EXAM QUESTIONS

UNIT 2: Projectile motion

Multiple-choice questions

Four possible answers are given for the following questions. Each question has only ONE correct answer. Choose the correct answer and mark the applicable LETTER with a cross (X).

1. A cricket ball flies through the air after a batsman has hit it.
Which one of the following vector diagrams represents the free body diagram of the ball at position X. Ignore air friction.

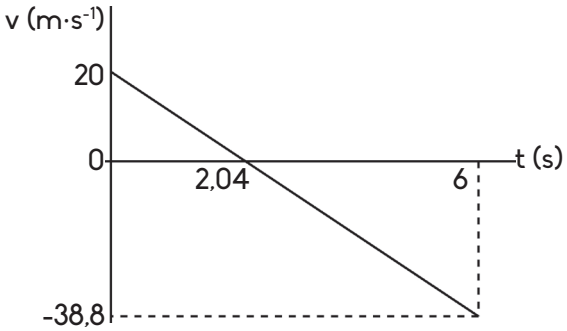
A. 

B. 

C. 

D. 

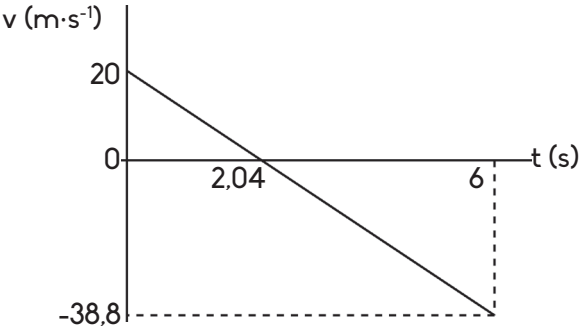
2. The graph represents the velocity-time graph of an object that is thrown upwards from the edge of a building and allowed to fall past the edge of the building to the ground below.



The gradient of the graph is:

A. equal to 9,8 m·s^{-2} and represents the gravitational velocity of the object.
B. equal to -9,8 m·s^{-2} and represents the gravitational acceleration of the object.
C. equal to 9,8 m·s^{-1} and represents the gravitational acceleration of the object.
D. equal to -9,8 m·s^{-2} and represents the gravitational velocity of the object.

3. The accompanying graph represents the velocity-time graph of an object that is thrown upwards from the edge of a building and allowed to fall past the edge of the building to the ground below.



The position of the ball after 6 s is:

A. back with the thrower on the way to the ground.
B. 20,4 m above the thrower on the way up.
C. 20,4 m below the thrower on the way to the ground.
D. 56,4 m below the thrower on the way to the ground.

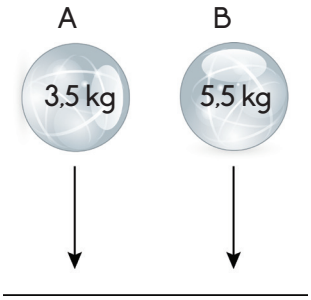
4. A hot air balloon rises vertically upwards at a constant velocity of 9,8 m·s^{-1} when a man throws out one of the sandbags at a velocity of 9,8m·s^{-1} downwards. What is the initial velocity of the sandbag with regards to Earth?

A. 0 m·s^{-2}
B. 9,8 m·s^{-2} downwards
C. 0 m·s^{-1}
D. 9,8 m·s^{-1} downwards

5. A rock is projected vertically upwards from the ground. The rock reaches a maximum height h. What will the maximum height be if the initial velocity at which the rock is projected is now three times larger? Ignore all effects of air resistance.

