Name: ______________________
Group #: ______________________
Date: ______________________

(Hands-on) Introduction to Rotation

Rotational motion is a common sight in our lives. It occurs in everything that twists and spins: you can see it in car wheels, washing machines, CDs, merry-go-rounds, blenders, spinning tops, hinges, screwdrivers, pulleys, toilet paper, figure staking, a see-saw, the motion of the Earth, and the list goes on. However, if you have not given it much thought, rotational motion can be less intuitive. Nonetheless, through careful observation of these motions, we can build some key conceptual understanding of rotational motion. In this lab, you will rotate (no pun intended) through a number of different stations, each with a hands-on mini-experiment to demonstrate particular aspects of rotational motion. At each station, perform the experiment and answer the discussion questions given below.

Station 0 – Life (complete this section during any downtime)

Equipment: life experience

1. Come up with at least 5 examples of rotational motion that you have observed in your life that is not one of the examples given above.

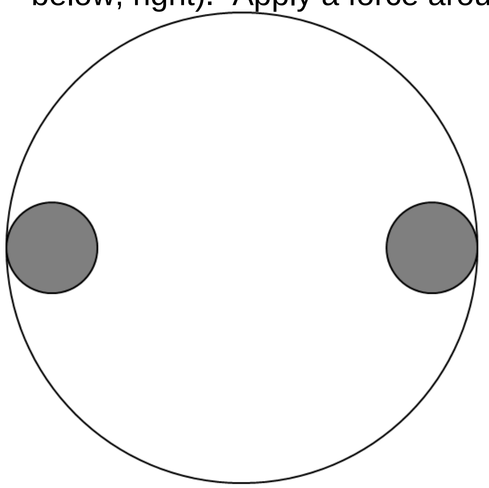
/5

Saved: 8/29/23, printed: 8/29/23

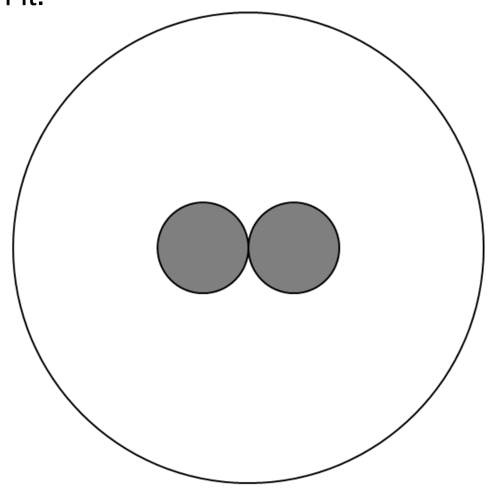
Station 1 – Mass Distribution on a Lazy Susan

Equipment: wooden lazy susan rotating plate, two 1kg masses

1. With the lazy susan not moving, place the two 1kg masses near the edges, approximately opposite so the lazy susan is roughly balanced (see diagram below, left). Apply a force around the edge to spin the lazy susan.
2. Stop the lazy susan. Move the two 1kg masses to near the center (see diagram below, right). Apply a force around the edge to spin it.



Masses near the edges



Masses close to the center

3. In both cases, there was the same amount of mass on the lazy susan, so why did it feel different?

/2

4. Now, instead of speeding up, try slowing the lazy susan down. Which case is easier to slow down the spinning?

/1

5. Based on your observations, if you have 2 more 1kg masses, how would you place all 4 masses to make it the most difficult to set lazy susan into rotational motion?

/2

Station 2 – Center of mass

Equipment: 5 styrofoam pieces of different shapes, a pole

1. Spin each of the styrofoam pieces as they lie flat on the desk. It should look like the styrofoam piece is spinning around a particular point. Draw each shape and mark the point about which it spins.

/5

2. Does this point change if you move the styrofoam piece sideway while spinning it?
/1 YES NO

3. Does this point change if you throw the styrofoam piece in the air while spinning it?
/1 YES NO

4. What is special about this point? (hint: try supporting the styrofoam at only that point with the pole.)
/2

Station 3 – Twisting a wheel

Equipment: A bike wheel, fidget spinners

1. Hold a fidget spinner in your hand and make it spin horizontally. Once the spinner is spinning quickly, try to flip the spinner upside-down to change the direction of the rotation. What do you feel?

/3

2. Do the same with the bike wheel. Try to flip the bike wheel upside-down with it spinning and without it spinning. Compare and comment.

