Topic	Kinematics: Velocity
Element Teaching guide: Lesson 1 Skills:	• Understand that a particle's motion in spacetime can be described by position, distance, displacement, (average) speed, (average) velocity, and acceleration. • Interpret and calculate using distance/displacement–time graphs. • Apply the equations for speed and velocity; solve linear equations.
Time	1 hour

1.

- In reference to the video **Introduction to kinematics**, check in with the class about:
  - Concepts of position; coordinate system; time interval; rate of change in general and of position in particular; speed; velocity; and acceleration.
  - Concepts of vector and scalar.
  - Everyday use of the phrases 'speed up', 'slow down', 'shortest distance', 'stationary', etc.
- Ask students to note down the questions from the **Skills check** that they found challenging and/or got incorrect.

2.

- Ask the students to read through the lesson material on Vector and scalar quantities, Vectors in one dimension, and Displacement and distance.
- Confirm through their answers to **Check your understanding** questions 1 to 5 that students understand the key concepts and skills:
  - Vector quantities have size and direction.
  - Direction in one dimension is captured by +/− signs.
  - The application of Pythagoras's theorem.

3.

- Ask the students to read through the lesson material on Velocity and speed
- Confirm through their answers to the **Check your understanding** questions 6 to 9 that students understand the key concepts and skills:
  - The use of displacement in calculating velocity, the use of distance in calculating speed.
  - Using linear equations to solve for velocity/speed, displacement/distance, and time given any two of these quantities.
  - The ability to convert between kilometres per hour and metres per second.

4.

- Ask the students to read through the lesson material on Distance–time graphs.
- Confirm through their answers to **Check your understanding** questions 10 to 13 that students understand the key concepts and skills:
  - How to compare gradients and how to calculate them.
  - How to graph linear data and analyse its features.
- Finish the lesson by doing a think–pair–share exercise on how one could determine whether a body is experiencing a change in velocity (accelerating).

Topic	Kinematics: Acceleration
Element Teaching guide: Lesson 2 Skills:	• Understand that a particle's motion in spacetime can be described by position, distance, displacement, (average) speed, (average) velocity, and acceleration. • Interpret and calculate data from velocity–time graphs. • Apply the speed/velocity/time equations; solve linear equations.
Time	1 hour

1.

- In reference to the **Introduction to kinematics video**, check in with the class about:
  - Everyday use of the words 'acceleration' and 'deceleration'. Point out the correct usage, including the opposing signs for velocity and deceleration.
  - Enquire informally whether students know what it is that all accelerating systems share (the answer being forces), as a precursor to the next lesson.
- Ask the students to read through the lesson material on Acceleration.
- Confirm through their answers to **Check your understanding** questions 1 and 2 that students understand the key concepts and skills:
  - Acceleration is a vector quantity.
  - Applying the change in velocity equation correctly, for example $10\ \text{m s}^{-1} - (-5\ \text{m s}^{-1}) = 15\ \text{m s}^{-1}$.

2.

- Ask the students to read through the lesson material on Velocity–time graphs.
- Confirm through their answers to the **Check your understanding** questions 3 to 7 that students understand the key concepts and skills:
  - Why uniform acceleration produces linear velocity–time graphs.

3.

- Ask the students to read through the lesson material on Area under a velocity–time graph.
- Confirm through their answers to **Check your understanding** questions 8 and 9 that students understand the key concepts and skills:
  - The use of basic geometry to calculate the area of rectangles and triangles.
  - Using a calculator to find the square and square root of values.

Topic	Kinematics: Measuring constant velocity
Element Teaching guide: Lesson 3 Skills:	• Calculating the arithmetic mean. • Graphing linear, or linearised, date, including gradient, area, and intercepts. • Graphing and using error bars.
Time	1 hour

1.

- Do a think–pair–share exercise with students about:
  - How to graph data.
  - How to include error bars on data values.
  - How to draw a best fit line.
  - **Extension**: how to draw a max/min line.

2.

- In small groups, ask students to read through the material on Measuring constant velocity and Laboratory example: Constant velocity.
- Confirm, through class/small group discussion, that students understand the key concepts and skills:
  - How to graph data.
  - How to include error bars on data values.
  - How to draw a best fit line.
  - **Extension**: how to draw a max/min line.

3.

- In pairs, ask students to read through and complete the instructions in the material entitled Investigation: Measuring the acceleration due to gravity.
- Follow up either with a discussion of their findings in class or in pairs with the provided solutions.