Question 4: Short Answer Paragraph Argument — 7 points

(a)

For a correct expression for the angular acceleration of the pulley in terms of the appropriate quantities: $\alpha_D = \frac{2F_T}{MR}$ — **1 point**

Example Response

$\alpha_D = \frac{RF_T}{\frac{1}{2}MR^2}$ ***OR*** $\alpha_D = \frac{2F_T}{MR}$

Total for part (a) — **1 point**

(b)

For indicating that the torque, τ, is the same for both pulleys — **1 point**

For indicating that the impulse, $\tau\Delta t$, (or change in momentum ΔL) is the same for both pulleys because τ and Δt are the same — **1 point**

For indicating that the rotational inertia, I, of the disk and hoop are different — **1 point**

For providing reasoning that because the rotational inertia, I, are different for the disk and hoop, the kinematic quantities ($\Delta\theta$, ω, α) are also different for the disk and hoop — **1 point**

For **one** of the following: — **1 point**

- Relating I and ω to reason that ΔK is greater for the disk
- Indicating that because $\Delta\theta$ is greater for the disk the work done on the disk is greater

For a logical, relevant, and internally consistent argument that follows the guidelines described in the published requirements for the paragraph-length response — **1 point**

Example Response

The rotational inertia, I, of the hoop is larger than the rotational inertia of the disk because the hoop's mass is all on the outside instead of distributed throughout like the disk. Equal forces are applied to both pulleys at the same distance, which means that the torques exerted on the pulleys will also be equal. Since the same torque is applied to both pulleys for the same time period, the change in angular momentum will be the same for the disk and hoop. The magnitude of the angular velocity for the hoop will be smaller than that of the disk since angular velocity is inversely proportional to the rotational inertia $\left(\omega = \frac{L}{I}\right)$.

Since kinetic energy is proportional to rotational inertia and the square of angular velocity $\left(K_R = \frac{1}{2}I\omega^2\right)$, the difference in angular velocity more greatly affects the rotational kinetic energy. That means the disk will have a greater rotational kinetic energy than the hoop.

Total for part (b) — **6 points**

Total for question 4 — **7 points**