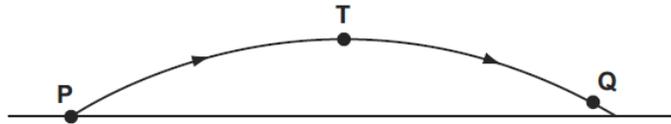## Projectile Motion

MCQ

1   A ball is thrown horizontally in still air from the top of a very tall building. The ball is not affected by air resistance. What happens to the horizontal and to the vertical components of the ball's velocity?
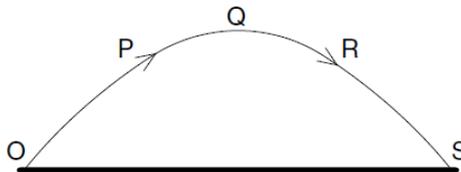
	horizontal component of velocity	*vertical component of velocity*
A	decreases to zero	increases at a constant rate
B	decreases to zero	increases to a constant value
C	remains constant	increases at a constant rate
D	remains constant	increases to a constant value

2   In the absence of air resistance, a stone is thrown from P and follows a parabolic path in which the highest point reached is T. The stone reaches point Q just before landing.

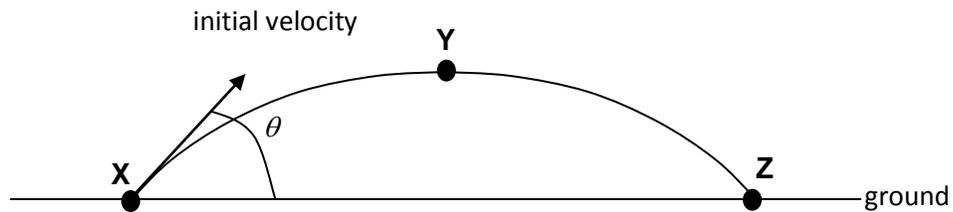The vertical component of acceleration of the stone is

A   zero at T.
B   greatest at T.
C   greatest at Q.
D   the same at Q as at T.

3   A projectile is launched at point O and follows the path OPQRS, as shown. Air resistance may be neglected.

Which statement is true for the projectile when it is at the highest point Q of its path?

A   The horizontal component of the projectile's acceleration is zero.
B   The horizontal component of the projectile's velocity is zero.
C   The kinetic energy of the projectile is zero.
**D**   The momentum of the projectile is zero.

4   The figure below shows the path of a ball leaving the ground at point X and about to hit the ground at point Z.

If air resistance is negligible, the vertical component of

A   velocity is maximum at Y.
B   displacement is minimum at Y.
C   velocity is the same at X and Z.
D   acceleration is the same at Y as at Z.

5   When a ball is thrown upwards at an angle to the horizontal with an initial speed. Assuming that air resistance is not negligible, which of the following statement is incorrect?

A   The path of the ball is asymmetrical about the highest point.
B   Horizontal range of the ball is shorter than the case with negligible air resistance.
C   The maximum height reached by the ball is smaller than the case with negligible air resistance.
D   The time taken for the flight up to the highest point is longer than the time taken for the flight down.

6   A double-ended launching device fires two identical steel balls X and Y at exactly the same time. The diagram shows the initial velocities of the balls. They are both launched horizontally, but Y has greater speed.
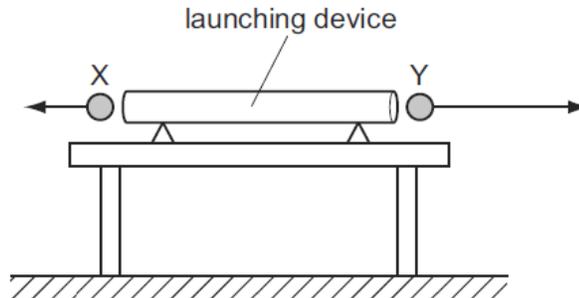
Which statement explains what an observer would see?

A   Both X and Y reach the ground simultaneously, because air resistance will cause both to have the same final speed.

B   Both X and Y reach the ground simultaneously, because gravitational acceleration is the same for both.

C   X reaches the ground before Y, because X lands nearer to the launcher.

D   Y reaches the ground before X, because Y has greater initial speed.

