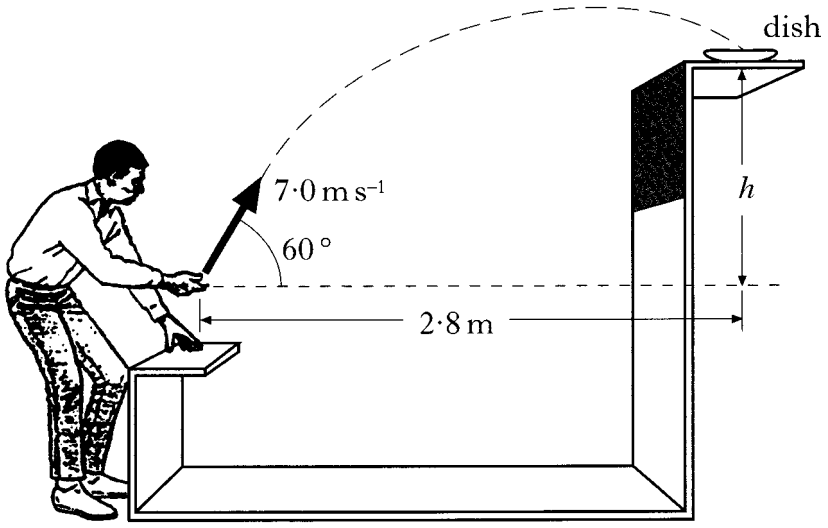
2000 Q21.

At a funfair, a prize is awarded if a coin is tossed into a small dish.
The dish is mounted on a shelf above the ground as shown.

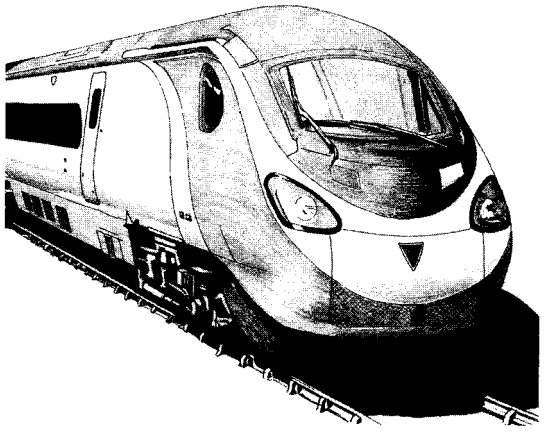


A contestant projects the coin with a speed of 7.0 ms^{-1} at an angle of 60° to the horizontal.
When the coin leaves his hand, the **horizontal distance** between the coin and the dish is 2.8 m.
The coin lands in the dish.
The effect of air friction on the coin may be neglected.

(a) Calculate:
  (i) the horizontal component of the initial velocity of the coin;
  (ii) the vertical component of the initial velocity of the coin.
(b) Show that the time taken for the coin to reach the dish is 0.8 s.
(c) What is the height, h, of the shelf above the point where the coin leaves the contestant's hand?
(d) How does the value of the kinetic energy of the coin when it enters the dish compare with the kinetic energy of the coin just as it leaves the contestant's hand?
  Justify your answer.

2004 Q22.

A train of mass 7.5×10^5 kg is travelling at 60 ms^{-1} along a straight horizontal track.



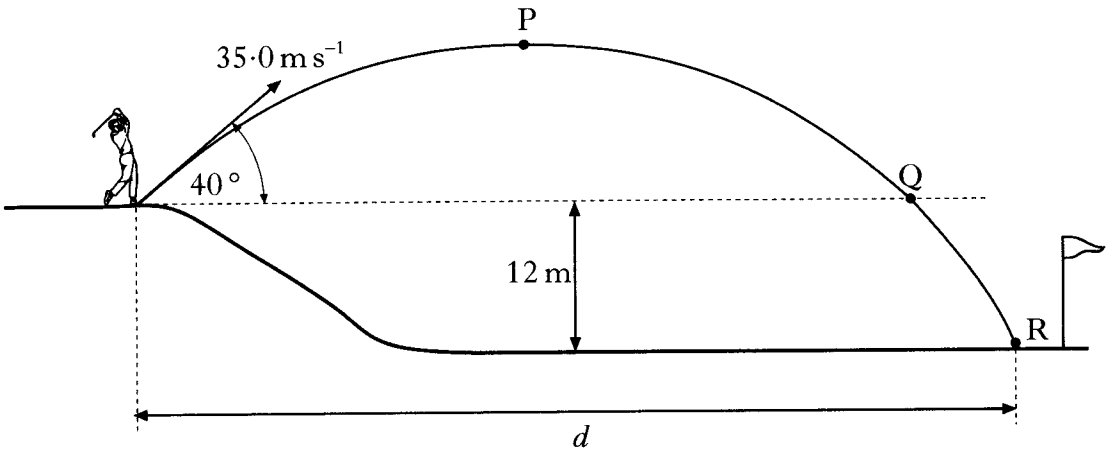
The brakes are applied and the train decelerates uniformly to rest in a time of 40 s.

