IB Physics Motion Problems

2. Two identical balls are dropped from a tall building, one a few seconds after the other. Air resistance is **not** negligible. As the balls fall, the distance between the balls will

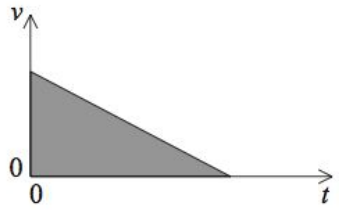
A. decrease.

B. increase.

C. increase then remain constant.

D. remain constant.

3. The graph below shows how velocity v varies with time t for a ball thrown vertically upwards from the Earth's surface.



The shaded area is equal to the

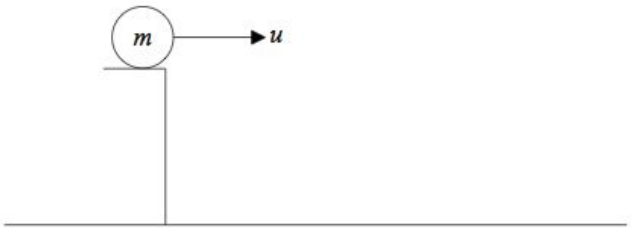
A. displacement.

B. final velocity.

C. change in velocity.

D. acceleration.

22. A ball of mass m is thrown horizontally from a cliff with initial velocity u. Air resistance is negligible.



A change in which of the following will affect the horizontal distance travelled?

A. m only

B. u only

C. both m and u

D. neither m nor u

3. An object, initially at rest, travels a distance d in a time t at a constant acceleration. What is the time taken for the object to travel $16d$ from rest at the same acceleration?

A. $16t$

B. $8t$

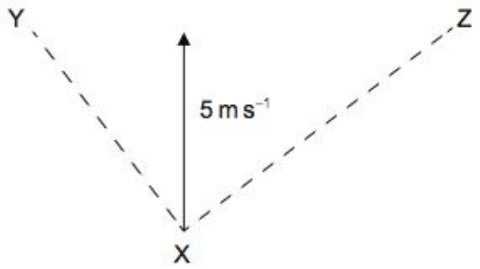
C. $4t$

D. $2t$

7. An object is thrown horizontally from the edge of a high crater on the Moon. The Moon has no atmosphere. Which of the following describes the changes, if any, to the horizontal and vertical components of the velocity of the object?

	Horizontal velocity	**Vertical velocity**
A.	stays constant	increases at a constant rate
B.	decreases	increases at a constant rate
C.	stays constant	increases at a non-constant rate
D.	decreases	increases at a non-constant rate

2. A velocity of 5 m s^{-1} can be resolved along perpendicular directions XY and XZ.



The component of the velocity in the direction XY is of magnitude 4 m s^{-1}. What is the magnitude of the component in the direction XZ?

A. 4 m s^{-1}

B. 3 m s^{-1}

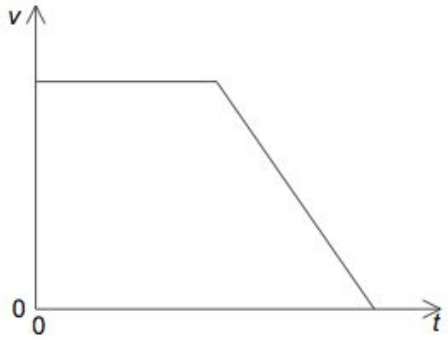
C. 2 m s^{-1}

D. 1 m s^{-1}

3. A tennis ball is released from rest and falls vertically through a small distance in air. What is the change in the speed of the ball and the change in the acceleration of the ball as it falls?

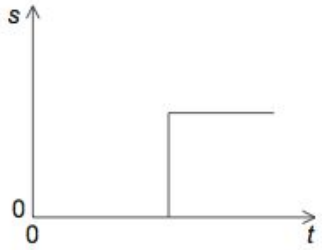
	Speed of the ball	Acceleration of the ball
A.	increases	decreases
B.	decreases	increases
C.	increases	increases
D.	decreases	decreases

4. The graph below shows the variation with time t of the velocity v of a car travelling in a straight line.

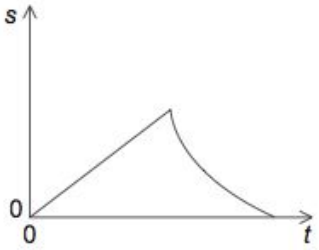


Which graph shows the variation with t of the displacement s of the car?