A. 3h B. 6h
C. 9h D. $^1/_3$h

6. Two metal spheres, masses 3,5 kg and 5,5 kg respectively, are dropped from a height of 30 m simultaneously.
The spheres reach the ground at the same time. Metal B has a greater:



A. impact speed.
B. acceleration.
C. impact velocity.
D. momentum.

7. A person on planet A, having radius R, experiences a gravitational force F. When the person is on planet B having a radius 5R, the gravitational force experienced will be:

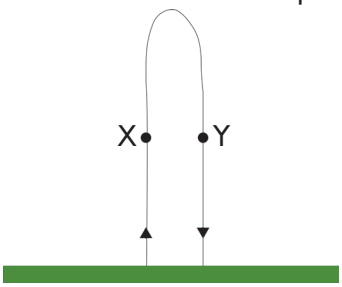
A. $\frac{1}{25}$ F. B. $\frac{1}{5}$ F.
C. 5F. D. 25 F. (Gr. 12: September 2018, Eastern Cape)

8. Three masses m, 2m and 3m are simultaneously dropped form the same height in vacuum. The accelerations of the masses are a_1, a_2 and a_3 respectively. Which ONE of the options below, regarding their accelerations, is correct?

A. $a_1 < a_2 < a_3$ B. $a_1 > a_2 < a_3$
C. $a_1 < a_2 > a_3$ D. $a_1 = a_2 = a_3$

(Gr. 12: September 2018, Eastern Cape)

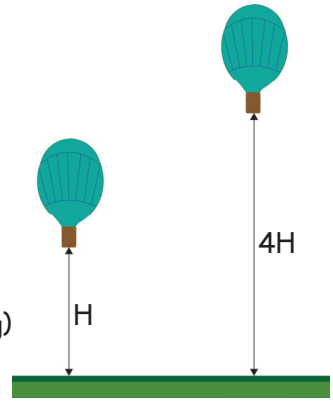
9. A ball is thrown vertically upwards and returns to the point of its projection.
Which statement about the acceleration at points X and Y is CORRECT? The acceleration is:



A. downwards at both points.
B. upwards at both points.
C. downwards at X and upwards at Y.
D. upwards at X and downwards at Y.

(Gr. 12: September 2018, Free State)

10. A package is dropped from a hot air balloon from two different heights. In the first instance the height of the balloon from the ground is H and it takes t seconds for the package to reach the ground. In the second instance the package is dropped from a height of 4H.
The time for the package, dropped from the height of 4H, to reach the ground compared to the time t of the package dropped from H is:

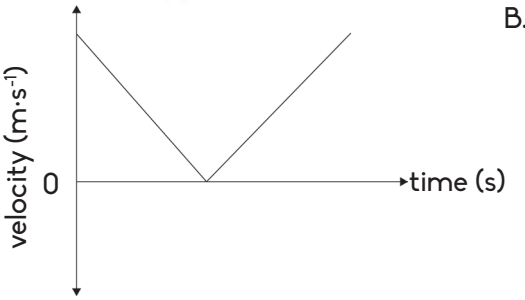


A. t. B. 2t.
C. 4t. D. 16t.

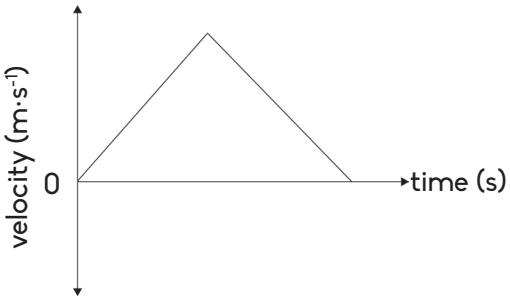
(Gr. 12: September 2018, Gauteng)

11. A ball is rolled up a smooth, inclined plane. The ball stops briefly at some point on its way up and rolls back to the point where it was first released.
Which ONE of the following velocity-time graphs best shows the motion of the ball?

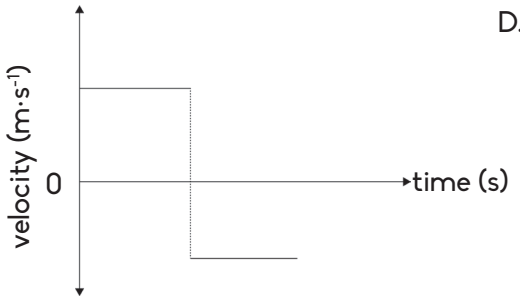
A.