**7**   Peter and Susan both stand at the edge of a tall building.
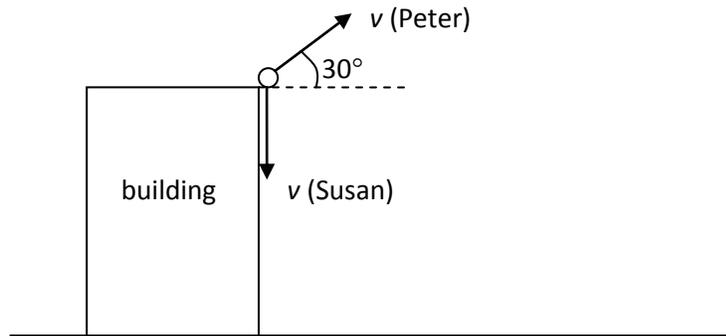
Susan throws a stone vertically downwards and, at the same time, Peter throws a stone upwards at an angle of 30° to the horizontal. The speed *v* with which both stones are thrown is the same.

Neglecting air resistance, which one of the following statements is true?

A   The stone thrown by Susan will hit the ground with a greater speed than the stone thrown by Peter.

B   Both stones will hit the ground with the same speed no matter what the height of the building.

C   In order to determine which stone will hit the ground with a greater speed, the height of the building must be known.

D   In order to determine which stone hits the ground first, the height of the building must be known.

8   A projectile is fired at an angle α to the horizontal at a speed u, as shown.
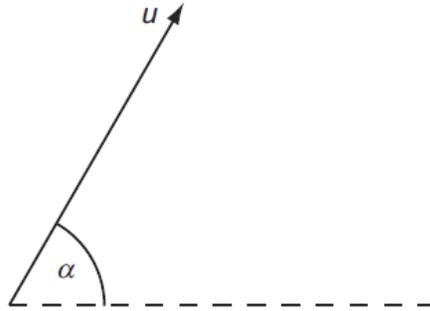
What are the vertical and horizontal components of its velocity after a time t? Assume that air resistance is negligible. The acceleration of free fall is g.

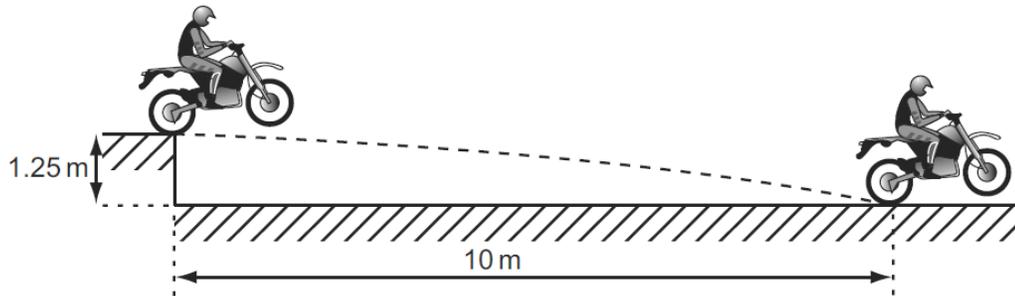|	vertical component	horizontal component
A	$u \sin \alpha$	$u \cos \alpha$
B	$u \sin \alpha - gt$	$u \cos \alpha - gt$
C	$u \sin \alpha - gt$	$u \cos \alpha$
D	$u \cos \alpha$	$u \sin \alpha - gt$

9   A cannon fires a cannonball with an initial speed v at an angle α to the horizontal.
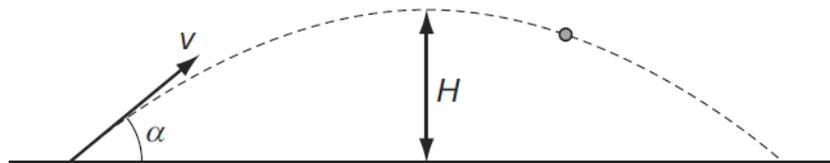
Which equation is correct for the maximum height H reached?

A $H = \dfrac{v \sin \alpha}{2g}$ B $H = \dfrac{g \sin \alpha}{2v}$ C $H = \dfrac{(v \sin \alpha)^2}{2g}$ D $H = \dfrac{g^2 \sin \alpha}{2v}$

hwq

10 A motorcycle stunt-rider moving horizontally takes off from a point 1.25 m above the ground, landing 10 m away as shown.


What was the speed at take-off?