(a) (i) Calculate the distance the train travels between the brakes being applied and the train coming to rest.
  (ii) Calculate the force required to bring the train to rest in this time.

2003 Q21.

A golfer on an elevated tee hits a golf ball with an initial velocity of 35.0 ms-1 at an angle of 40º to the horizontal. The ball travels through the air and hits the ground at point R. Point R is 12 m below the height of the tee, as shown.

diagram not to scale



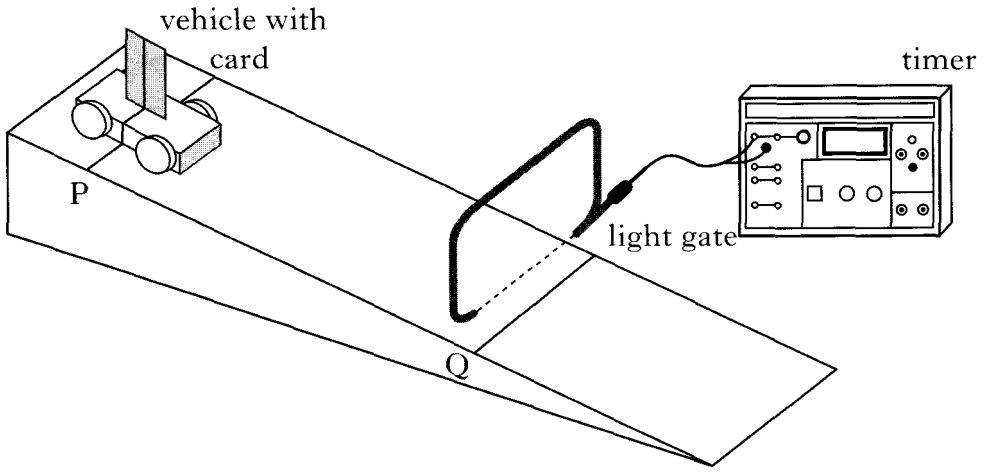
The effects of air resistance can be ignored.

(a) Calculate:
  (i) the horizontal component of the initial velocity of the ball;
  (ii) the vertical component of the initial velocity of the ball;
  (iii) the time taken for the ball to reach its maximum height at point P.

(b) From its maximum height at point P, the ball falls to point Q, which is at the same height as the tee. It then takes a further 0.48 s to travel from Q until it hits the ground at R.
Calculate the total horizontal distance d travelled by the ball.

2005 Q21.

(a) A student uses the apparatus shown to measure the average acceleration of a trolley travelling down a track.



The line on the trolley is aligned with line P on the track.
The trolley is released from rest and allowed to run down the track.
The timer measures the time for the card to pass through the light gate.
This procedure is repeated a number of times and the results shown below.

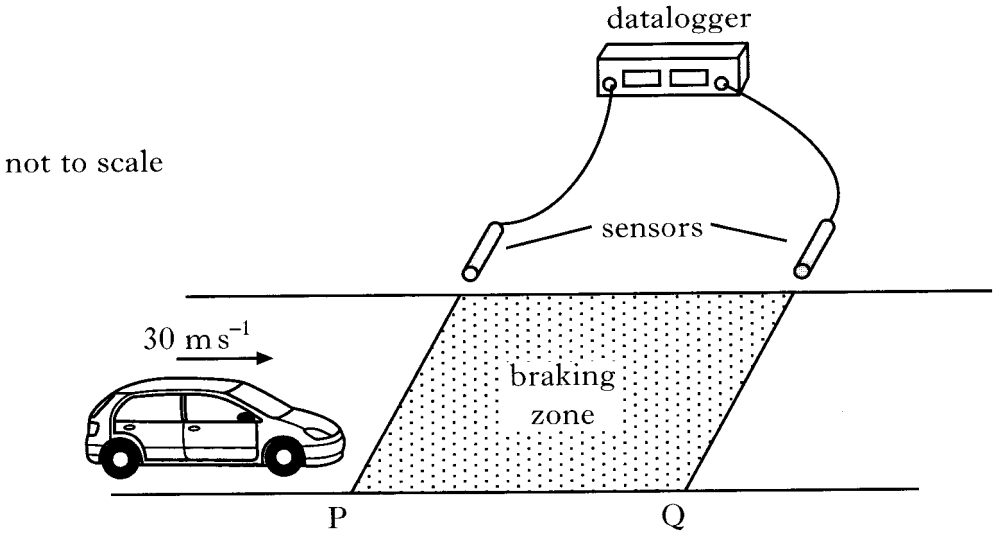
0.015 s 0.013 s 0.014 s 0.019 s 0.017 s 0.018 s