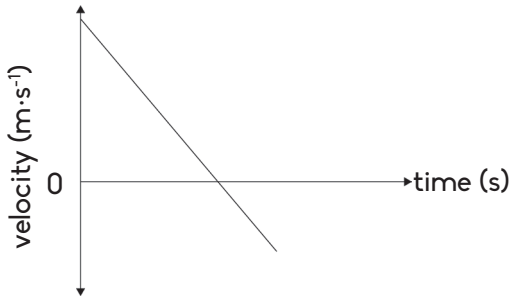
B.



C.



D.



(Gr. 12: September 2018, Gauteng)

12. A ball is dropped vertically downwards from rest. Ignore air friction. The ball attains a velocity v after it has travelled a vertical distance 2y. When the ball has travelled a vertical distance of 8y, the magnitude of its velocity, in terms of v, will be:

A. ½v. B. $\sqrt{2}$v.
C. 2v. D. 4v.

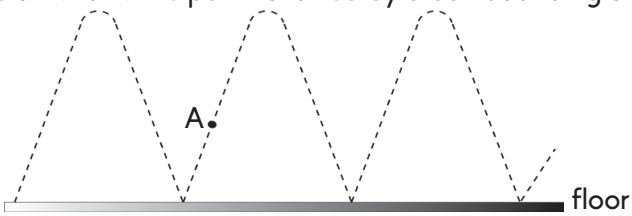
(Gr. 12: September 2018, KwaZulu-Natal)

13. A man has a mass m, and a weight w on Earth. What is the man's mass and weight on a planet which has twice the mass of Earth and has the same radius as Earth?

	Mass	Weight
A.	m	w
B.	2m	w
C.	2m	2w
D.	m	2w

(Gr. 12: September 2018, KwaZulu-Natal)

14. The sketch below shows the path followed by a ball bouncing on the floor in the absence of air resistance:



Which ONE of the following vectors CORRECTLY represents the force F acting on the ball when it is in position A?

A. 

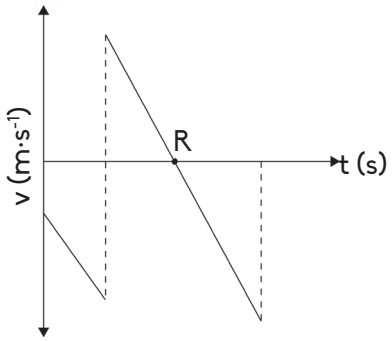
B.

C. 

D. 

(Gr. 12: September 2018, Limpopo)

15. A ball is projected vertically downwards from a height above the ground. It strikes the ground and bounces up.
The velocity-time-graph represents the motion of the bouncing ball:
Which ONE of the combinations of the position and magnitude of the acceleration of the ball at point R on the graph, is CORRECT?

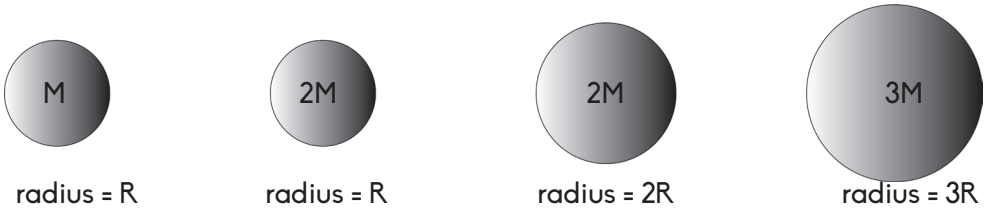


	Position	Magnitude of acceleration ($m \cdot s^{-2}$)
A.	On the ground	0
B.	Maximum height after bounce	9,8
C.	Maximum height after bounce	0
D.	On the ground	9,8

(Gr. 12: September 2018, Mpumalanga)

16. An object is dropped from a certain height above the surface of different planets. The mass and radius of each planet is shown in the options below. Which ONE of the following planets will cause the greatest gravitational acceleration on the object? Ignore any effects of air friction.