/2

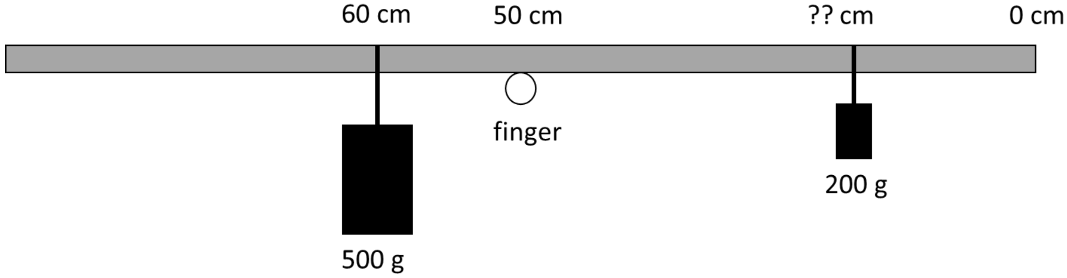
3. Based on what you observed, it seems like once an object is rotating, it tends to continue rotating in the same direction. You notice that the feeling increases with a larger wheel spinning at a faster rate. What could we call this, as a physical quantity? Is it a vector?

/2

Station 4 – Meter stick lever

Equipment: A wooden meter stick, loops made with string, masses, a mass scale

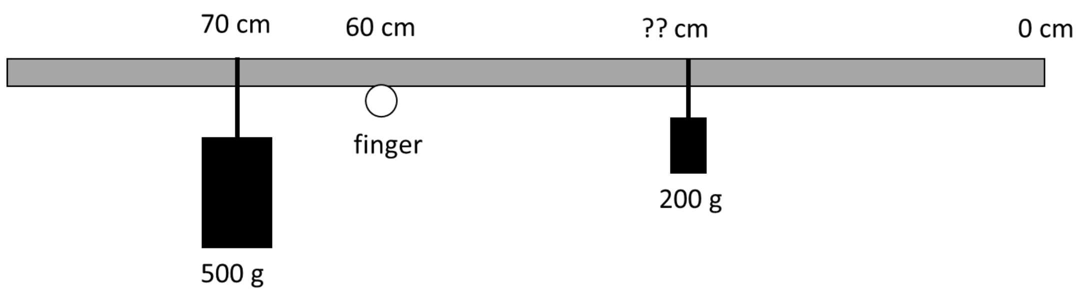
1. Put your finger under the 50cm mark on the meter stick - the meter stick should be balanced. Hang a 500g mass at the 60cm mark: where do you have to hang the 200g mass to have the meter stick balanced again?



2. How far is each of the masses from your finger? Do you notice any relationship between the masses and the distance they are from your finger?

/4

3. This time, put your finger under the 60cm mark on the meter stick. Hang the 500g mass at the 70cm mark" where do you have to hang the 200g mass to have the meter stick balanced?



/2

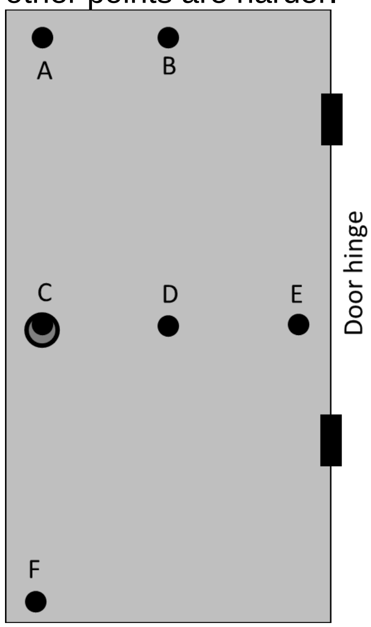
4. How can you use the above information to calculate the mass of the meter stick? What do you calculate the mass of the meter stick to be? Verify the mass by measuring the mass using the mass scale.

/4

Station 5 – Door on a hinge

Equipment: A wooden meter stick with padding on the end, a door

1. Since the door is spring-loaded to close, use the meter stick to push on the door at each of the points as drawn below to try to hold it still.
2. At which point(s) is the easiest hold the door? Provide an explanation why each of the other points are harder.



/4

3. At the easiest point, try to push with different angles by orienting the meter stick. Which direction do you have to push to get the door to stop most easily?

/3

Station 6 – Angular and linear velocity

Equipment: A wooden lazy susan rotating plate with two points marked on it, a stopwatch, ruler

1. Make the wheel spin at a steady speed. Do all the points complete the same number of rotations in a set time period (angular velocity)?

/1

2. When the disk spins steadily, do all the points move in the same direction?

/1

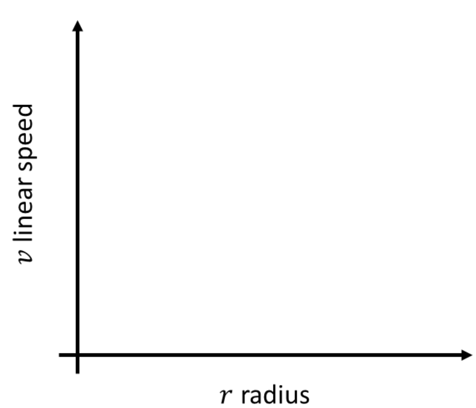
3. When the disk spins steadily, do all the points move at the same speed? Same velocity?

