Assessment Argument for Kinematics and Dynamics

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1 Conventions

Evidence models should be given a unique identifier (possibly pre-pend initials). Evidence statements are uniquely numbers within the evidence model. The evidence model should be tied to the knowledge model when possible. Individual pieces of evidence may call on other parts of the knowledge model.

2 Style

This section will become a style file.

3 Kinematics

3.1 1D Kinematics

3.1.1 Position, Distance, and Displacement

(ID: JCS3) Distance 1D

Performance Expectation: *The student should be able to determine the distance between two points and to compare distances between sets of points.*

Claim: Student understands distance in one dimension.

Knowledge Model: distance 1D

Evidence: (JCS3-1): Given two points on a coordinate axis, the student should be able to determine the distance between the points. **Distractors:** Student should return positive value regardless of orientation of points.

Evidence: (JCS3-2): Given two pairs of points on a coordinate axis, the student should be to compare the size of the distances between the points. **Distractors:** Student should treat all distances as positive regardless of orientation of points.

(ID: JCS4) Total Distance Traveled 1D

Performance Expectation: *The student should be able to determine the total distance traveled given a one-dimensional trajectory.*

Claim: Student understands total distance traveled in one dimension.

Knowledge Model: total distance traveled 1D

Evidence: (JCS4-1): Given a one-dimensional trajectory, the student can determine the total distance traveled. **Distractors:** Student should return positive value regardless of orientation of points and whether the trajectory overlaps.

Evidence: (JCS4-2): Given one or more one-dimensional trajectories, the student can compare the total distance traveled. **Distractors:** Student should return positive value regardless of orientation of points and whether the trajectory overlaps.

(ID: JCS5) Compare Distance and Total Distance Traveled 1D

Performance Expectation: *The student should be able to differentiate the total distance traveled and the distance between two points given a one-dimensional trajectory.*

Claim: Student understands the distinction between total distance traveled and distance in one dimension.

Knowledge Model: total distance traveled 1D, distance 1D

Evidence: (JCS5-1): Given a one-dimensional trajectory and two points on the trajectory, the student can compare the total distance traveled between the points to the distance between the points.

(ID: JCS1) Displacement 1D

Performance Expectation: *Students should be able to identify when an object is displaced in one dimension, and determine the sign and the magnitude of the displacement.*

Claim: Student understands displacement in one dimension.

Knowledge Model: displacement 1D

Evidence: (JCS1-1): Given two numeric positions on the x axis, the student can compute the signed displacement.

Evidence: (JCS1-2): Given two numeric positions on the x axis, the student can deduce the sign of the displacement.

Evidence: (JCS1-3): Given two positions labeled on a line with numeric labels, the student can compute the signed displacement.

Evidence: (JCS1-4): Given two positions labeled on a line with numeric labels, the student can deduce the sign of the displacement. **Distractors:** The deduced sign of the displacement is not sensitive to where the points lie on the axis (positive or negative).

Inferred Evidence: A student can provide evidence by showing proficiency with average velocity in one dimension

(ID: JCS6) Compare Distance and Displacement 1D

Performance Expectation: *The student should be able to differentiate the distance traveled and displacement between two points in one dimension.*

Claim: Student understands the distinction between distance and displacement in one dimension.

Knowledge Model: distance 1D, displacement 1D

Evidence: (JCS6-1): Given two points on the x axis, the student can compare the distance between the points and the displacement.

3.1.2 Velocity

(ID: JCS2) Average Velocity 1D

Performance Expectation: *The student should be able to convert a description of the change in location of an object in one dimension over some time interval into a correctly signed average velocity.*

Claim: Student understands average velocity in one dimension.

Knowledge Model: average velocity 1D

Evidence: (JCS2-1): Given the positions of two points on the x axis and the time separating the two points, the student can calculate the average velocity

Evidence: (JCS2-2): Given a motion diagram with equally space points in time, the student can compare the average velocity between pairs of points. **Distractors:** This should correctly compare the signed average velocity regardless of the direction of motion.

Evidence: (JCS2-3): Given a position vs. time diagram, the student can compare the average velocity between pairs of points. **Distractors:** This should correctly compare the signed average velocity regardless of the direction of motion.

Evidence: (JCS2-4): Given a position vs. time diagram with a constant slope, the student can calculate the average velocity.

Evidence: (JCS2-5): Given the average velocity of an object and the position of the object, the student can describe the change in position of the object with time.

(ID: JCS7) Instantaneous Velocity 1D

Performance Expectation: *The student should be able to convert a description of the change in location of an object in one dimensional a function of time into a correctly signed instantaneous velocity.*

Claim: Student understands instantaneous velocity in one dimension.