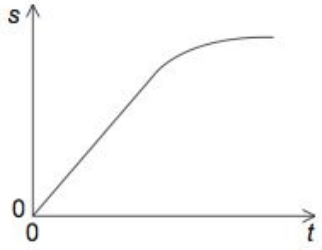
A.



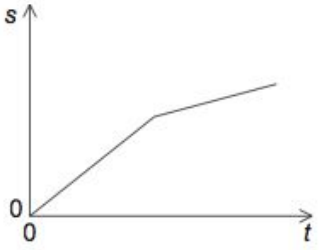
B.



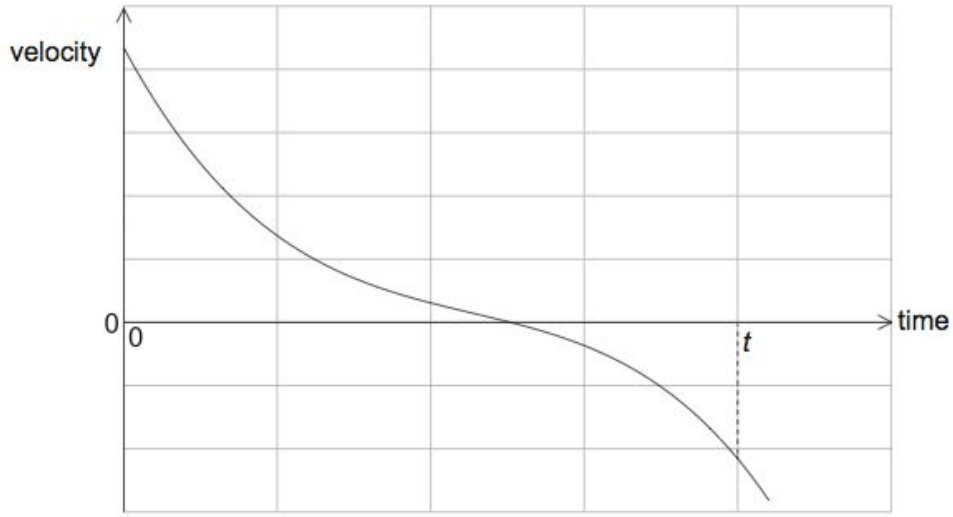
C.



D.



4. The graph shows the variation with time of the velocity of a truck of fixed mass.



What can be deduced from the graph?

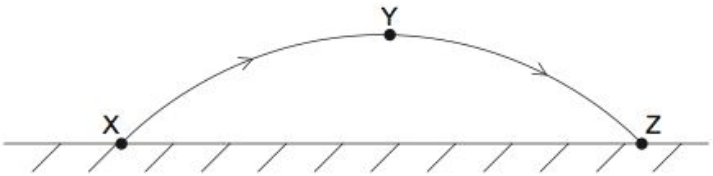
A. The truck is always accelerating.

B. The truck is always moving.

C. The truck is always moving in one direction.

D. The displacement of the truck after time *t* is zero.

24. A ball is thrown from point X and follows path XYZ. Air resistance is negligible.



Which quantity is zero when the ball is at the highest point Y of the path?

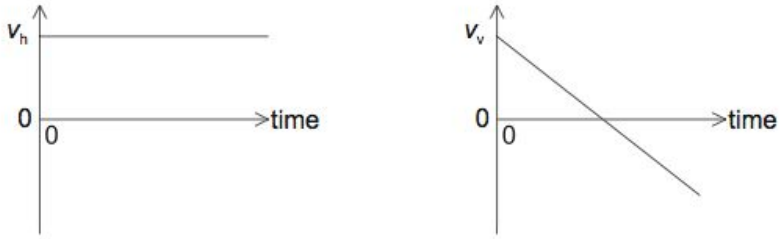
A. The horizontal component of the ball's acceleration

B. The vertical component of the ball's acceleration

C. The horizontal component of the ball's velocity

D. The kinetic energy of the ball

23. The horizontal component v_h and the vertical component v_v of velocity of an object are shown on the graphs. Air resistance is negligible.



