Name:

Physics 11
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Kinematics Video Analysis

Block:

Objective
Use video analysis to construct d-t and v-t graphs and determine the acceleration of an object

Website: https://goo.gl/okcwxV (requires VSB Office 365 sign-in)

Assigned video:
- Ball Rolling Down a Ramp 1
- Ball Rolling Down a Ramp 2
- Ball Rolling Down a Ramp 3
- Endeavor Launch
- Curiosity Launch

1. Download the video to your computer. Do not open the video in your internet browser.

2. Open the assigned video on your computer. The playback tool must have a frame-by-frame option which allows you to move through the frames one-by-one (e.g. QuickTime Player, VLC). *You may have to look up the button to advance frame-by-frame for your video player.*

3. Move to the frame in which the object begins moving. This will be your starting time, $t = 0$ s. *Some videos may already indicate this frame, others may not. Since the object will not be moving much initially, it may help to use other indicators such as the movement of the hand or fingers to determine this starting time.*

Example: Using the known frames per second of a video to determine time

Suppose you have a video recorded at 240 fps with a total of 684 frames.

The total length of the video can be calculated using the 684 frames:

$$672 \text{ frames} \times \frac{1 \text{ s}}{240 \text{ frames}} = 2.85 \text{ s}$$

Using 0.2 seconds as the length of each time interval would allow for 14 data points. Once again, the corresponding number of frames can be calculated using the known fps:

$$0.2 \text{ s} \times \frac{240 \text{ frames}}{1 \text{ s}} = 48 \text{ frames}$$

The following would be the corresponding frames for the first three time intervals (assuming you are starting from frame-0):
- *0 s to 0.2 s: frame-0 to frame-48*
- *0.2 s to 0.4 s: frame-48 to frame-96*
- *0.4 s to 0.6 s: frame-96 to frame-144*

Note that it is not necessary to use up all available frames if your chosen time interval does not allow for it. In this example, there would be 12 unused frames at the end (frame-673 to frame-684).

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4. Copy and complete Table 1 with the following information:
   - **Time interval**: an interval of time for which the displacement and average velocity will be measured. Adjust the length of the time intervals so you have at least ten data points.
   - **Position**: the position at the end of the time interval
     Displacement during interval: the difference between the initial and final positions for the time interval
   - **Velocity during interval**: the displacement during the time interval divided by the length of the time interval

Table 1: Displacement and Velocity Data for _____ (note that the time intervals chosen will depend on your assigned video.)

Time Interval (s)	**Position *x* (m)**	**Displacement during interval *d* (m)**	**Velocity during interval *v* (m/s)**
0 - 0.10			
0.10 - 0.20			
0.20 - 0.30			
…			

5. Draw a graph of position vs. time.

6. Draw a graph of velocity vs. time. Include a line of best fit.
   - Note: Use the mid-point of each time interval to plot velocity values. (e.g. the velocity for 0.10 s - 0.20 s should be plotted at 0.15 s)

7. Use the line of best fit on the velocity vs. time graph to determine the acceleration of the object.