(i) Calculate:
  (A) the mean time for the card to pass through the light gate;
  (B) the approximate absolute random uncertainty in this value.

(ii) The length of the card is 0.020 m and the distance PQ is 0.60 m.
  Calculate the acceleration of the trolley (an uncertainty in this value is not required).

2008 Q21.

To test the braking system of cars, a test track is set up as shown.



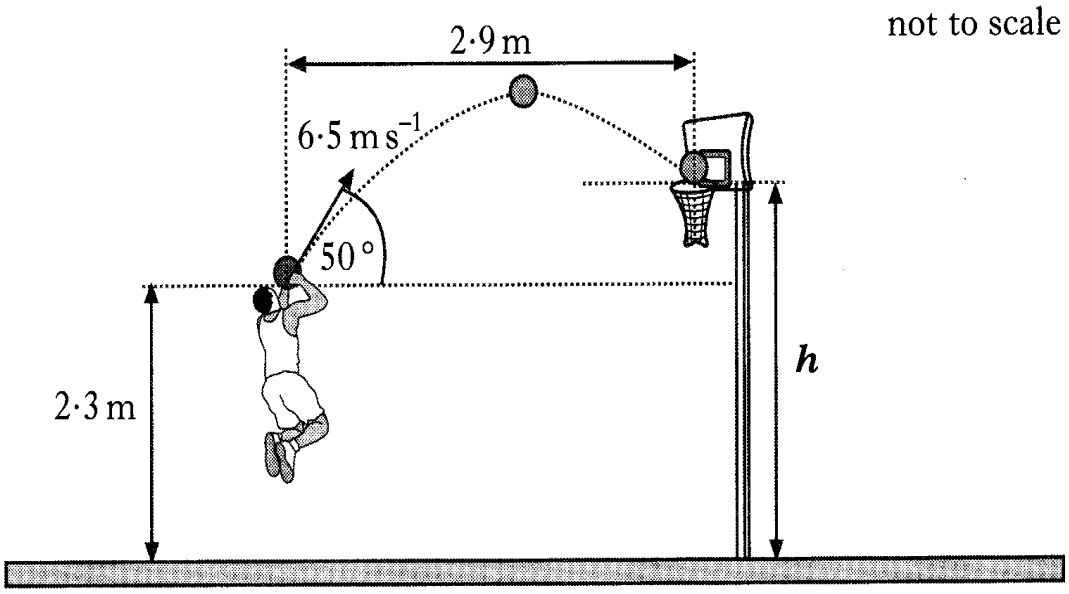
The sensors are connected to a datalogger which records the speed of a car at both P and Q.
A car is driven at a constant speed of 30 ms^{-1} until it reaches the start of the braking zone at P.
The brakes are then applied.

(a) In one test, the datalogger records the speed at P as 30 ms^{-1} and the speed at Q as 12 ms^{-1}.
The car slows down at a constant rate of 9.0 ms^{-2} between P and Q.
Calculate the length of the braking zone.

(b) The test is repeated. The same car is used but now with passengers in the car.
The speed at P is again recorded as 30 ms^{-1}.
The same braking force is applied to the car as in part (a).
How does the speed of the car at Q compare with its speed at Q in part (a)?
Justify your answer.

2009 Q21.

A basketball player throws a ball with an initial velocity of 6.5 ms^{-1} at an angle of 50º to the horizontal. The ball is 2.3 m above the ground when released.



The ball travels a horizontal distance of 2.9 m to reach the top of the basket.
The effects of air resistance can be ignored.

(a) Calculate:
  (i) the horizontal component of the initial velocity of the ball;
  (ii) the vertical component of the initial velocity of the ball.

(b) Show that the time taken for the ball to reach the basket is 0.69 s.

(c) Calculate the height **h** of the top of the basket.

(d) A student observing the player makes the following statement.
"The player should throw the ball with a higher speed at the same angle. The ball would then land in the basket as before but it would take a shorter time to travel the 2.9 metres."
Explain why the student's statement is incorrect.