1. An object begins from rest and accelerates at a rate of 2.5 meters per second$^2$ for 6.0 seconds.
   a. Calculate the distance that the object will travel.
   \[ d = \frac{1}{2}at^2 \]
   \[ d = (0 \text{ m/s})(6.0 \text{ s}) + \frac{1}{2}(2.5 \text{ m/s}^2)(6.0 \text{ s})^2 \]
   \[ d = 45 \text{ m} \]
   b. Determine the final speed of the object.
   \[ V_f = V_i + at \]
   \[ V_f = 0 \text{ m/s} + (2.5 \text{ m/s}^2)(6.0 \text{ s}) \]
   \[ V_f = 15 \text{ m/s} \]

2. A block starts from rest and begins sliding down an incline. The block reaches a speed of 12 meters per second as it slides a distance of 50 meters.
   a. Calculate the block's rate of acceleration.
   \[ V_f^2 = V_i^2 + 2ad \]
   \[ (12 \text{ m/s})^2 = (0 \text{ m/s})^2 + 2(a)(50 \text{ m}) \]
   \[ a = 1.44 \text{ m/s}^2 \]
   b. Calculate the time for which the block slides.
   \[ V_f = V_i + at \]
   \[ 12 \text{ m/s} = 0 \text{ m/s} + (1.44 \text{ m/s}) t \]
   \[ t = 8.3 \text{ s} \]

3. A jogger moving at +2.4 meters per second accelerates at a rate of +1.6 meters per second$^2$ while traveling +5.0 meters.
   a. Calculate the jogger's speed at the end of these 5.0 meters.
   \[ V_f^2 = V_i^2 + 2ad \]
   \[ V_f^2 = (2.4 \text{ m/s})^2 + 2(1.6 \text{ m/s}^2)(5.0 \text{ m}) \]
   \[ V_f = 4.7 \text{ m/s} \]
   b. Calculate the time that it takes the jogger to travel these 5.0 meters.
   \[ V_f = V_i + at \]
   \[ 4.7 \text{ m/s} = 2.4 \text{ m/s} + (1.6 \text{ m/s}^2) t \]
   \[ t = 1.4 \text{ s} \]

4. A skater increases her speed uniformly from 2.0 meters per second to 7.0 meters per second over a distance of 12 meters. The magnitude of her acceleration as she travels this 12 meters is
   (1) 1.9 m/s$^2$  (2) 2.2 m/s$^2$  (3) 2.4 m/s$^2$  (4) 3.8 m/s$^2$

   Proof: Show calculation.
   \[ V_f^2 = V_i^2 + 2ad \]
5. A boat initially traveling at 5.0 meters per second accelerates uniformly at the rate of 2.5 meters per second$^2$ for 8.2 seconds. How far does the boat travel during this time?

(1) 25 m  
(2) 125 m  
(3) 175 m  
(4) 250 m

Proof: Show calculation.

\[ d = V_i t + \frac{1}{2} a t^2 \]

6. A truck rolls 3.0 kilometers while changing its speed from 5.0 meters per second to 18.0 meters per second. At what rate did the truck accelerate?

(1) $5.8 \times 10^2$ m/s$^2$  
(2) $5.0 \times 10^2$ m/s$^2$  
(3) $5.8 \times 10^2$ m/s$^2$  
(4) $5.0 \times 10^2$ m/s$^2$

Proof: Show calculation.

\[ V_f^2 = V_i^2 + 2ad \]

\[ d = 3000 \text{ m!} \]

7. A ball starting from rest accelerates uniformly at 4.0 meters per second$^2$ as it rolls 60 meters down an incline. How much time is required for the ball to roll the 60 meters?

(1) 3.8 s  
(2) 5.4 s  
(3) 7.6 s  
(4) 10.8 s

Proof: Show calculation.

\[ d = V_i t + \frac{1}{2} a t^2 \]

\[ d = \frac{1}{2} a t^2 \]

8. An object begins from rest and accelerates at rate $A$ while traveling a distance $D$. Which of the following equations correctly expresses the object’s time of travel in terms of $A$ and $D$?

