Part B: Rotational Inertia

Rotational Inertia
Rotational inertia is specifically, resistance to any change in rotational motion - something that is not rotating resists beginning to rotate. - Something that is already rotating resists stopping, or any change in its rotational velocity

Rotational Inertia of Point Masses

Point Mass
One mass, located at one single point. As long as you are dealing only with point masses, you don't need to use calculus to do physics.

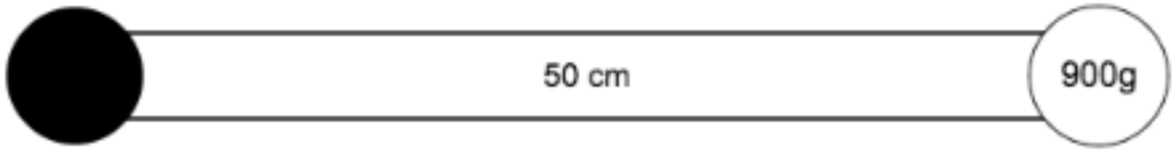
The formula for rotational inertia of a point mass:

$$I = mr^2$$

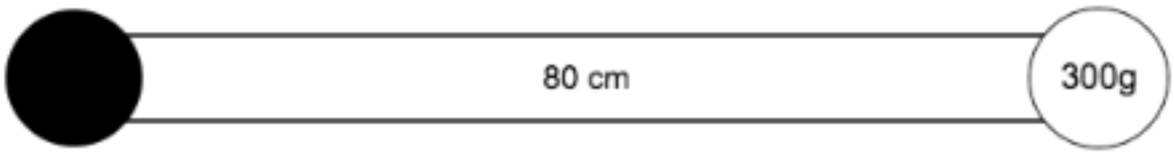
Symbol	**Quantity**	**SI Unit**
I	Rotational inertia	Kg-m^2
m	Mass	Kilograms
r	Distance from the pivot point	Meters

The following diagrams show rods designed to spin around. The black dot represents the pivot point, and all masses are labeled. In each case, the mass of the rod itself is negligible.

Use the formula above to calculate the rotational inertia of each rod.
Make sure that in each calculation you use proper SI units! (meters and kilograms)
B.1



B.2



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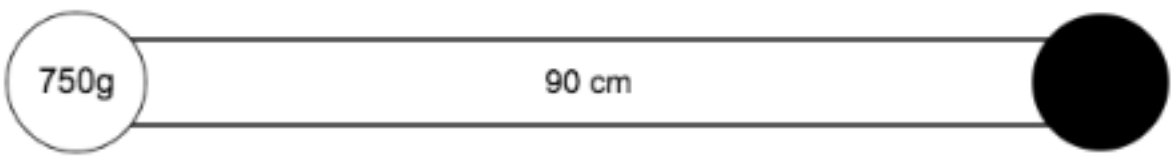


Rotational Inertia of a collection of point masses:

$$I = \sum_i m_i r_i^2$$

This is called *sigma notation* in mathematics. It means that you need to calculate the contribution for each point mass and add them all up:

Calculate the rotational inertia of each of the following rods. Remember that the pivot is th block dot, and often masses are on both sides of it.

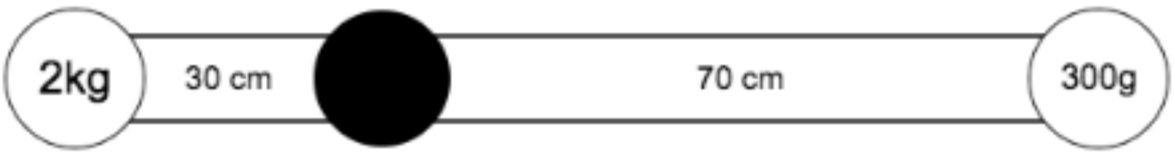
B.4


100g
80 cm
35 cm
600g

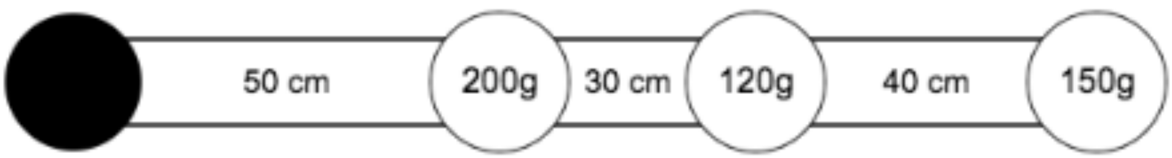
B.5


30 cm
250g
70 cm
90g

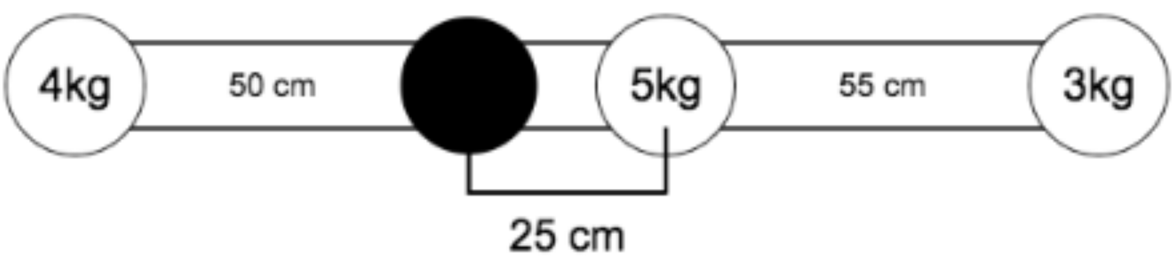
B.6


2kg
30 cm
70 cm
300g

B.7


50 cm
200g
30 cm
120g
40 cm
150g

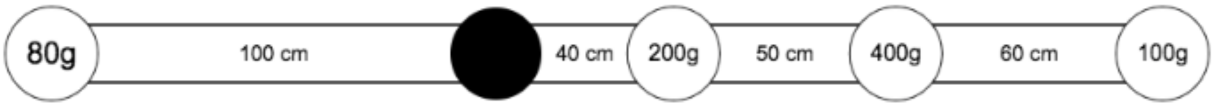
B.8


4kg
50 cm
5kg
55 cm
3kg
25 cm

B.9


1kg
50 cm
4kg
50 cm
50 cm
3kg
50 cm
2kg

B.10


80g
100 cm
40 cm
200g
50 cm
400g
60 cm
100g

B.11

Rotational inertia conceptual question:
If mass A = 200 g and mass B = 100 g, which mass provides a larger contribution to the overall rotational inertia?

Rotational inertial of continuous masses.
Determining the rotational inertia for a continuous mass (such as a rod, hoop, disc, or sphere) requires using a calculus method called an *integral*.