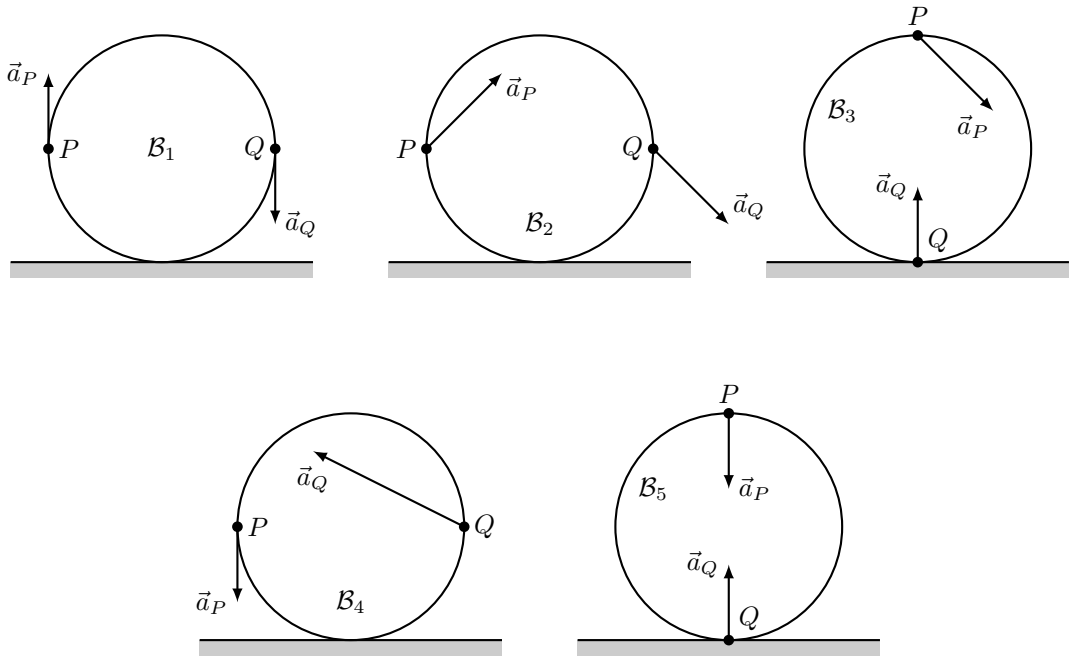
(B) $-1 \text{ rad/s}^2 \leq \alpha_1 < 0 \text{ rad/s}^2$

(C) $0 \text{ rad/s}^2 < \alpha_1 < 1 \text{ rad/s}^2$

(D) $\alpha_1 = 0 \text{ rad/s}^2$

(E) $\alpha_1 < -1 \text{ rad/s}^2$

4. (1 point) Five circular rigid bodies are rolling without slipping as shown, with the accelerations of points P and Q on the bodies as drawn.



Which body does *not* have physically possible accelerations for points P and Q?

(A) $\mathcal{B}_5$

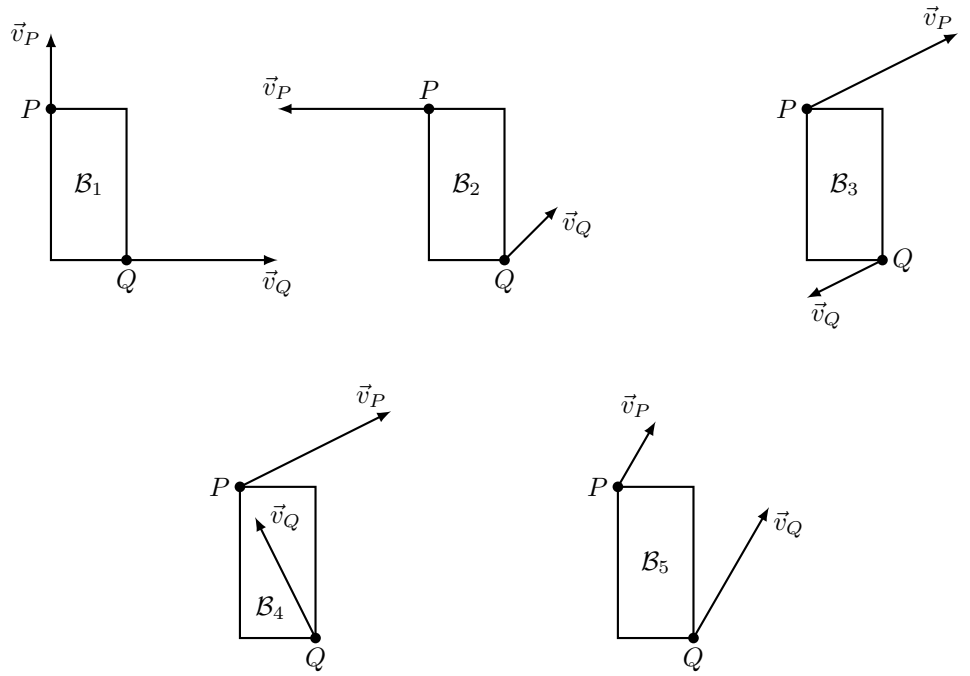
(B) $\mathcal{B}_2$

(C) $\mathcal{B}_3$

(D) $\mathcal{B}_1$

(E) $\mathcal{B}_4$

5. (1 point) Five bodies moving in 2D are shown below with the velocities of points P and Q on the bodies as drawn.



Which body has physically possible velocities for point P and Q?

(A) $\mathcal{B}_5$

(B) $\mathcal{B}_3$

(C) $\mathcal{B}_2$

(D) $\mathcal{B}_4$

(E) $\mathcal{B}_1$