Knowledge Model: instantaneous velocity 1D

Evidence: (JCS7-1): Given a position vs. time diagram, the student can compare the instantaneous velocity at different points in time.

Evidence: (JCS7-2): Given a position vs. time diagram, the student can identify the points where instantaneous velocity is zero.

Evidence: (JCS7-3): Given a position vs. time diagram with a constant slope, the student can calculate the instantaneous velocity.

Evidence: (JCS7-6): Given the velocity of an object as a function of time, the student can compare the distance traveled by the objects.

Evidence: (JCS7-7): Given the velocity vs. time graph of an object, the student can describe how the velocity is changing.

(ID: JCS8) Compare Instantaneous Velocity 1D and Average Velocity

Performance Expectation: *The student should be able to convert a description of the change in location of an object in one dimension as a function of time into a correctly signed instantaneous velocity.*

Claim: Student understands the difference between instantaneous velocity and average velocity in one dimension.

Knowledge Model: instantaneous velocity 1D

Evidence: (JCS8-1): Given a position vs. time diagram, the student can compare the instantaneous velocity at a point to the average velocity between two points.

(ID: JCS9) Speed

Performance Expectation: *The student can convert velocity to speed.*

Claim: The student understands speed in one dimension.

Knowledge Model: speed 1D

Evidence: (JCS9-1): Given the instantaneous velocity of an object, the student can compute the speed.

(ID: JCS10) Average Speed

Performance Expectation: *The student can convert the description of the motion of an object to an average speed. The student can differentiate average speed and average velocity.*

Claim: The student understands average speed in one dimension.

Knowledge Model: Average speed 1D

Evidence: (JCS10-1): Given a description of the motion of an object, the student can compute the average speed.

Evidence: (JCS10-2): Given a description of the motion of an object, the student can compare average speed and average velocity.

3.1.3 Constant Velocity Kinematics

(ID: JCS11) Constant Velocity Kinematics

Performance Expectation: *Given an initial location and a constant velocity, the student can describe the motion of the object.*

Claim: The student understands constant velocity motion in one dimension.

Knowledge Model: constant velocity kinematic equation 1D

Evidence: (JCS11-1): Given the position and the constant velocity of an object, the student can describe the motion.

Evidence: (JCS11-2): Given a position vs. time graph with multiple constant velocity segments, the student can describe the motion.

3.1.4 Acceleration

(ID: JCS12) Acceleration 1D

Performance Expectation: *Given a description of the change in velocity of an object, a student can recognize the object is accelerating and compare acceleration at different points.*

Claim: The student understands acceleration in one dimension.

Knowledge Model: Acceleration 1D

Evidence: (JCS12-1): Given the velocity vs. time graph of an object, the student can compare the acceleration at different points.

Evidence: (JCS12-2): Given the velocity vs. time graph of an object, the student can determine how the acceleration is changing.

Evidence: (JCS12-3): Given the position vs. time graph of an object, the student can determine how the acceleration is changing.

Evidence: (JCS12-4): Given the acceleration vs. time graph of an object, the student describe the object's motion given the initial velocity.

(ID: JCS13) Average Acceleration 1D

Performance Expectation: *Given a description of the velocity of an object at two points, a student can recognize to object is accelerating; given multiple points, the student can compare acceleration between different pairs of points.*

Claim: The student understands acceleration in one dimension.

Knowledge Model: Acceleration 1D

Evidence: (JCS13-1): Given the velocity vs. time graph of an object, the student can compare the average acceleration at different points.

Evidence: (JCS13-2): Given a description of the change in velocity of an object between two points, the student can determine if the object is accelerating and the sign of the average acceleration.

3.1.5 Relation of Kinematic Concepts

(ID: JCS14) Distinguish 1D Kinematic Concepts

Performance Expectation: *The student can correctly identify the relation of different kinematic concepts given a description of the motion of an object.*

Claim: The student understands the differences of kinematic concepts in one dimension.

Knowledge Model: position, displacement, velocity, and acceleration 1D

Evidence: (JCS14-1): Given a linear velocity vs. time graph of an object, the student can compare the velocity and acceleration.

3.1.6 1D Constant Acceleration Kinematics

(ID: JCS15) Constant Acceleration Velocity

Performance Expectation: *Given an object moving under constant acceleration, the student can describe the qualitative motion of the object.*

Claim: The student understands velocity under constant acceleration.

Evidence: (JCS15-1): Given a constant acceleration and an initial velocity, the student can describe the subsequent motion of the object.

3.2 2D Kinematics

3.3 3d Kinematics

This topic is generally not explicitly covered in introductory physics texts. One presumes (without evidence) that a knowledge of 2D kinematics provides evidence of a knowledge of 3D kinematics.