/1

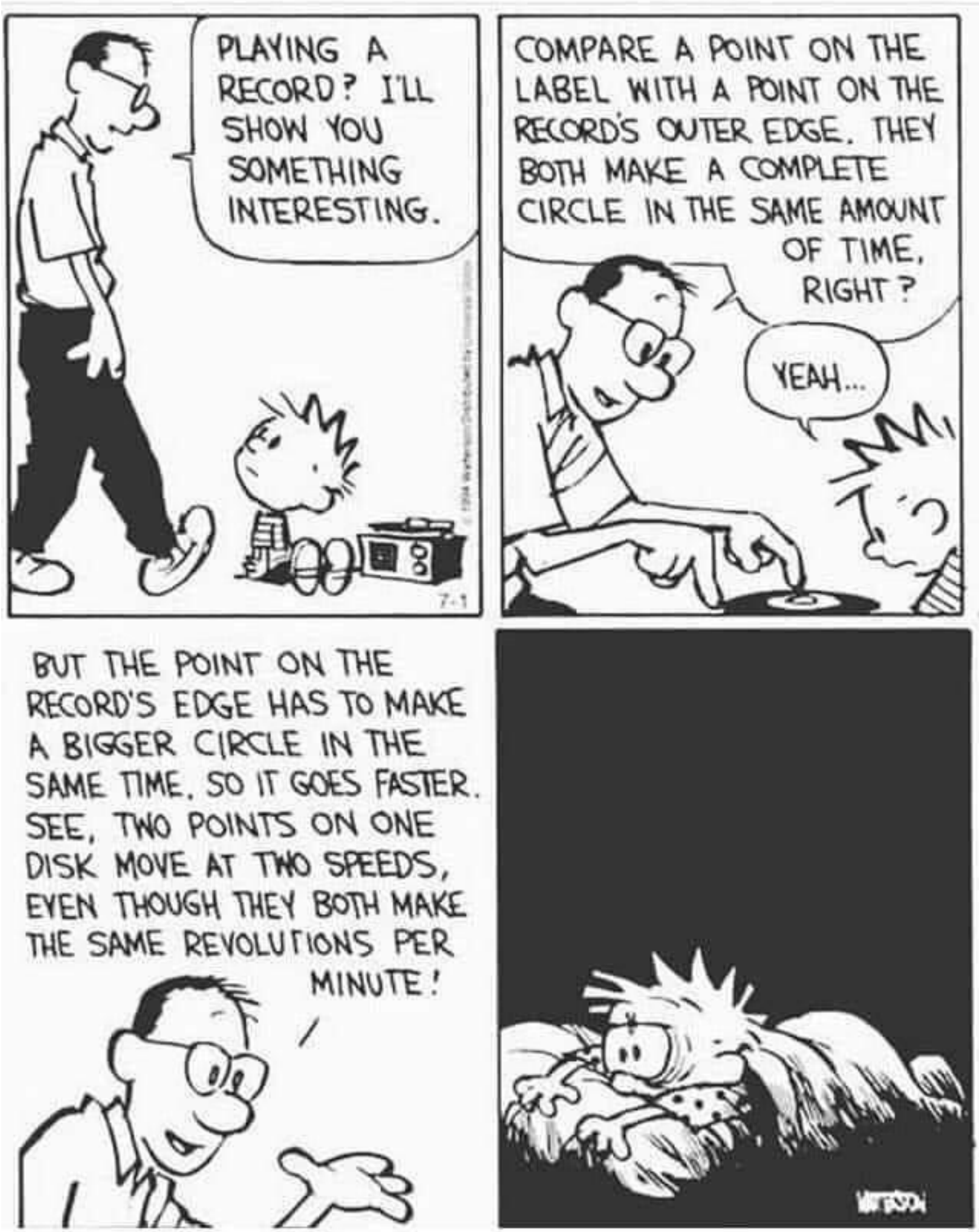
4. Find your own method of estimating the speed of point A and of point B. Describe your method. What are the drawbacks of your method?

/4

5. Imagine if you were to graph between the linear speed and the radius of different points on the rotating plate. Sketch what you think the graph will look like below:



/3


PLAYING A RECORD? I'LL SHOW YOU SOMETHING INTERESTING.
COMPARE A POINT ON THE LABEL WITH A POINT ON THE RECORD'S OUTER EDGE. THEY BOTH MAKE A COMPLETE CIRCLE IN THE SAME AMOUNT OF TIME, RIGHT?
YEAH...
BUT THE POINT ON THE RECORD'S EDGE HAS TO MAKE A BIGGER CIRCLE IN THE SAME TIME, SO IT GOES FASTER. SEE, TWO POINTS ON ONE DISK MOVE AT TWO SPEEDS, EVEN THOUGH THEY BOTH MAKE THE SAME REVOLUTIONS PER MINUTE!
WATERSON