TEACHER INFORMATION

Graph Matching

1. Editable Microsoft Word versions of the student pages and pre-configured TI-Nspire files can be found on the CD that accompanies this book. See *Appendix A* for more information.

2. Motion Detectors without a range switch do not properly detect objects closer than 0.5 m. The maximum range is about 6 m, but stray objects in the wide detection cone can be problematic at this position.

3. This experiment may be the first time your students use the Motion Detector. A little coaching on its use now will save time later in the year as the Motion Detector is used in many experiments. Here are some hints for effective use of the Motion Detector.

   - When using the Motion Detector, it is important to realize that the ultrasound is emitted in a cone about 30º wide. Anything within the cone of ultrasound can cause a reflection and possibly an accidental measurement. A common problem in using Motion Detectors is getting unintentional reflections from a desk, chair, or computer in the room.
   - If you begin with a velocity or acceleration graph and obtain a confusing display, switch back to the position graph to see if it makes sense. If not, the Motion Detector may not be properly detecting the target.
   - Tilting the Motion Detector slightly can minimize unintended reflections.

4. If you are using a computer, you may have to place the motion detector on a table and walk towards and away from the motion detector. Here are some tips for collecting data when an object is moving in front of a stationary motion detector.

   - You may want to have your students hold a large book out in front of them as they walk in front of the Motion Detector. This will tend to produce better graphs because it smoothes out the motion.
   - Sometimes a target may not supply a strong reflection of the ultrasound. For example, if the target is a person wearing a bulky sweater, the resulting graph may be inconsistent.
   - If the velocity and acceleration graphs are noisy, try to increase the strength of the ultrasonic reflection from the target by increasing the target's area.

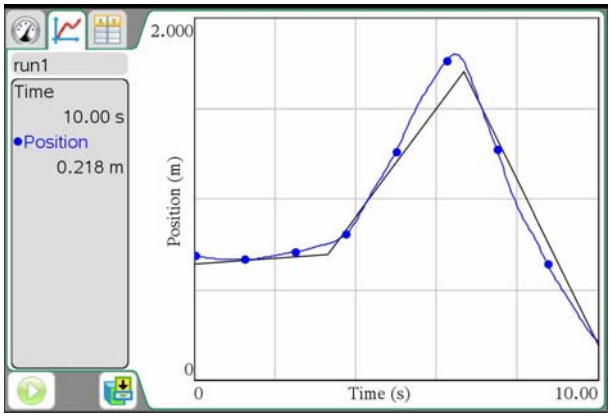
5. It is very helpful to use masking tape and place 1 meter marks on the floor. The student instructions ask students to place the tape on the floor. If this is not practical in your classroom, lay meter sticks on the floor to show distances from the motion detector.

6. Students at first may find it difficult to match a position *vs.* time graph. Be sure to encourage them to repeat data collection until they get acceptable results. This may take some practice and will be easiest if the person who is walking can see the screen.

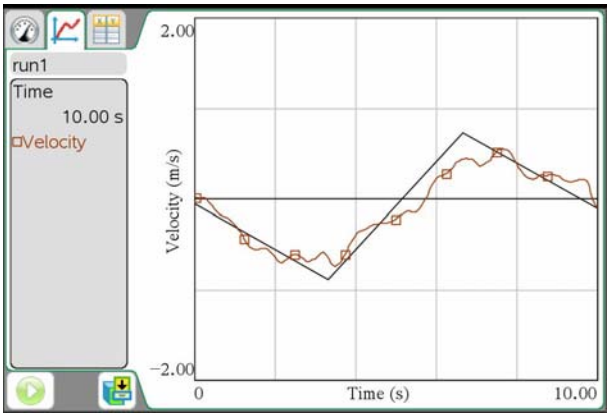
7. Students will find that matching the velocity graphs will be more difficult than the position graphs. The biggest problem will be to generate a smooth graph since the trunk of the body undergoes accelerations during each step. The best results occur with small, shuffling steps.

8. This activity can be split over two days if desired. On the first day, have students do Parts I and II. On the second say, have them do parts III and IV.

SAMPLE RESULTS



Typical position match.



Typical velocity match.

ANSWERS TO QUESTIONS

Part II Position *vs*. Time Graph Matching

1. Answers will vary.

2. A positive slope on a position *vs.* time graph corresponds to moving *away* from the Motion Detector and positive velocity. A negative slope corresponds to motion toward the detector and negative velocity.

3. A zero slope for a position *vs.* time graph corresponds to zero velocity.

4. A constant slope for a position *vs.* time graph corresponds to a constant velocity.

5. A changing slope in a position *vs.* time graph corresponds to a changing velocity; that is, either speeding up or slowing down.

Part IV Velocity *vs*. Time Graph Matching

7. Answers will vary.

8. A zero slope on a velocity *vs.* time graph represents zero acceleration.

9. A non-zero slope on a velocity *vs.* time graph represents a non-zero acceleration; that is, speeding up or slowing down.