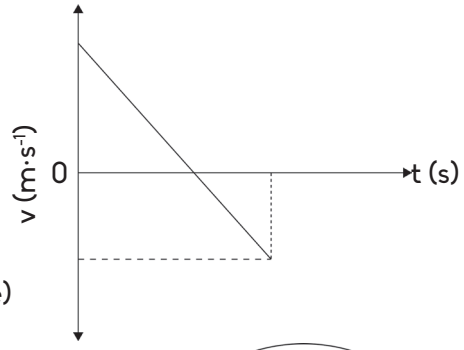
A. B. C. D.



radius = R radius = R radius = 2R radius = 3R

(Gr. 12: September 2018, Mpumalanga)

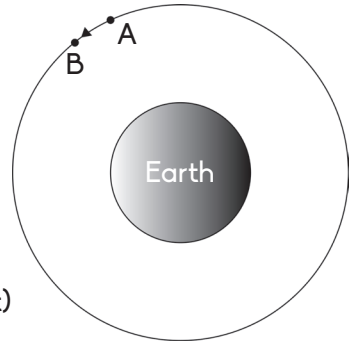
17. The velocity-time graph shows the motion of a ball which is thrown vertically upwards.
Air friction is ignored. The gradient of this graph represents the:



A. linear momentum of the ball.
B. displacement of the ball.
C. average velocity of the ball.
D. acceleration of the ball.

(Gr. 12: September 2018, Northern Cape)

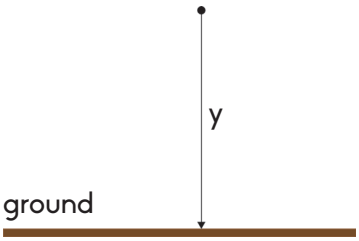
18. A satellite is moving at a constant speed on a circular orbit around Earth. The only force acting on the satellite is the gravitational force of Earth.
Which ONE of the following statements is TRUE as the satellite moves from A to B in its orbit?

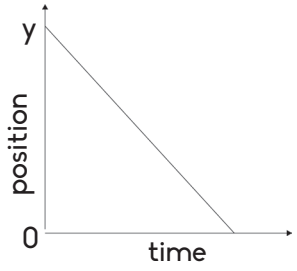


A. Work done by the gravitational force is zero.
B. Work done by the gravitational force is negative.
C. Gravitational potential energy decreases.
D. Velocity remains unchanged.

(Gr. 12: September 2018, North West)

19. A small stone is dropped from a height y above the ground. It strikes the ground after time t, as shown in the diagram:
Take upwards as the positive direction and the ground as zero reference. Ignore the effects of air resistance. Which ONE of the following diagrams shows a correct position-time graph for the motion of the stone?



A.


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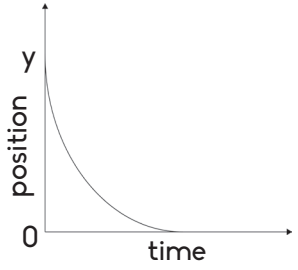
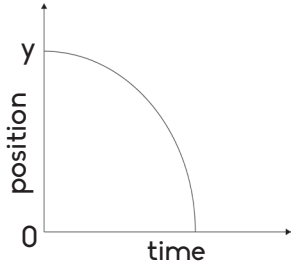
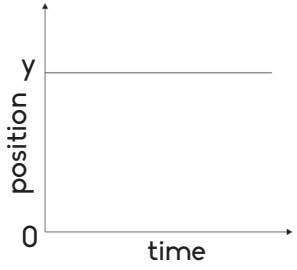


C.