A 5.0 m s^{-1} **B** 10 m s^{-1} **C** 15 m s^{-1} **D** 20 m s^{-1}

11 An aeroplane, flying in a straight line at a constant height of 500 m with a speed of 200 m s^{-1}, drops an object. The object takes a time t to reach the ground and travels a horizontal distance d in doing so. Taking g as 10 m s^{-2} and ignoring air resistance, which one of the following gives the values of t and d?

	t/s	d/km
A	25	10
B	25	5
C	10	5
D	10	2

12 In the figure below, a helicopter is flying with a constant horizontal speed 35.0 m s^{-1} and 100 m above the ground and the tank is traveling with a constant horizontal speed 15.0 m s^{-1} and is 550 m away from the helicopter.
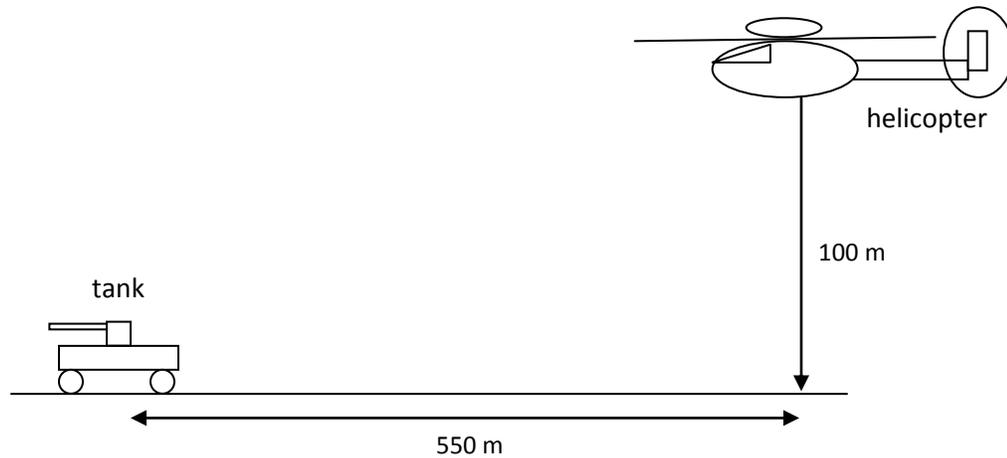
Assuming at $t = 0$ s, the helicopter and the tank is at the above position, how many seconds later should the helicopter drop a bomb so that it will hit the tank? Ignore air resistance.

A   4.47 s   **B**   10.2 s   **C**   23.0 s   **D**   27.5 s

13 A projectile is fired with an initial speed of 51.2 m s^{-1} at angle 44.5° above the horizontal on a long flat firing range. Point A is the maximum height attained by the projectile.

What is the vertical component of the velocity and location of the projectile 1.50 s after firing?

	speed / m s^{-1}	location
A	20.9	before point A
B	20.9	after point A
C	50.9	before point A
D	50.9	after point A

14 A ball is projected horizontally from the top of a cliff on the surface of the Earth with a speed of 40 m s^{-1}. Assuming that there is no air resistance, what will its speed be 3.0 s later?

A   40 m s^{-1} **B**   50 m s^{-1} **C**   60 m s^{-1} **D**   70 m s^{-1}

15 When a rifle is fired horizontally at a target P on a screen at a range of 25 m, the bullet strikes the screen at a point 5.0 mm below P. The screen is now moved to a distance of 50 m and the rifle again fires horizontally at P in its new position. See figure below.
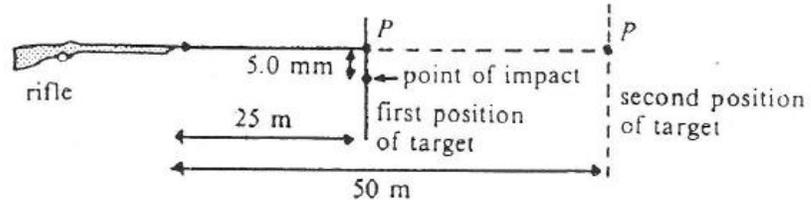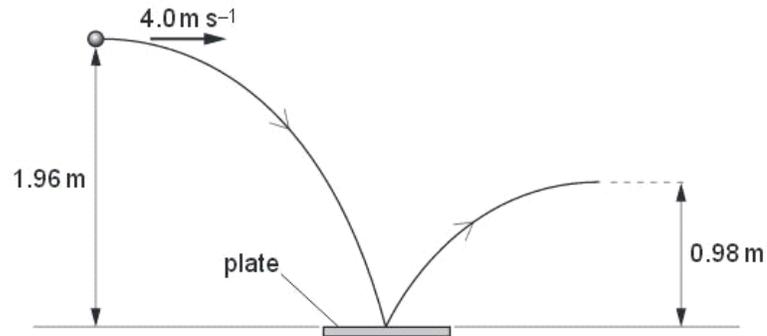

Assuming that air resistance may be neglected, what is the new distance below P at which the screen would now be struck?

