I. A 2-kg ball undergoes acceleration. During the 5 seconds that it is accelerated, the ball’s velocity changes from 5 m/s east to 7 m/s west.

![Diagram showing initial velocity of 5 m/s east and final velocity of 7 m/s west after 5 seconds.]

- Find both the size and direction of the average acceleration of the ball.

- Find both the size and direction of the displacement of the ball during the 5 seconds that it was accelerated.

- Write an equation that describes \( x(t) \) and \( v(t) \), including all of the numeric values that you can determine.

\[
x(t) = \ldots
\]

\[
v(t) = \ldots
\]
II. You’re at an amusement park with your physics class, and your instructor asks you to take data as you go on a water ride. You and your team determine that between t=0 s and t=8 s your cart moves 80 m at a steady speed. Between t=8 s and t=12 s your cart goes down a very steep hill, and your team measures your acceleration to be 5 m/s². At the bottom of the hill your cart continues moving at a steady speed until t=16 s.

   a) Graph the velocity of your cart as a function of time from t=0 seconds to t = 16 seconds. Indicate on the graph what kind of motion ("constant v", "constant a" or "other") where appropriate. Assume the positive direction is the direction your cart moved.

   ![Velocity Graph]

   b) How far did your cart travel altogether between t=0 and t=16 s?

   c) At the time t=16s, the cart experiences a braking force that causes it to slow down at a rate of 3 m/s². How much time will it take for the cart to come to a stop? Clearly explain your reasoning using words and symbols.
3. A car is moving in the negative sense along the x-axis and it is slowing down steadily. Assuming the positive sense is to the right, which of the following sets of vectors could correctly describe the quantities \( \vec{v}, \Delta \vec{v} \) and \( \vec{a} \) for the car during its motion?

   a) \( \vec{v} \rightarrow \Delta \vec{v} \rightarrow \vec{a} \)
   b) \( \vec{v} \rightarrow \Delta \vec{v} \rightarrow \vec{a} \)
   c) \( \vec{v} \rightarrow \Delta \vec{v} \rightarrow \vec{a} \)
   d) \( \vec{v} \rightarrow \Delta \vec{v} \rightarrow \vec{a} \)
   e) \( \vec{v} \rightarrow \Delta \vec{v} \rightarrow \vec{a} \)

4. As you drive along the highway at 22 m/s (50 mph) you suddenly see a deer coming into your path. Your reaction time is 0.25 seconds so it takes you that long to hit the brakes after seeing the deer. Once you hit the brakes you slow down at a rate of 14 m/s\(^2\). How far do you travel after seeing the deer before your car stops?

   a) 28 m
   b) 23 m
   c) 17 m
   d) 5.5 m
   e) 5.9 m

5. Determine the components of the vector \( \vec{L} \) such that \( 0 = \vec{L} + \vec{E} + \vec{F} + \vec{G} + \vec{H} \).

   \[
   \begin{array}{cc}
   \vec{L}_x & \vec{L}_y \\
   \hline
   a) & +2 \quad -2 \\
   b) & +3 \quad -5 \\
   c) & -2 \quad +2 \\
   d) & -3 \quad +5 \\
   e) & +2 \quad +5 
   \end{array}
   \]
6. Your friend Zelda holds two identical rocks while you are standing at the edge of a cliff with a group of friends, and she says, “If I throw one of these rocks up and the other down and both leave my hand with the same speed, they will hit the ground at the same time because in the relation \( \Delta y = v_0 t + \frac{1}{2}at^2 \), \( \Delta y \), \( v_0 \) and \( a \) all have the same values.” The following discussion takes place:

**Yaqub:** Not only will they take the same amount of time, but they will also have the same velocity just before hitting the ground.

**Xavier:** The rocks will land at different times because the upward thrown rock has a greater displacement.

**Wendy:** The downward rock will land first because it speeds up the whole time while the upward rock slows down and then speeds up. Both rocks will have same velocity just before hitting the ground, though.

**Virginia:** The upward rock will land before the downward rock because it will be moving faster as it approaches the ground since it is essentially falling from a higher point.

Who do you agree with?

a) Yaqub
b) Xavier
c) Wendy
d) Virginia
e) I don’t agree with any of them.

7. An object’s position is described by \( x(t) = (-8 - 4t + 3t^2) \text{ meters} \). Which of the following statements is TRUE?

a) The object starts from the origin.
b) The object slows down for all values of \( t \).
c) It stops instantaneously at \( t = 8.0 \text{ s} \).
d) It stops instantaneously at \( t = 0.67 \text{ s} \).
e) The object never stops because it is already moving at the time \( t = 0 \text{ s} \).

8. Anya is on ice skates being pulled by two friends. The force with which each friend pulls (in pulling units) is described by the vectors below:

\[
\mathbf{F}_1 = +60 \text{ PU} \mathbf{i} \quad \mathbf{F}_2 = -20 \text{ PU} \mathbf{i} + 30 \text{ PU} \mathbf{j}
\]

What is the direction of the total force acting on Anya? Let the \( \mathbf{i} \)-direction represent the positive x-axis, and the \( \mathbf{j} \)-direction represent the positive y-axis.

a) \(+ 53^\circ\) from the positive x-axis
b) \(+ 70^\circ\) along the positive x-axis
c) \(+ 37^\circ\) from the positive x-axis
d) \(- 34^\circ\) from the positive x-axis
e) \(+ 156^\circ\) from the positive x-axis