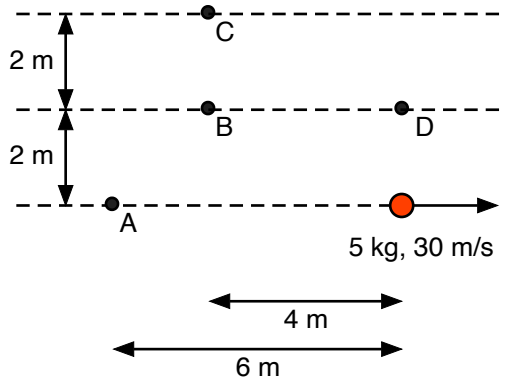
Angular Momentum Problems

1. Calculate the angular momentum of a 5 kg object moving horizontally at 30 m/s from the four points shown.



2. A 4 kg object is located at $5\mathbf{i} - 9\mathbf{j}$ m. It has a velocity of $-3\mathbf{i} + 7\mathbf{j}$ m/s. What is its angular momentum about the origin?

3. A solid ball of mass 10 kg and radius 25 cm is rotating at 200 rpm.
   a. What is its angular momentum?

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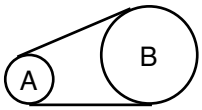
b. What is its kinetic energy?

4. Two wheels are connected by a belt that does not slip. The radius of one wheel (B) is three times the radius of the second (A). What would be the ratio of the rotational inertias I_A/I_B if



a. both wheels had the same angular momentum?

b. both wheels had the same rotational kinetic energy?

5. A child of mass 35 kg is sitting on a large rotating disk (100 kg and radius 2 m) in a playground. The disk is rotating at 1 revolution per second, and the child is initially sitting 0.5 meters from the center. The child carefully crawls to the edge of the disk. What is the new rotation rate?

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6. You are sitting on a rotating stool with your arms held out. If you pull your arms in, your rotational speed increases.
   a. Are there any external forces exerted on you during this process? If so, list them.

   b. Are there any external torques exerted on you during this process? If so, list them.

   c. What happens to your moment of inertia in this process? Explain.

   d. Why does your rotational speed increase?

   e. What happens to your kinetic energy in this process? Explain.

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Answers:

1. *A) 0 kg•m²/s B) 300 kg•m²/s C) 600 kg•m²/s D) 300 kg•m²/s*

2) 32 kg•m²/s 3. a) 5.24 kg•m²/s b) 54.8 J

4. *a) I_A:I_B = 1:3 b) I_A:I_B = 1:9 5) 0.61 rps*

6. *a) Weight and normal force. b) None. The 2 forces are parallel to rotation axis, so no torque.*

   c) I goes down as hands and arms pull in. d) Since L is conserved, as I goes down, ω goes up

   e) K goes up! The energy comes from you – it takes work to pull your arms in, that energy goes into your rotational kinetic energy