1. [1pt] A wheel spins in the direction indicated by the little arrow and around an axis in line with the z-axis. In which direction points the angular momentum of the wheel? (draw the vector into the figure)

\[ \text{solid, symmetric body } \vec{L} = I \vec{\omega} \]

so \( \vec{L} \) points in the direction of \( \vec{\omega} \).

A) +X direction.
B) +Z direction.
C) +Y direction.
D) -Z direction.
E) +Y direction.

2. [2pt] To the same wheel a Force \( F \) is applied at the rim for a short time. The direction of \( F \) is tangential along the rim of the wheel and pointing along the +x direction. In which direction does the vector of the torque associated with force \( F \) point?

\[ \vec{\tau} = \vec{r} \times \vec{F} \]

use right hand rule

A) -X direction.
B) +Z direction.
C) -Y direction.
D) -Z direction
E) +Y direction.
3. [1pt] In which direction points the vector of the (small) angular momentum change $d\vec{L}$ associated with the torque in problem 2.7? (draw the vectors $\vec{L}$ and $d\vec{L}$ into the figure)

A) $+x$ direction
B) $-x$ direction
C) $-y$ direction
D) $+x$ direction
E) $+y$ direction

$$d\vec{L} = \vec{r} \, dt$$
name direction as $\vec{r}$

4. [2pt] How does the angular momentum of the system change after applying the torque from problem 2 (The final angular momentum is the vector sum of the initial angular momentum and $d\vec{L}$ from problem 3)?

A) Magnitude and direction change
B) The direction changes but the magnitude stays the same
C) The direction stays the same but the magnitude becomes larger
D) Magnitude and direction stay the same
E) The direction stays the same but the magnitude becomes smaller

$$\vec{L}_f = \vec{L}_i + d\vec{L}$$

5. [2pt] Now assume the bottom end of the axis is fixed at point $A$, but the whole system can pivot around that point. In an attempt to tilt the axis you push on the axis of the spinning disk using the force $F$ shown in the diagram below. The force acts on the axis at the location shown and points in the $+x$ direction. In which direction does the (small) resulting change in angular momentum $d\vec{L}$ point now? (draw the vectors $\vec{L}$ and $d\vec{L}$ into the figure)

A) $+x$ direction
B) $+y$ direction
C) $-y$ direction
D) $-x$ direction
E) $+y$ direction

$$\vec{r} = \vec{r} \times \vec{F}$$
right hand rule

6. [2pt] How does the angular momentum of the system change after applying the torque from problem 5?

A) Tilts in the direction of the $+x$ axis (same direction as the force applied)
B) Tilts in the direction of the $-x$ axis (opposite direction as the force applied)
C) The direction stays the same but the magnitude changes
D) Tilts in the direction of the $-y$ axis (perpendicular to force applied)
E) Tilts in the direction of the $+y$ axis (perpendicular to force applied)