Guiding Questions Activity 2

What is motion? How can we measure motion?

Purpose: To define speed as a function of distance and time

Materials: 30 cm ruler
book about 1.5cm thick
1 marble
stopwatch

Formula used: $$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Note: Please remind students to include the proper units. For example if the data given is measured in kilometers and time in hours, then the speed must be reported as kilometers per hour (km/hr).

Procedure:

1. **On a level floor place a 30 cm metric ruler at an incline of about 1.5 cm using a book at one end of the ruler to raise it.**
2. **Roll a marble down the incline. Do not push the marble, simply hold and then release it. Be certain to start at the top of the incline each time.**
3. **Begin timing the movement of the marble immediately upon hitting the floor. Record the distance the marble rolls from the bottom of the incline across the floor in two seconds. Repeat this procedure two more times. Each time be certain to record the distance in the data table (see below).**
4. **Repeat the procedure, but this time allow the marble to travel for three seconds. Again repeat this two more**

times each time recording the distance traveled in the distance table.

Questions:

1. **What is the average distance the marble rolls in two seconds? What is its average speed?**
2. **What is the average distance the marble rolls in the third second? What is its average speed during that second?**
3. **How does the speed during the third second compare with the speed during the first two seconds?**
4. **What must be true about the marble's speed during the third second?**

DATA TABLE

Time(sec)	Distance (cm)		
	Trial 1	Trial 2	Trial 3
2			
3			

Purpose: To define velocity as a function of speed and direction

Velocity: Velocity is speed in a given direction. Suppose a runner travels westward at 7 meters /second. Her speed is given as 7 m/sec. Her velocity is 7 m/sec west.

If we assume that the marble in trial 1, 2, and 3 is traveling in a southerly direction, give the velocity of the marble after 2 seconds. After 3 seconds. Remember to use the average speed for all 3 trials to calculate velocity.____

Thought problem: SuitSat 2 will be nudged out of the International Space Station. Describe the effect that will have on SuitSat 2's velocity and the distance she will be traveling from the ISS.____

____

____

Purpose: To define acceleration

Acceleration: Acceleration is the rate of change in velocity.

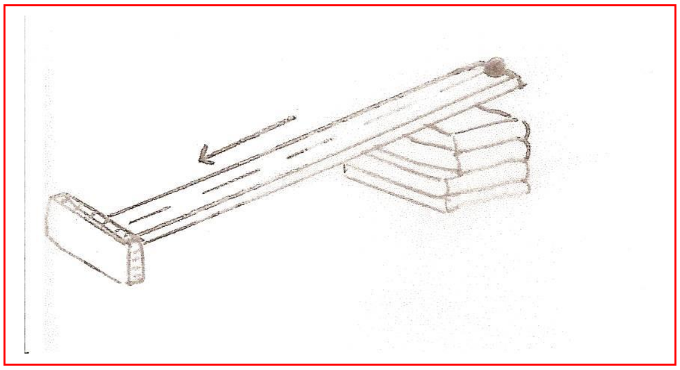
Materials: 30 cm ruler
Book(s)
15/16" steel bearing
stopwatch
grooved ramp about 100 cm long
masking tape
target block

Procedure:

1. **Set up ramp by placing grooved ramp on level floor. Place books under one end of the ramp to raise it off of the floor 15 to 20 cm.**
2. **Place the target block at the bottom of the incline. Place the steel bearing at the top of the ramp. Use a ruler to hold it in position. Raise the ruler allowing the steel bearing to proceed down the ramp. Begin timing immediately.**
3. **Stop the watch the instant the ball strikes the target block. Record the time**
4. **Repeat steps 2 and 3 at least two more times.**

Measuring "t" "t" = time on incline
Trial 1 _____________sec.

Trial 2 ____________sec.
Trial 3 ____________sec.
Average=__________sec.



Measuring final velocity

5. **Place the target block 100 cm from the bottom of the incline.**
6. **Hold the ball motionless at the top of the incline.**
7. **Release the ball and start the watch simultaneously.**
8. **Stop the watch the instant the ball strikes the target.**
9. **Record the time. The total time measured equals the time on the incline plus the time required for the ball to travel 100 cm along the floor.**
10. **Repeat the procedure at least two more times.**

Time to travel 100 cm along the floor =total time - time on incline

Once the ball leaves the incline its velocity does not increase. We assume that during the first 100 cm of travel along the floor the velocity of the ball is constant and equal to the final velocity.

v = d/t, so final velocity = 100 cm / time to travel 100 cm

Measuring final velocity data:

Time measured = Time on incline +Time to travel 100 cm along the floor

Trial 1 _______sec
Trial 2 _______sec
Trial 3 _______sec
____
Average=_____sec.

The average time to travel 100 cm along the floor = total time measured – time on incline

Final velocity = d/t = 100 cm/sec = _____sec - ______sec = ______seconds
(t=time to travel 100 cm along the floor)

Conclusion:
a (acceleration) = final velocity – original velocity / time on incline

Since the original velocity is zero:
a = final velocity /t =____cm/sec x sec

Questions:

1. **If the height of the incline was increased the ACCELERATION of the ball would (increase) (decrease) (not change).**
2. **What was the acceleration of the bearing?**