Question 6 (7 marks)

A rock of mass 2.0 kg is thrown horizontally from the top of a vertical cliff 20 m high with an initial speed of 25 m s^{-1}, as shown in Figure 3.

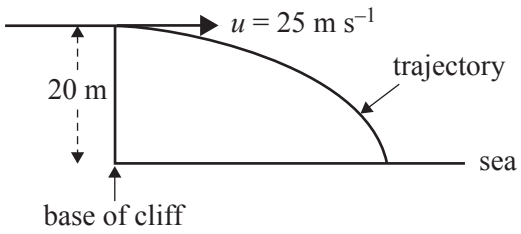


Figure 3

a. Calculate the time taken for the rock to reach the sea. Show your working. 3 marks

s

b. Calculate the horizontal distance from the base of the cliff to the point where the rock reaches the sea. Show your working. 2 marks

m

c. Calculate the kinetic energy of the rock as it reaches the surface of the sea. Show your working. 2 marks

J

Question 7 (6 marks)

A small ball of mass 0.20 kg rolls on a horizontal table at 3.0 m s^{-1}, as shown in Figure 9.

The ball hits the floor 0.40 s after rolling off the edge of the table. The radius of the ball may be ignored. In this question, take the value of g to be 10 m s^{-2}.

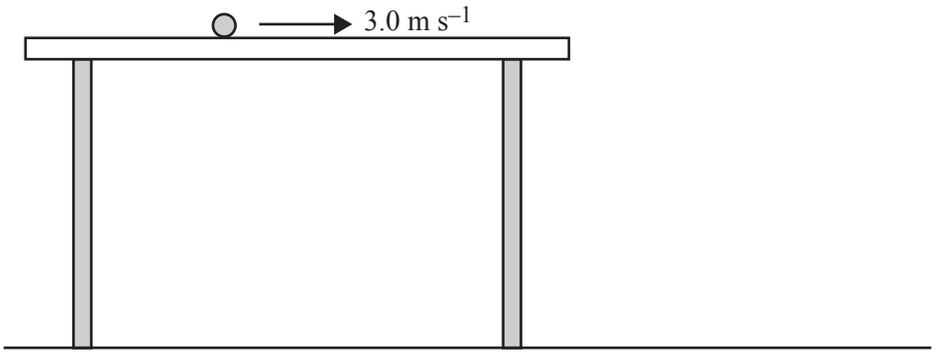


Figure 9

a. Calculate the horizontal distance from the right-hand edge of the table to the point where the ball hits the floor. 1 mark

m

b. Calculate the height of the table. Show your working. 2 marks

m

c. Calculate the speed at which the ball hits the floor. Show your working. 3 marks

m s^{-1}

Question 6 (6 marks)

A golfer hits a ball so that it leaves the ground at a speed of 40 m s^{-1} at an angle of 30° to the horizontal, as shown in Figure 7.

Take $g = 9.8$ m s^{-2}.

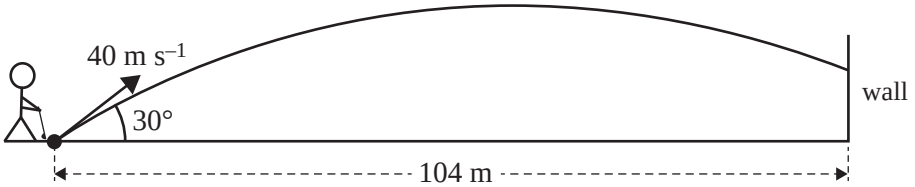


Figure 7

a. Calculate the maximum height that the ball rises above the ground. Show your working. 2 marks

