1. A powerful motorcycle can accelerate from rest to 23.8 m/s (53 mi/h) in only 1.90 s. (For each answer, enter a number.)

(a)

What is its average acceleration in m/s2?  
  m/s2

(b)

How far (in m) does it travel in that time?  
  m

2.(a)

Calculate the height (in m) of a cliff if it takes 2.19 s for a rock to hit the ground when it is thrown straight up from the cliff with an initial velocity of 8.06 m/s. (Enter a number.)  
  m

(b)

How long (in s) would it take to reach the ground if it is thrown straight down with the same speed? (Enter a number.)  
1.82  s

3. A graph of v(t) is shown for a world-class track sprinter in a 100-m race. (See figure below. For each answer, enter a number.)

Chart, line chart

Description automatically generated

A graph of Runner Velocity vs. Time has a horizontal axis labeled Time (s) and a vertical axis labeled Velocity (m/s). Straight lines connect adjacent points, which have approximate values as follows.

* (0, 0),
* (2, 6),
* (4, 12),
* (6, 12),
* (8, 12),
* and (10, 12).

#### (a)

What is his average velocity (in m/s) for the first 4 s?  
  m/s

#### (b)

What is his instantaneous velocity (in m/s) at t = 6 s?  
  m/s

#### (c)

What is his average acceleration (in m/s2) between 0 and 4 s?  
  m/s2

#### (d)

What is his time (in s) for the race?  
  s

4. Suppose you walk 18.0 m straight west and then 25.0 m straight north. (If you represent the two legs of the walk as vector displacements **A** and **B**, as in the figure below, then this problem asks you to find their sum **R** = **A** + **B**.)Chart, line chart

Description automatically generated

Three vectors labeled **A**, **B** and **R** are on an *x* *y* coordinate plane. Vector **A** begins from the origin and extends to the left along the negative *x*-axis. The tail of vector **B** begins at the head of vector **A** and extends straight up in the positive *y*-direction. The tail of vector **R** is located at the origin and the head of vector **R** is located at the same position as the head of vector **B**. Next to the coordinate system, the equation **A** + **B** = **R** and a coordinate system depicting North, East, South, and West with an arrow facing upward toward the north are also shown.

How far, in meters, are you from your starting point? (Enter a number.)  
  m

What is the compass direction of a line connecting your starting point to your final position measured in degrees west of north? (Enter a number.)  
55  °

5. A ball is kicked with an initial velocity of 22 m/s in the horizontal direction and 13 m/s in the vertical direction. (Assume the ball is kicked from the ground. For each answer, enter a number.)

#### (a)

At what speed (in m/s) does the ball hit the ground?  
  m/s

#### (b)

For how long (in s) does the ball remain in the air?  
  s

#### (c)

What maximum height (in m) is attained by the ball?  
  m

6. Near the end of a marathon race, the first two runners are separated by a distance of 45.0 m. The front runner has a velocity of 3.50 m/s, and the second a velocity of 4.20 m/s.

#### (a)

What is the velocity of the second runner relative to the first? (Enter a number. Enter your answer in m/s faster than the front runner.)  
  m/s faster than the front runner

#### (b)

If the front runner is 250 m from the finish line, who will win the race, assuming they run at constant velocity?

The second runner will win.The first runner will win.

#### (c)

What distance (in m) ahead will the winner be when she crosses the finish line? (Enter a number.)  
  m