Answer the following question on your own paper. Neatly show all work for all calculations and place a box around all final numerical answers. Pay attention to significant figures and units!

1. How much work is needed to stop a 25 cm diameter solid cylindrical flywheel rotating at 3.6×10^3 RPM? The flywheel has a mass of 2.0×10^3 kg.

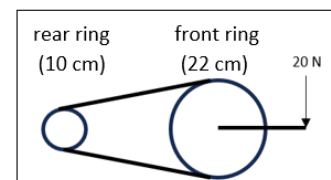2. An object is initially at rest. When $250 \text{N} \cdot \text{m}$ of work is done on the object, it rotates through 20. revolutions in 4.0 s. What is its moment of inertia?

3. The graph to the right shows the net torque exerted on a rigid system that is free to rotate around a fixed axis as a function of the angular displacement θ. Two trials are performed. In Trial A, a constant net torque is applied to the system and in Trial B a varying net torque is applied to the system, as indicated in the graph.
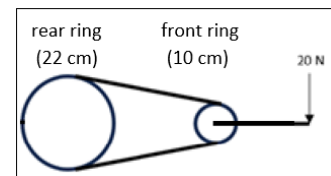   a) What does the area under a torque vs. angular displacement graph equal?
    b) From the graph, how does the work done by the constant torque (A) compare to the work done by the varying torque (B)?
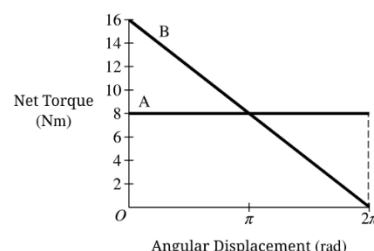
4. A constant perpendicular force of 20.0 N is applied to a bicycle crank (shown to the right) which causes the bicycle to move at a constant velocity. The crank is 25.0 cm long. The front ring has a diameter of 22.0 cm. The rear ring has a diameter of 10.0 cm.

a) How much torque is produced by the applied force? (Assume all of the force is transferred to the center of the crank.)
b) If the applied force does 200. J of work on the front ring, how many revolutions does the front ring go through?
c) Since the front ring is moving at a constant velocity, how does the torque caused by the 20.0 N force compare to the torque the ring is exerting on the chain?
d) What force is the ring exerting on the chain?
e) Since the chain is moving at a constant velocity, what must be true about force that the tension of the chain is exerting on the front ring and the rear ring?
f) What torque is the the chain exerting on the rear ring?
g) How must the work done on the front ring compare to the work done on the rear ring assuming no energy losses due to non-conservative forces?
h) How many revolutions does the rear ring complete when the applied force does 200. J of work as indicated in part (b)?
i) What is the benefit of this arrangement of front and rear rings on a bicycle? When would this arrangement be beneficial when riding? Be sure to include comparisons of distances, forces, and torques of the front and rear rings in your answer.

5. Repeat the above problem, but this time the small ring is in front and the large ring is in the back as shown in the diagram to the right. A constant perpendicular force of 20.0 N is applied to a bicycle crank (shown to the right) which causes the bicycle to move at a constant velocity. The crank is 25.0 cm long. The front ring has a diameter of 10.0 cm. The rear ring has a diameter of 22.0 cm.

    a) How much torque is produced by the applied force? (Assume all of the force is transferred to the center of the crank.)
    b) If the applied force does 200. J of work on the front ring, how many revolutions does the front ring go through?
    c) Since the front ring is moving at a constant velocity, how does the torque caused by the 20.0 N force compare to the torque the ring is exerting on the chain?
    d) What force is the ring exerting on the chain?
    e) Since the chain is moving at a constant velocity, what must be true about force that the tension of the chain is exerting on the front ring and the rear ring?
    f) What torque is the the chain exerting on the rear ring?
    g) How must the work done on the front ring compare to the work done on the rear ring assuming no energy losses due to non-conservative forces?
    h) How many revolutions does the rear ring complete when the applied force does 200. J of work as indicated in part (b)?

i) What is the benefit of this arrangement of front and rear rings on a bicycle? When would this arrangement be beneficial when riding? Be sure to include comparisons of distances, forces, and torques of the front and rear rings in your answer.