(1) $\sqrt{\frac{D}{A}}$  
(2) $\sqrt{\frac{2D}{A}}$  
(3) $\sqrt{\frac{A}{D}}$  
(4) $\sqrt{\frac{D}{2A}}$

Proof: Demonstrate solution.

\[ d = V_i t + \frac{1}{2} a t^2 \]

\[ d = \frac{1}{2} a t^2 \]

\[ 2d = a t^2 \]

9. What is the acceleration of the car at $t = 5.0$ seconds?

(1) 0.0 m/s$^2$  
(2) 2.0 m/s$^2$  
(3) 2.5 m/s$^2$  
(4) 10. m/s$^2$

Proof: Show calculation or explain.

Zero Slope!
1. A person drops a stone from the top of a 45 meter high building.
   a. Determine the time that it will take for the stone to reach the ground.

   \[ d = v_i t + \frac{1}{2} a t^2 \]

   \[ -45 \text{ m} = 0 \text{ m/s} \cdot t + \frac{1}{2} (-9.8 \text{ m/s}^2) t^2 \]

   \[ t = 3.0 \text{ s} \]

   b. Determine the final speed of the stone as it hits the ground (not after it hits the ground).

   \[ v_f^2 = v_i^2 + 2ad \]

   \[ v_f^2 = (0 \text{ m/s})^2 + 2(-9.8 \text{ m/s}^2)(-45 \text{ m}) \]

   \[ v_f = -89.7 \text{ m/s} \rightarrow -30 \text{ m/s} \]

2. A man throws a rock directly upward with an initial speed of 15 meters per second.
   a. Determine the time that it takes for the rock to reach its maximum height.

   \[ v_f = v_i + at \]

   \[ -15 \text{ m/s} = 0 \text{ m/s} + (-9.8 \text{ m/s}^2) t \]

   \[ t = 1.5 \text{ s} \]

   b. Determine the maximum height that the rock will reach.

   \[ d = vt + \frac{1}{2} at^2 \]

   \[ d = \frac{1}{2} at^2 \]

   \[ d = \frac{1}{2} (-9.8 \text{ m/s}^2)(1.5 \text{ s})^2 \]

   \[ d = -11.5 \text{ m} \rightarrow -11 \text{ m} \]

   (from peak)

3. An object that is dropped from a helicopter takes 15 seconds to reach the ground.
   a. Determine height from which the object was dropped.

   \[ d = vt + \frac{1}{2} at^2 \]

   \[ d = 0 \text{ m/s} \cdot 15 \text{ s} + \frac{1}{2} (-9.8 \text{ m/s}^2)(15 \text{ s})^2 \]

   \[ d = -110.25 \text{ m} \rightarrow -110 \text{ m} \]

   b. Determine the speed with which the object hits the ground.

   \[ v_f^2 = v_i^2 + 2ad \]

   \[ v_f^2 = (0 \text{ m/s})^2 + 2(-9.8 \text{ m/s}^2)(-110 \text{ m}) \]

   \[ v_f = -147 \text{ m/s} \rightarrow -150 \text{ m/s} \]

4. As an object falls freely near the surface of the Earth, its acceleration
   (1) decreases
   (2) increases
   (3) remains the same

   Proof: Explain.

   Acceleration due to gravity is always \(-9.8 \text{ m/s}^2\).
5. Which of the following sets of graphs describe an object in freefall near the surface of the Earth?

- Velocity/Speed increases
- Acceleration is constant

6. An object starts from rest and falls freely. What will the velocity of this object be after it has fallen for 0.050 minutes?

   (1) 9.8 m/s  
   (2) 20. m/s  
   (3) 29. m/s  
   (4) 88. m/s

   Proof: Show calculation.

\[
\frac{0.050 \text{ min}}{1 \text{ min}} \times 60 \text{ s} = 3.00 \text{ s}
\]

\[V_f = V_i + at\]

\[V_f = 0 \text{ m/s} + (-9.8 \text{ m/s}^2)(3.00 \text{ s})\]

\[V_f = 29.4 \text{ m/s}\]

7. Starting from rest, object A falls freely for 2.0 seconds while object B falls for 4.0 seconds. Compared with object A, object B falls

   (1) one half as far  
   (2) twice as far  
   (3) three times as far  
   (4) four times as far

   Proof: Show calculation for each object.

\[
d = \frac{1}{2} at^2
\]

\[
d = \frac{1}{2} (10 \text{ m/s}^2)(2.0 \text{ s})^2
\]

\[d = 20 \text{ m}
\]

8. A student throws a baseball vertically upward and then catches it. If vertically upward is considered to be the positive direction, which graph best represents the relationship between velocity and time for the baseball? [Neglect friction]

   A.  
   B.  
   C.  
   D. 

   Proof: Explain.

\[v = 0 \text{ m/s}\]

\[v_{\text{high}} \downarrow \quad v_{\text{high}} \uparrow\]
L.1.A. Explain the difference between distance and displacement.