A   10 mm   B   15 mm   C   20 mm   D   25 mm

16   A small ball is thrown horizontally with a speed of 4.0 m s^{-1}. It falls through a vertical height of 1.96 m before bouncing off a horizontal plate, as shown in the figure below.

Air resistance is negligible.

(a)   For the ball, right before it hits the horizontal plate,
   (i)   state the magnitude of the horizontal component of its velocity,
   (ii)   determine the vertical component of its velocity.

(b)   After bouncing on the plate, the ball rises to a vertical height of 0.98 m. Calculate the vertical component of the velocity of the ball as it leaves the plate.

17   A stone is thrown with a horizontal velocity of 20 m s^{-1} from the top of a cliff 15 m high. The path of the stone is shown in the figure below.
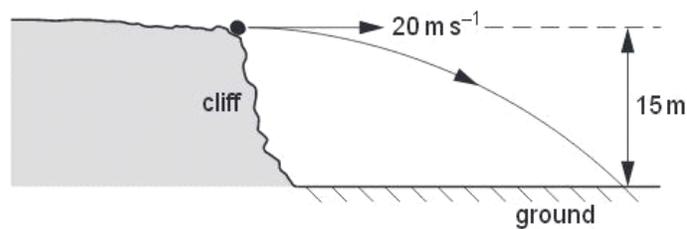
Air resistance is negligible.
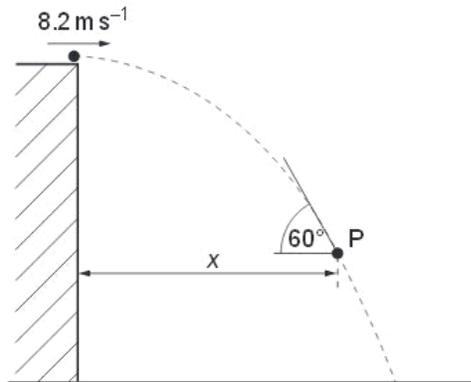
For this stone,

(a)   calculate the time to fall 15 m,

**(b)**   calculate the magnitude of the resultant velocity after falling 15 m.

hwq

18 A ball is thrown horizontally from the top of a building as shown in the figure below.

The ball is thrown with a horizontal speed of 8.2 m s^{-1}. The side of the building is vertical. At point P on the path of the ball, the ball is distance x from the building and is moving at an angle of 60° to the horizontal. Air resistance is negligible.

(a) For the ball at point P,
  (i) determine the vertical component of its velocity,
  (ii) determine the vertical distance through which the ball has fallen,
  (iii) determine the horizontal distance x.

(b) On the figure above, sketch the new path of the ball for the ball having an initial horizonal speed
  (i) greater than 8.2 m s^{-1} and with negligible air resistance (label this path G),
 **(ii)** equal to 8.2 m s^{-1} but with air resistance (label this path A).

19   A ball is thrown from a point P, which is at ground level, as shown in the figure below.
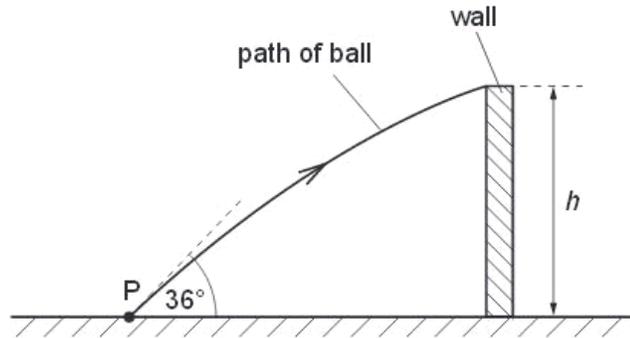
The initial velocity of the ball is 12.4 m s^{-1} at an angle of 36° to the horizontal. The ball just passes over a wall of height h. The ball reaches the wall 0.17 s after it has been thrown.

(a)   Assuming air resistance to be negligble, calculate
    (i)   the horizontal distance of point P from the wall,
    (ii)   the height h of the wall.

