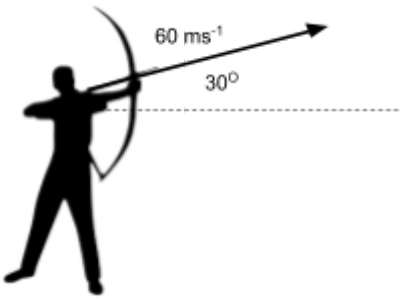
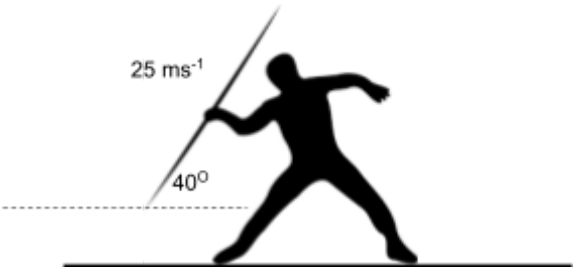
Our Dynamic Universe

Projectiles at an angle

1) An archer fires an arrow with a velocity of 60 ms^{-1} at an angle of 30^{O}
    a) Calculate the initial vertical and horizontal components of the arrow`s velocity.
    b) Determine the time it takes for the arrow to reach its maximum height.

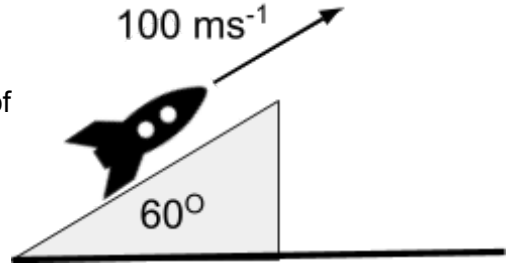


2) A javelin is thrown with a velocity of 25 ms^{-1} at an angle of 40^{O}.
    a) Calculate the initial vertical and horizontal components of the javelin`s velocity.
    b) Determine the time it takes to land.
    c) Find the horizontal distance the javelin travelled.



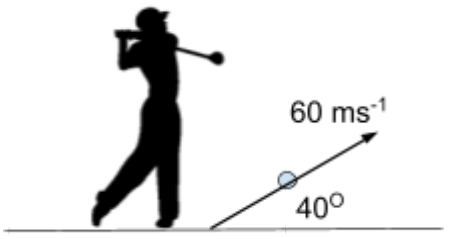
3) An experimental rocket is launched at an angle of 60^{O} with a velocity of 100 ms^{-1}

    a) Calculate the vertical & horizontal components of the rocket's velocity.
    b) Determine the maximum height the rocket reached.
    c) Calculate the time the rocket was in flight.
    d) Find the range of the rocket.

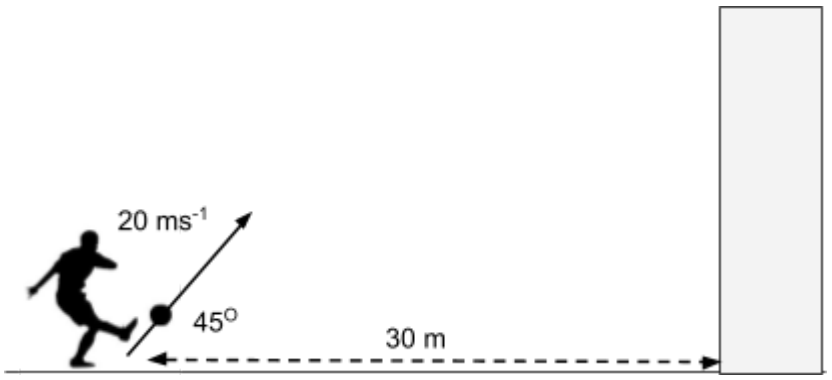


4) A golfer strikes a golf ball which moves off with a velocity of 60 ms^{-1} at an angle of 40^{O}.

    a) Determine the time of flight of the golf ball.
    b) Find the range of the golf ball.

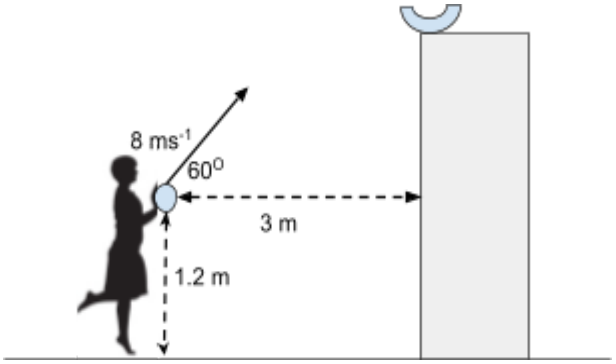


5) A footballer kicks a ball with a velocity of 20 ms^{-1} at an angle of 45^{O} from the ground. It strikes a wall 30 m away.



