MCQ Set 4 – Solutions for Posting

1. B

① See what I know:
$\Delta\theta = ?$
$\omega_i = 0$
$\omega_f =$
$\alpha =$
$\Delta t = T$
I need $\Delta\theta$. I could use kinematics if I had α. Find α

② Finding α:
$\Sigma\tau = I\alpha$
$RF\sin 90° = I\alpha$
$\frac{RF}{I} = \alpha$

③ Use kinematics to find $\Delta\theta$:
$\Delta\theta = \omega_i \Delta t + \frac{1}{2}\alpha\Delta t^2$
$\Delta\theta = (0)\Delta t + \frac{1}{2}\left(\frac{RF}{I}\right)T^2$
$\boxed{\Delta\theta = \frac{RFT^2}{2I}}$

2. D

$v_t = r\,\omega$, and they have the same w since they are on the same rotating object, but person A has a greater r because he/she is further from the axis of rotation.

3. D

- linear speed is the same since a point on the belt must move the same distance during the same Δt, no matter where it is
- Angular speed is different because $V_T = \omega r$, so $\omega = \frac{V_T}{r}$ and the radii are different.

You might also see that the disks rotate through a different $\Delta\theta$ in the same Δt, so ω is not the same.

4. B

① Conditions of static eq. are: $\Sigma\vec{F} = 0$ and $\Sigma\vec{\tau} = 0$

② Apply $\Sigma\vec{\tau} = 0$:

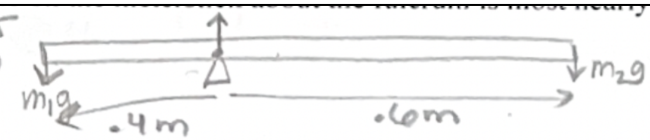
$\Sigma\tau = 0$
$r_1 F_1 \sin\phi_1 - r_2 F_2 \sin\phi_2 = 0$
$aT_1 \sin 90 - bT_2 \sin 90 = 0$
$am_1 g - bm_2 g = 0$
$(am_1 = bm_2)$

$T_1 = m_1 g$ and $T_2 = m_2 g$ because it is at rest.

5. A

<u>Tip</u>: For all MCQs, you can actually use **g = 10 N/kg** instead of g = 9.8 N/kg. The questions are actually written assuming g = 10 N/kg and it makes the math simpler.

① Draw FBD



② put pivot point at fulcrum and find net torque:

$\Sigma\tau = r_1F_1\sin\phi - r_2F_2\sin\phi$

$= (.4m)(1kg)(9.8N/kg) - (.6m)(.5kg)(9.8N/kg)$

$= 3.92 - 2.94$

$= \boxed{0.98\ Nm}$

6. A

① Think about how net torque is related to α:

$\Sigma\tau = I\alpha$

② So, when net torque is greatest, α is greatest, since I is constant.

③ According to the graph, α is greatest in segment A, so net torque is greatest in segment A.

7. E

Ⓔ For the wheel, $\Sigma\tau = I\alpha$

- If the wheel had negligible mass, it would have no rotational inertia, and I would be 0. Then $\Sigma\tau = (0)\alpha$, and $\Sigma\tau = 0$, and so $T_1 = T_2$ since they are both at the same radius and cause equal magnitude torques.
- Because the wheel has mass, $I \neq 0$, so $\Sigma\tau = I\alpha$, and the torques caused by T_1 and T_2 have to be different to make a net torque that can cause an angular acceleration. $T_2 > T_1$ because we need greater torque clockwise.

8. D

When you find the rotational inertia for each system, they all come out the same:

$$I = mr^2$$

(A) $I = m_0 (D_0)^2 = m_0 D_0^2$

(B) $I = M_0 (D_0)^2 = m_0 D_0^2$ (the left sphere doesn't contribute because its r is 0)

(C) $I = \frac{M_0}{4} (2D_0)^2 = \frac{4 M_0 D_0^2}{4} = M_0 D_0^2$