(b)   A second ball is thrown from point P with the same velocity as the ball in **(a)**. For this ball, air resistance is not negligible. This ball hits the wall and rebounds. On the figure above, sketch the path of this ball between point P and the point where it first hits the ground.

20 A ball is thrown against a vertical wall. The path of the ball is shown in the figure below.
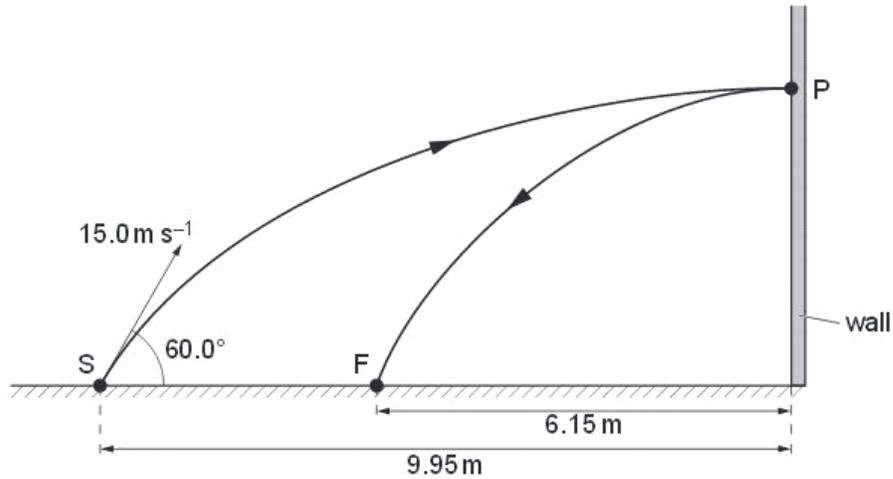
The ball is thrown from S with an initial velocity of 15.0 m s^{-1} at 60.0° to the horizontal. Assume that air resistance is negligible.

(a) For the ball at S, calculate
(i) its horizontal component of velocity,
(ii) its vertical component of velocity.

(b) The horizontal distance from S to the wall is 9.95 m. The ball hits the wall at P with a velocity that is at right angles to the wall. The ball rebounds to a point F that is 6.15 m from the wall. Using your answers in **(a)**,
(i) calculate the vertical height gained by the ball when it travels from S to P,
(ii) calculate the time taken for the ball to travel from S to P,
(iii) calculate the velocity of the ball immediately after rebounding from the wall.

<u>**Answers**</u>

MCQ

CDADD BBCCD DCABC

Structured Questions
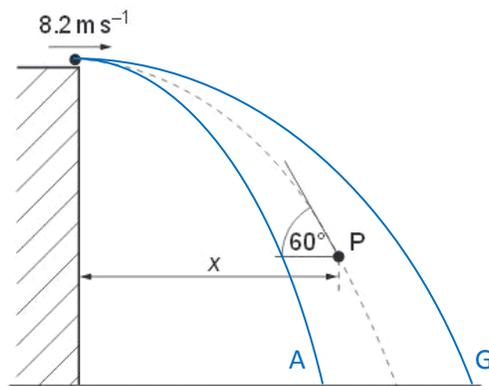
16 (a) (i) 4.0 m s^{-1}
    (ii) 6.26 m s^{-1}

  (b) 4.4 m s^{-1}

17 (a) 1.7 s

  (b) 26 m s^{-1}

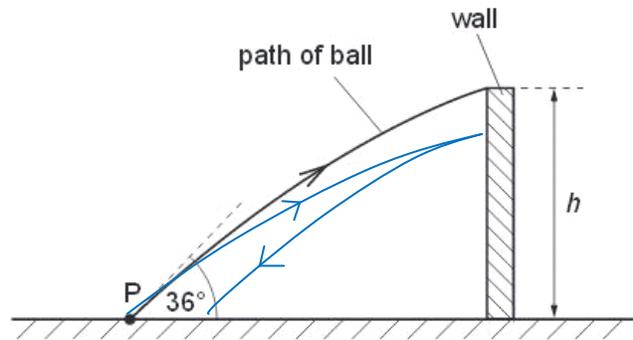18 (a) (i) 14 m s^{-1}
    (ii) 10 m
    (iii) 12 m

  (b)

19   (a)   (i)   1.7 m
              (ii)   1.1 m

      (b)

20   (a)   (i)   7.50 m s^{-1}
              (ii)   13.0 m s^{-1}

      (b)   (i)   8.44 m
              (ii)   1.30 s
              (iii)   4.73 m s^{-1}