Projectiles – Tutorial

You can ignore the effect of air resistance in all these questions.
You can assume that the ground is level and horizontal.

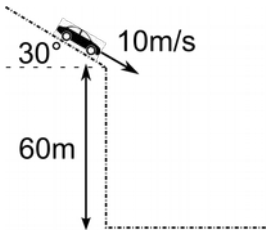
1. A footballer kicks a ball at 25m/s (with no spin) from the ground at 60° to the horizontal. Calculate:
   (a) the time that the ball in the air, *(4.4 s)*
   (b) the distance away from the footballer that the ball lands. *(55 m)*

2. A cannon fires a cannonball at 45° to the horizontal. It hits the ground 500m away. Calculate the velocity with which the cannonball left the cannon. *(70 m/s)*

3. An arrow is shot from the top of a building 42 m high. The arrow is shot at 25 m/s at an angle of 30° above the horizontal. Calculate:
   (a) the time for the arrow to reach its maximum height, *(1.27 s)*
   (b) the maximum height above the ground that the arrow reaches, *(50 m)*
   (c) the time for the arrow to fall from maximum height to the ground again, *(3.2 s)*
   (d) the horizontal distance from the building that the arrow lands. *(97m)*

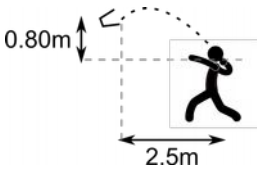
4. A football is kicked at 37° above the horizontal at 20m/s from the player's hand, which is 1.0 m above the ground.
   Calculate the horizontal distance travelled by the football before hitting the ground.
   (hint use the method of the previous question) (40.5m)

5. A car rolls of a cliff, 60m above the sea, at an angle of 30° below the horizontal at a speed of 10 m/s. Calculate:



   (a) the time taken for the car to hit the sea, *(3.02 s)*
   (hint: you will need to solve a quadratic equation)
   (b) the distance from the cliff that the car hits the sea. *(26 m)*

. At a fairground challenge, a stone is thrown at an angle of 40° above the horizontal into a bucket 2.5 m away and 0.80 m above the hand of the thrower.



Calculate the speed with which the stone must be thrown to go into the bucket.
(hint: write equations for the horizontal and vertical motions and solve them to eliminate t) (6.3 m/s)