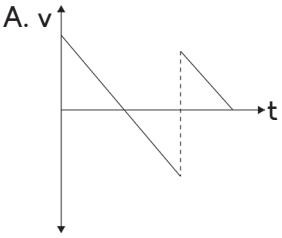
D.


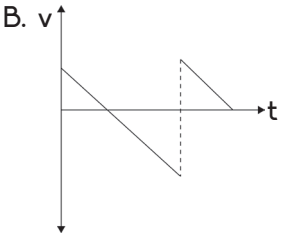
(Gr. 12: February 2018, National)

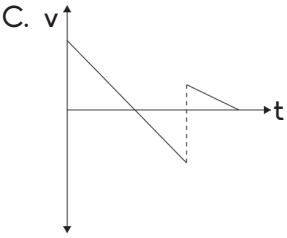
20. The diagram shows a section of the path of a stone projected vertically upwards.
At which ONE of the positions indicated on the diagram will the magnitude of the momentum of the stone be the GREATEST? Ignore air resistance.

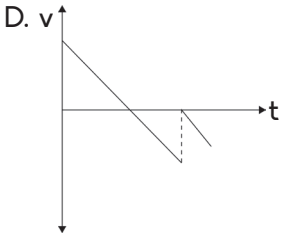
A. I B. II
C. III D. IV (Gr. 12: May 2018, National)

21. A ball is projected vertically upwards from the ground. It returns to the ground, makes an elastic collision with the ground and then bounces to a maximum height. Ignore air resistance.
Which ONE of the following velocity-time graphs CORRECTLY describes the motion of the ball?

A.


B.


C.


D.


(Gr. 12: February 2017, National)

22. If the object falls freely near Earth's surface, the acceleration will always:
A. increases in a downward direction.
B. decreases in a downward direction.
C. 9,8 $m \cdot s^{-2}$ in an upward direction.
D. 9,8 $m \cdot s^{-2}$ in a downward direction. (Gr. 12: June 2017, Eastern Cape)

Contextual questions

1 A hot air balloon rises at a constant vertical velocity of 4,3 $m \cdot s^{-1}$. At a height of 95 m above an inland lake, a man in the hot air balloon drops a can of cooldrink with a mass of 410 g over the edge of the basket. Ignore all effects of resistance.

1.1 Calculate the impact velocity of the can with the water.

1.2 Calculate the time it takes the can of cooldrink to reach the water.

The hot air balloon keeps moving at a constant vertical velocity of 4,3 $m \cdot s^{-1}$.

1.3 Calculate the vertical distance between the hot air balloon and the can of cooldrink 3 s after the man dropped it.

1.4 What is the relative velocity of the can of cooldrink with regards to the hot air balloon 3 s after the man dropped the can?

2 A gymnast jumps on a trampoline. During one of the jumps the gymnast leaves the trampoline at a velocity of 3,3 $m \cdot s^{-1}$.

2.1 Calculate the height that the gymnast reaches above the trampoline.

2.2 Calculate the time it takes to reach a position back at the surface of the trampoline.

3 A cannon mounted at the edge of a stationary ship, fires a bullet vertically upward at a starting velocity of 109 $m \cdot s^{-1}$. Ignore all effects of air resistance.

3.1 Calculate the maximum height that the bullet reaches above the deck of the ship.

3.2 Calculate the time it takes the bullet to reach maximum height.

The captain of the ship realises that the bullet is going to hit the deck. 5 s after the bullet is fired, he lets the ship accelerate forward from rest at 0,2 $m \cdot s^{-2}$.

3.3 Calculate the horizontal distance that the ship will move before the bullet will reach the height of the ship's deck again.

3.4 If the cannon is situated 15 m from the back of the ship, will the bullet hit the ship? Motivate your answer.

4 A boy stands on the edge of a cliff. He throws a rock vertically downward at a velocity of 1,6 $m \cdot s^{-1}$. A goat stands at the foot of the cliff, 65 m lower down. Ignore all effects of air resistance.