m

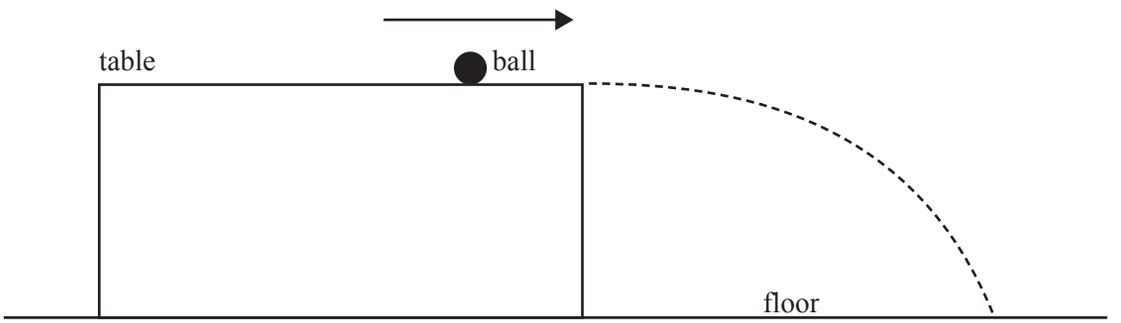
b. Instead of landing on the ground, the ball hits a wall that is 104 m away from the point at which the golfer hits the ball.

At what height up the wall does the ball hit the wall? Show your working. 4 marks

m

Question 12

A small ball is rolling at constant speed along a horizontal table. It rolls off the edge of the table and follows the parabolic path shown in the diagram below. Ignore air resistance.



Which one of the following statements about the motion of the ball as it falls is correct?

A. The ball's speed increases at a constant rate.

B. The momentum of the ball is conserved.

C. The acceleration of the ball is constant.

D. The ball travels at constant speed.

Question 10 (4 marks)

A projectile is launched from the ground at an angle of 39° and at a speed of 25 m s^{-1}, as shown in Figure 10. The maximum height that the projectile reaches above the ground is labelled *h*.

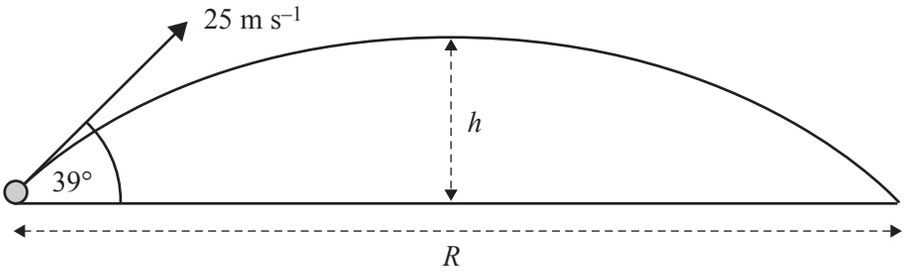


Figure 10

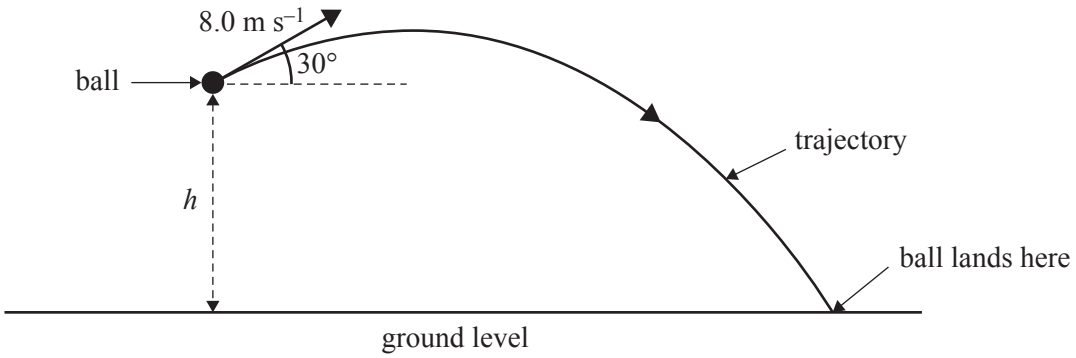
a. Ignoring air resistance, show that the projectile's time of flight from the launch to the highest point is equal to 1.6 s. Give your answer to two significant figures. Show your working and indicate your reasoning. 2 marks

b. Calculate the range, *R*, of the projectile. Show your working. 2 marks

m

Use the following information to answer Questions 10 and 11.

Melissa launches a ball from height h above the ground at a speed of 8.0 m s^{-1} and at an angle of 30° above the horizontal. The time of the ball's flight is 1.0 s. The diagram below shows the trajectory of the ball.