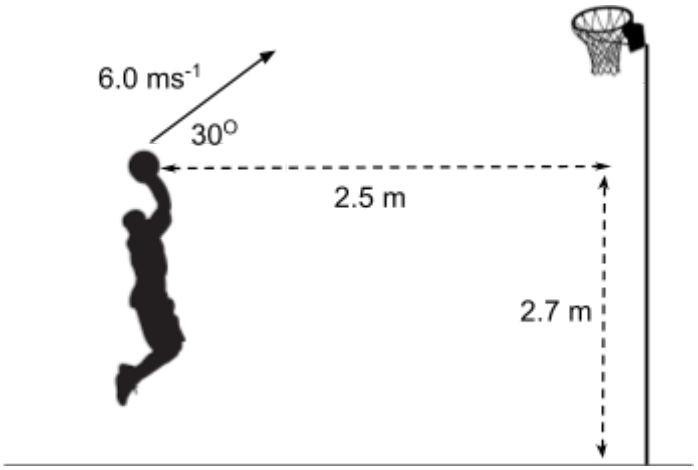
a) Calculate the horizontal and vertical component of the ball's velocity.
b) Find the time taken for the ball to strike the wall.
c) Calculate the height of the ball as it strikes the wall.

6) A girl lobs a ball towards a dish with a velocity of 8 ms^{-1} at an angle of 60^{O} to the horizontal. The dish is 3 m away on a shelf level with the girl's hand.
The ball lands in the dish.



a) Calculate the horizontal and vertical components of the ball's velocity.
b) Show that the ball takes 0.75 s to reach the dish.
c) The ball is released at a height of 1.20 m from the ground.
Determine the height of the dish above the ground.

7) A basketball player throws a basketball towards a basket with a velocity of 6.0 ms^{-1} at an angle of 30^{O} to the horizontal. The basketball player is 2.5 m away from the centre of the basket.



a) Calculate the horizontal and vertical components of the basketball`s velocity.

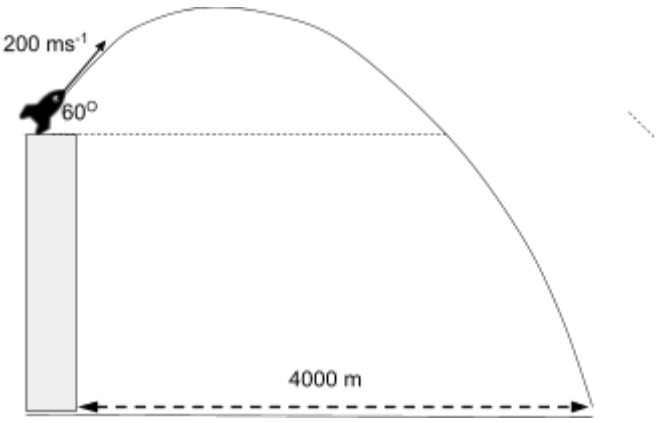
b) Show that the basketball reaches the basket in a time of 0.48 s

c) Determine the height the basketball is above the ground when it reaches the basket.

d) Show that the basketball`s vertical velocity is 1.7 ms^{-1} downwards when it reaches the basket.

e) Determine the speed of the ball as it reaches the basket.

8) An experimental rocket is launched from a tower at an angle of 60^{O} with a speed of 200 ms^{-1}. It lands 4000 m away from the foot of the tower.



a) Find the horizontal component of the rocket's velocity.
b) Calculate the time it took the rocket to land.
c) Find the height of the tower.
d) Determine the vertical velocity of the rocket just prior to landing.
e) Find the speed of the rocket just prior to landing.

Answers

1 a) vertical = 30 ms^{-1}, horizontal = 52 ms^{-1} b) 3.06 s

2 a) vertical = 16 ms^{-1}, horizontal = 19 ms^{-1} b) 2.6 s c) 56.4 m

3 a) vertical = 87 ms^{-1}, horizontal = 50 ms^{-1} b) 386 m c) 17.7 s d) 888 m

4 a) 8 s b) 368 m

5 a) vertical = 14 ms^{-1}, horizontal = 14 ms^{-1} b) 2.1 s c) 8 m

6 a) vertical = 6.9 ms^{-1}, horizontal = 4 ms^{-1} b) 0.75 s c) 3.6 m

7 a) vertical = 3 ms^{-1}, horizontal = 5.2 ms^{-1} b) 0.48s c) 3.0m e) 5.5 ms^{-1}

8 a) 100 ms^{-1} b) 40s c) 920 m d) 219 ms^{-1} e) 279 ms^{-1}