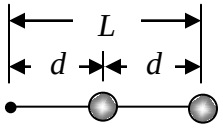
Name _____
Period___Date_____

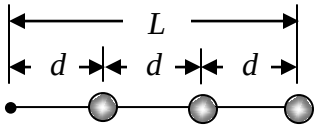
Rotation: Worksheet 6
Rotational Inertia

Answer questions 1 – 3 & 5 in terms of M and L only. Assume the objects below rotate in the horizontal plane, start from rest and there is no friction.

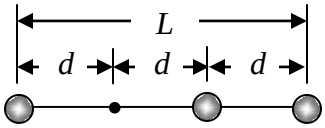
1. Two identical balls each of mass M are connected by thin, massless rods as in the diagram. If the object is rotated about its left end, what is its rotational inertia?



2. A third identical ball is added as in the diagram. If this new object is rotated about its left end, what is its new rotational inertia?

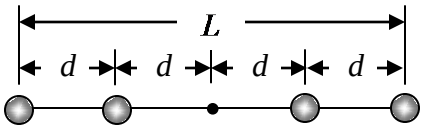


3. The three balls are rearranged as in the diagram below. If this new object is rotated about the point shown, what is its new rotational inertia?

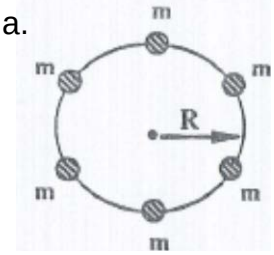


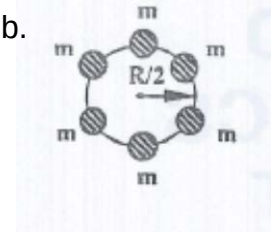
4. Compare the Rotational Inertias of the objects in #2-3. Explain qualitatively (without reference to the actual rotational inertia math models) why this ranking makes sense.

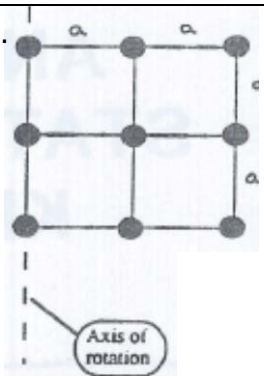
5. A fourth ball is added as in the diagram below. If this new object is rotated about the point shown, what is its new rotational inertia?



6. Write an expression for the rotational inertia of each group of masses shown below. Assume each ball has the same mass.

<table>
<tr>
<td>a.
 

About the axis through the center and perpendicular to the page.</td>
<td>b.
 

About the axis through the center and perpendicular to the page.</td>
<td>c.
 
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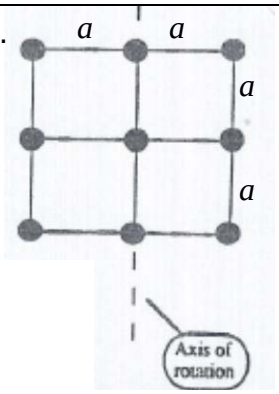
<td>d.
 
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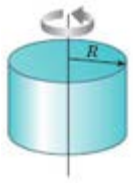
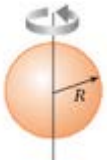
<tr>
<td colspan="2">Which ring is easiest to start (or stop) rotating? Explain.</td>
<td colspan="2">About which axis is it easiest to start (or stop) the rotation of the above masses? Explain</td>
</tr>
</table>

7. The following objects are some of the most commonly used objects when dealing with rotational dynamics. Using what you know about rotational inertia, rank them in order of the easiest to start and stop (lowest rotational inertia) to the hardest to start and stop (greatest rotational inertia). Assume the mass and the radius of each object is the same.

A: Solid cylinder or disk	B: Hoop or thin cylindrical shell	C: Solid sphere	D: Thin-walled hollow sphere	E: Rod, axis through the center (L = 2R)	F: Rod, axis through the end (L=2R)
					

Easiest to start/stop Hardest to start/stop

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____

Explain your reasoning.

8. Use the rotational inertia of common objects sheet to calculate the rotational inertia of the following objects
   a. A solid disk of mass $5.0\ kg$ and radius $0.50\ m$ about a central axis.
   b. A solid sphere of mass $2.0\ kg$ and radius $0.75\ m$ about a diameter.
   c. A spherical shell of mass $2.0\ kg$ and radius $0.75\ m$ about a diameter.
   d. Explain why the rotational inertia of the solid sphere is less than the rotational inertia of the spherical shell.