4.1 With what velocity will the rock hit the goat if the goat does not move?

4.2 Calculate the time it takes the rock to reach the goat's position.

The moment the boy throws the rock, the goat starts to accelerate horizontally from rest at 0,15 $m \cdot s^{-2}$.

4.3 How far from the goat's starting position is the goat when the rock reaches the point where the goat was standing?

4.4 What is the goat's velocity when the rock reaches the bottom end of the movement?

5 A newspaper seller stands on the back of a stationary delivery vehicle. A man stands on a balcony which is 3,8 m above ground. The seller throws the paper to the man on the balcony. He lets go of the paper at a velocity of 5,6 $m \cdot s^{-1}$ at a height of 2,3 m above the ground and the man on the balcony catches the paper at a height of 3,8 m above the ground while the paper is moving downwards. Ignore all effects of air resistance.

5.1 Calculate the velocity of the paper the moment the man catches it.

5.2 Calculate the time that it takes the paper to reach the man on the balcony.

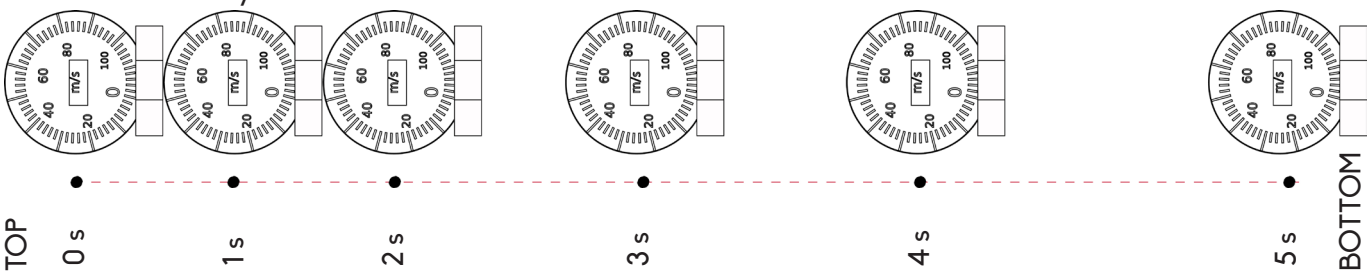
5.3 If the man misses the paper and it falls past the delivery vehicle to the ground, calculate the velocity at which the paper hits the ground.

6 A girl throws a tennis ball vertically upwards from a height of 1,4 m. The ball reaches a maximum height of 3,1 m above the ground. Ignore all effects of air resistance.
6.1 Calculate the initial velocity with which the girl threw the ball.
6.2 Calculate the speed of the tennis ball at a height of 1,9 m above the ground.
6.3 How long does it take the ball to fall back to the ground?

7 A boy throws a cricket ball vertically upwards from a high building at 8,16 $m \cdot s^{-1}$. Ignore all effects of air resistance.
7.1 Calculate the velocity of the ball 0,8 s after it is thrown.
7.2 Calculate the displacement of the ball 0,8 s after the ball is thrown.
7.3 Calculate the height of the building if the ball hits the ground after 3,2 s.

8 A boy and his dog play in the park. He throws a ball from a height of 1,1 m at 6 $m \cdot s^{-1}$ vertically into the air. The dog is a certain distance away from the boy at the moment when the boy throws the ball, the dog accelerates horizontally from rest at 1,5 $m \cdot s^{-2}$. The dog catches the ball in the air 40 cm above the ground, while it is moving downwards again.
8.1 Calculate the time that the ball is in the air before the dog catches it.
8.2 Calculate the velocity at which the dog moves at the moment he catches the ball.
8.3 Calculate the distance that the dog was away from the boy.