Question 10

Ignoring air resistance, which one of the following is closest to the horizontal distance that the ball landed from Melissa?

A. 4.6 m

B. 5.0 m

C. 6.9 m

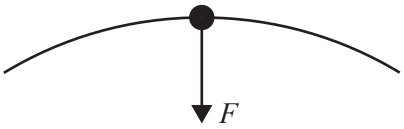
D. 8.0 m

Question 11

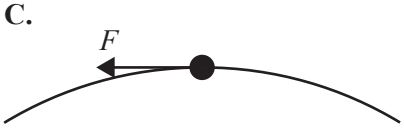
Which one of the following diagrams best shows the direction of the resultant force, F, on the ball at the position of maximum height in the real situation where air resistance is **not** ignored?

A.

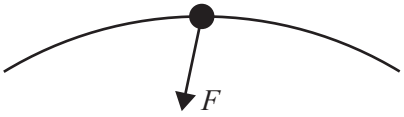
B.



C.



D.



Question 10 (6 marks)

A basketball player throws a ball with an initial velocity of 7.0 m s^{-1} at an angle of 50° to the horizontal, as shown in Figure 7. The ball is 2.2 m above the ground when it is released. By the time the ball passes through the ring at the top of the basket, it has travelled a horizontal distance of 3.2 m. Ignore air resistance.

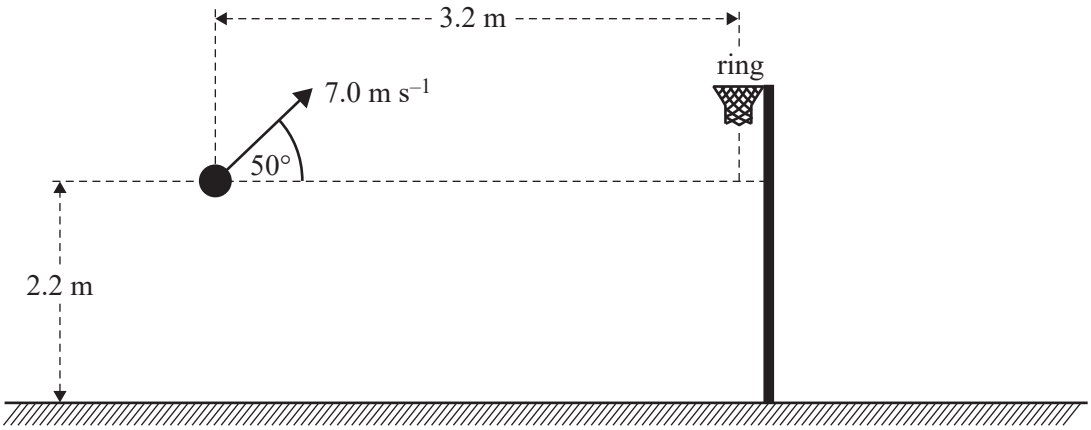


Figure 7

a. Show that the time taken for the ball's flight from launch to passing through the ring is 0.71 s. Show your working. 2 marks

b. How far above the ground is the ring at the top of the basket? Show your working. 4 marks

m

Question 12 (8 marks)

Two students investigate the physics of long jumps. They analyse a video of their friend Jemina as she runs along a track and then jumps. She lands in a sand pit that is level with the track.

Jemina's horizontal speed at the moment she jumps is 8.0 m s^{-1}. She is in the air for 0.6 s before landing in the sand pit. The students use g = 10 m s^{-2} for their calculations. The motion is modelled as that of a point mass, as shown in Figure 12.

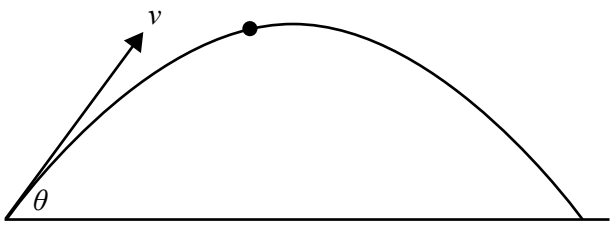


Figure 12

a. Calculate the horizontal distance that Jemina would be expected to travel if her motion were modelled as a projectile with point mass as shown in Figure 12. Show your working. 2 marks

m

b. Calculate Jemina's vertical speed as she takes off from the track. Show your working. 2 marks

m s^{-1}

c. Calculate Jemina's velocity as she launches. Include both the magnitude and the angle from the horizontal of her velocity at take-off. 3 marks

m s^{-1}	°

d. The students use a tape measure to check the horizontal distance that Jemina actually jumps, and find that it is less than the distance they calculated in **part a.**

