

Please note: only full solutions = "GRASS" method and with labeled diagrams and assumptions clearly stated whenever appropriate will earn a full mark.

1. A steam engine train is moving along a straight track at its maximum velocity of 110 km/h [North]. Suddenly it starts experiencing constant acceleration. What is the train's acceleration if the engine comes to a complete stop after 8 minutes?

2. A boat moves with velocity of 25 km/h [East] while experiencing constant acceleration of 18 km/h^2 [East].

a) How fast does the boat move when it passes a lighthouse that is 36 km east from the starting point?

b) What is its velocity when by the lighthouse?

c) What assumptions did you make while solving this problem?

d) How many minutes does it take for the boat to reach the lighthouse?



3. A speed skater Kristina Groves won a bronze medal at the 3000m race at the Vancouver Olympics.

a) What was her average speed if she lost only 2.31 seconds on the winner whose finish time was 4 minutes 2.53 seconds?

b) What was the winner's speed?

4. Convert the following:

35 m/s (km/h)

120 m/min (km/h)

350 km/h (m/s)

10 m/s^2 (km/h^2)



5. Consider an object being thrown straight upwards from a 20-m height with a velocity of 60 m/s. Include a diagram.

- How much time does the object take to reach its maximum height?
- What is the object's maximum height, measured from the ground?
- How much time does the object take to fall from the maximum height to the point it was thrown from?
- Assuming that there is nothing in the object's way, how much time will it take to reach the ground from its maximum height?
- What is the object's final velocity just before it hits the ground?
- How much time will the object spend in the air?
- What assumptions do you make?

6. A baseball is thrown with a velocity of 27.0m/s [35° above horizontal].

Include a diagram.

- What are the components of the ball's initial velocity?
- How high (maximum height) and how far (range) will the ball travel?



7. A projectile is fired with an initial speed of 120m/s at an angle of 55° above horizontal from the top of a cliff 50.0 m high. Sketch a diagram of the projectile's path as well as a separate diagram of the initial velocity vector. Find

- the time taken to reach maximum height
- the maximum height with respect to the ground next to the cliff
- the total time in the air
- the range
- the components of the final velocity just before the projectile hits the ground.

Recall: A component of a vector is a vector and such it needs not only units but also **direction**.

Bonus:

A football is thrown to a moving receiver. The football leaves the quarterback's hand 1.75m above the ground with a velocity of 17.0 m/s [25° above horizontal]. If the receiver starts 25.0 m away from the quarterback along the line of flight of the ball when it is thrown, what constant velocity must she have to get the ball at the same instant it is 1.75 m above ground? A complete solution must include your assumptions and a labeled diagram.