9 A rock is dropped from the top of a cliff at a certain height. Ignore air resistance.
Calculate the velocity and displacement of the rock after each second for the first 5 s.
9.1 Each time, draw the values of the velocity with an arrow on the speedometer and fill in the values of the distance covered on the odometer.
9.2 For which position on the path of the rock does the rock have the greatest acceleration? Motivate your answer.



9.3 How will the displacement of the rock change from the starting position if the time that the rock is falling:
9.3.1 doubles;
9.3.2 becomes three times more?
9.4 Draw an accurate position-time graph for the rock's movement where all available information is indicated.
9.5 Use the graph and determine the:
9.5.1 instantaneous velocity of the rock at three seconds;
9.5.2 instantaneous velocity of the rock at five seconds.
9.5.3 How do these values compare to the values you calculated in Question 9.1?
9.6 Use the answers of Question 9.5 and calculate the acceleration of the rock.
9.7 Calculate the percentage error you made during your calculations in Questions 9.4 to 9.6.

10 A daredevil performs a life-threatening stunt during which he dives from a 25 m high scaffold into a kid's pool below. Ignore all effects of air resistance.

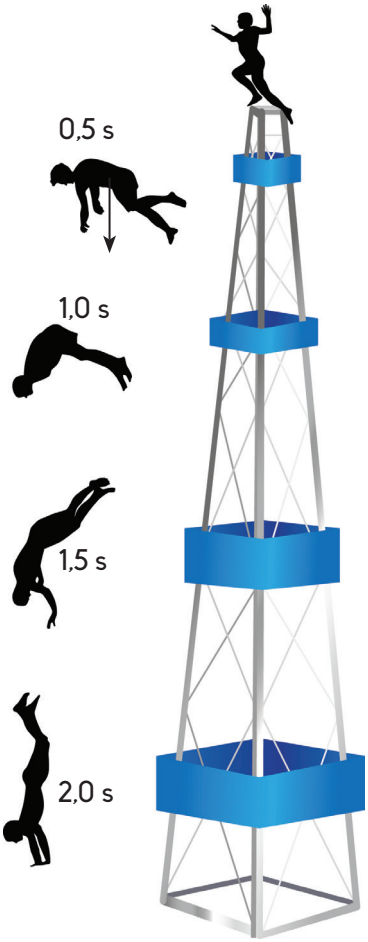
10.1 What is the acceleration of the daredevil during the diving stunt?

10.2 Complete the table by calculating the following values:

10.2.1 The velocity of the daredevil during each consecutive half second.

10.2.2 The displacement covered during each consecutive half second.

10.2.3 The height above the ground during each consecutive half second.



Time (s)	Velocity ($m \cdot s^{-1}$)	Distance covered (m)	Height (m)

10.3 The velocity of the daredevil after the first second is indicated on the diagram with an arrow. Use the scale of the diagram and draw an arrow for each of the subsequent positions according to scale.

10.4 Draw an accurate height-time graph for the movement of the daredevil on which all relevant values are indicated.

10.5 Use the same set of axes as for Question 10.4 and draw the graph for distance covered vs time graph for the movement.

10.6 What do you notice about the two graphs?

10.7 Use the graph and read off at which moment the daredevil reaches the pool.

10.8 Calculate the percentage error of your reading in Question 10.7.

11 A man stands on the roof of a building and throws a rubber ball from a height of 23 m vertically into the air at a velocity of 6 $m \cdot s^{-1}$. The ball moves upward and then falls past the roof back to the ground. Ignore all effects of air resistance. Use the information at your disposal and calculate the time that the ball takes to:

11.1.1 reach maximum height:

11.1.2 reach the ground.

11.2 Calculate the position of the ball relative to the ground as the ball reaches the highest position.

11.3 Calculate the velocity of the ball as:

11.3.1 the ball reaches the highest position;

11.3.2 the ball reaches the ground.

11.4 Use the ground as the zero position and draw the following accurate graphs:

11.4.1 Position-time graph

11.4.2 Velocity-time graph

11.4.3 Acceleration-time graph