Suggest **one** possible reason for this. 1 mark

9c. The ball leaves Giorgos's racquet with an initial speed of 24 m s^{-1} in a horizontal direction, as shown in Figure 12. A tennis net is located 12 m in front of Giorgos and has a height of 0.90 m.

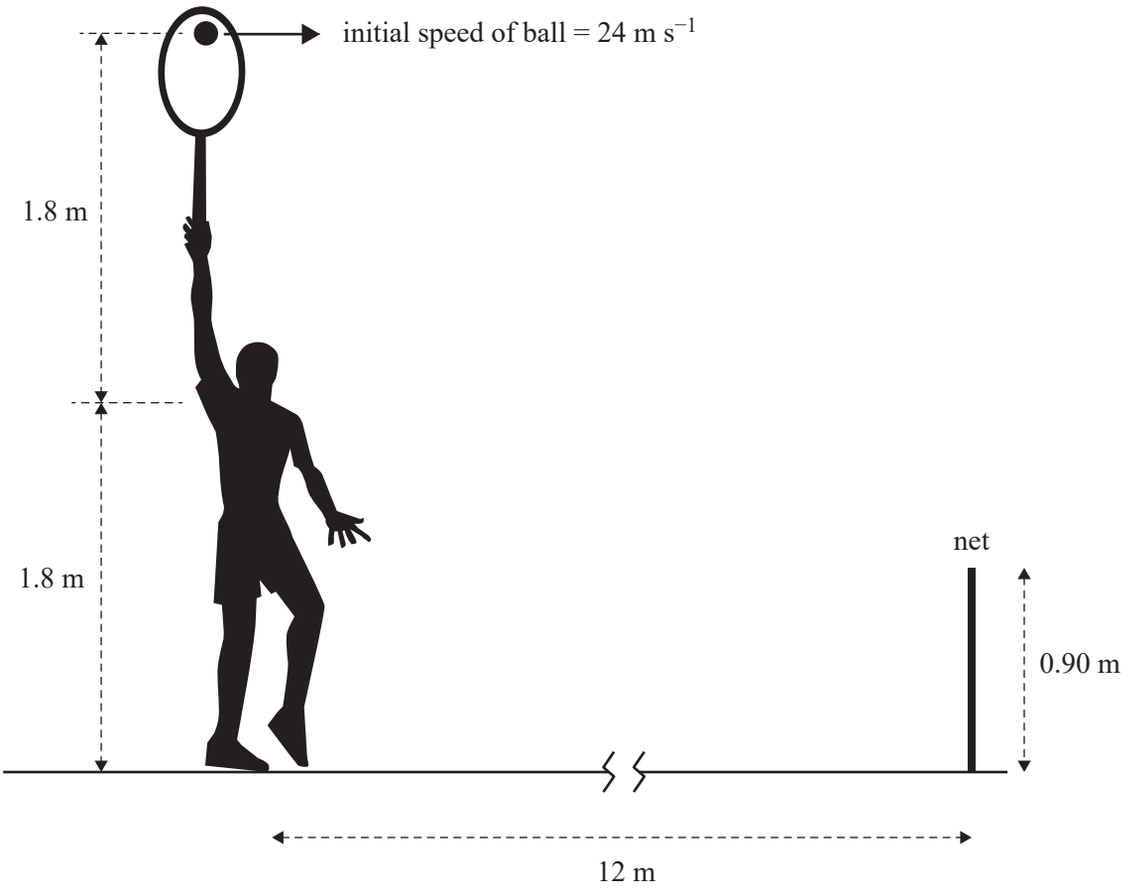


Figure 12

How far above the net will the ball be when it passes above the net? Assume that there is no air resistance. Show your working. 3 marks

m