- Which man travels the greater distance?
- Which man travels the greater displacement?
- Sketch a diagram of the their paths.
- Two men leave the same house at the same time. Bill walks 5 m/h to the east. Joe walks 3 m/h to the west.
- How far did each object travel?
- During what time intervals was the object traveling?
- How far did the object travel?
- What is the speed of the object?
- Which of the following are vectors? Which are scalars?
- Which vector has magnitude only?
The graph below shows an object's velocity as a function of time.

The graph below shows the speed of an object as a function of time.

1. To interpret graphs of speed vs. velocity vs. time, use the graphs to determine average speed, acceleration, displacement, or distance.
3.0 s

It takes 3.0 seconds to reach the ground.

5.1 m

The object is thrown with an initial velocity of 5.1 meters per second.

10 m

The object is dropped from a height of 10 meters.

11.5 m

The object is thrown directly upward with a speed of 11.5 meters per second.

12 m

The object will reach its maximum height of 12 meters.

12.5 m

The object will reach its maximum height of 12.5 meters.

29.43 m/s

The object will fall 29.43 meters after 2.9 seconds.

What is the final speed of an object that is dropped from the top of a 10 meter building?

9.2 m/s

The object has a final speed of 9.2 meters per second.

42.25 m

The object travels a distance of 42.25 meters.

20 m per second

The object starts from rest and accelerates at a rate of 20 m/s^2.

1.7 – Use equations to determine distance, displacement, speed, acceleration that act upon this object.

While moving at 5 m/s, the object travels a distance of 5.5 meters.

5 m/s

The object travels a distance of 5 m/s.

5 m/s

The object travels a distance of 5 m/s.

22 m/s

The object travels a distance of 22 meters.

2.5 m/s

The object travels a distance of 2.5 meters.

2.5 m/s

The object travels a distance of 2.5 meters.

2.5 m/s

The object travels a distance of 2.5 meters.

2.5 m/s

The object travels a distance of 2.5 meters.

2.5 m/s

The object travels a distance of 2.5 meters.
Vectors

Use a protractor and a ruler to construct a resultant for the following pair of vectors.

1.2.04 - Add vectors graphically.

Which graph best represents:

Acceleration vs. time for an object that is increasing its speed at a constant rate.

Acceleration vs. time for an object that is moving toward the left point of origin.

Acceleration vs. time for an object that is moving at a constant speed.

Displacement vs. time for an object with a constantly increasing speed.

Displacement vs. time for an object with a decreasing speed.

Displacement vs. time for an object moving with a constant speed.

Speed vs. time for a decelerating object.

Speed vs. time for an accelerating object.

Speed vs. time for an unchanging object.

Which sets of graphs could describe the motion of the same objects?
16) **SAMPLE ANSWER:** A scalar quantity has magnitude only. A vector quantity has both magnitude and direction. OR A scalar quantity has no direction.

17) **SAMPLE ANSWER:** In order to obtain the measurements necessary for this experiment, the physics students would need to set up the traffic cones to mark the distance from the incline to a point after the incline. Next they would need to use the tape measures to determine the distance from the first traffic cone at the incline to the last traffic cone after the incline. The students would then use their stopwatches to record the time for the student on skates to coast from the incline to the last traffic cone. The distance and time measurements are adequate data to determine the students acceleration.

18) **SAMPLE ANSWER:** \(d = v_f t + \frac{1}{2}at^2\) OR \(a = \frac{2d}{t^2}\)

19) **50. m**

WORK SHOWN: \(d = v_f t + \frac{1}{2}at^2\), \(d = 0 + \frac{1}{2}(1.0 \text{ m/s}^2)(10. \text{ s})^2 = 50. \text{ m}\) OR \(d = \text{area} = \frac{1}{2}bh\), \(d = \frac{1}{2}(10. \text{ s})(10. \text{ m/s}) = 50. \text{ m}\)

**Diagram:**

**Speed vs. Time**
- **Time (s)**: 0, 1.0, 2.0, 3.0, 4.0, 5.0
- **Speed (m/s)**: 0, 1.0, 2.0, 3.0, 4.0, 5.0

(d) **1.2 m/s²**