These graphs could represent the motion of an object fired from a cliff

A. vertically upwards.

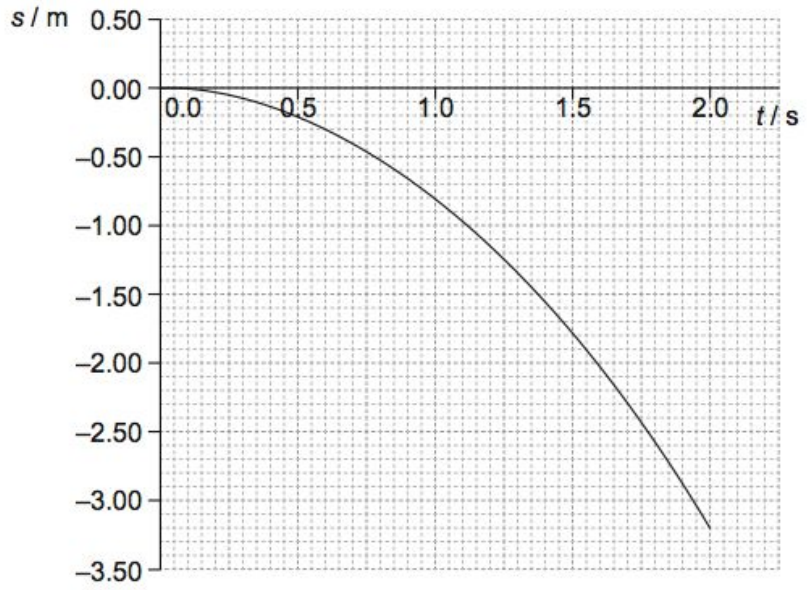
B. at an angle above the horizontal.

C. horizontally.

D. at an angle below the horizontal.

Part 1 Kinematics and gravitation

A ball is released near the surface of the Moon at time $t = 0$. The point of release is on a straight line between the centre of Earth and the centre of the Moon. The graph below shows the variation with time t of the displacement s of the ball from the point of release.



(a) State the significance of the negative values of s. [1]

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. . . . . .

(b) Use the graph to

(i) estimate the velocity of the ball at $t = 0.80$ s. [3]

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. . . . . .
. . . . . .

(ii) calculate a value for the acceleration of free fall close to the surface of the Moon. [3]

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. . . . . .

A2. This question is about kinematics.

(a) Fiona drops a stone from rest vertically down a water well. She hears the splash of the stone striking the water 1.6 s after the stone leaves her hand. Estimate the

(i) distance between Fiona's hand and the water surface. *[1]*

. . . . . .
. . . . . .

(ii) speed with which the stone hits the water. *[2]*

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. . . . . .
. . . . . .
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(b) After the stone in (a) hits the water surface it rapidly reaches a terminal speed as it falls through the water. The stone leaves Fiona's hand at time $t=0$. It hits the water surface at t_1 and it comes to rest at the bottom of the water at t_2. Using the axes below, sketch a graph to show how the speed v of the stone varies from time $t=0$ to just before $t=t_2$. (There is no need to add any values to the axes.) *[3]*

MARKSCHEME

2 C
3 A
22 B
3 C
7 A
2 B
3 A, C
4 C
4 A
24 A
23 B

6. Part 1 Kinematics and gravitation

(a) upwards (or away from the Moon) is taken as positive / downwards (or towards the Moon) is taken as negative / towards the Earth is positive; **[1]**

(b) (i) tangent drawn to curve at 0.80 s;
correct calculation of gradient of tangent drawn;
-1.3 ± 0.1 m s^{-1} ***or*** 1.3 ± 0.1 m s^{-1} downwards; **[3]**

or

correct coordinates used from the graph;
substitution into a correct equation;
-1.3 ± 0.1 m s^{-1} ***or*** 1.3 ± 0.1 m s^{-1} downwards;

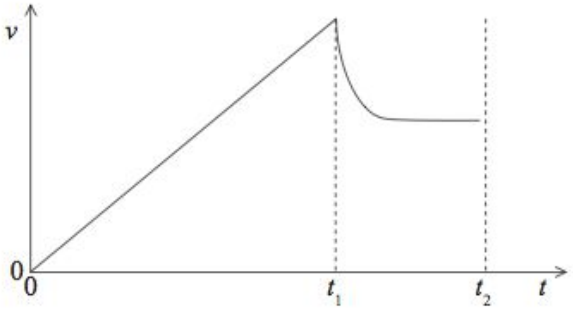
(ii) any correct method used;
correct reading from graph;
1.6 to 1.7 m s^{-2}; **[3]**

A2. (a) (i) $s = 12.5/12.6$ m; ***[1]***

(ii) $v = \sqrt{2gs}$ ***or*** gt; *(allow any use of* suvat *equations)*
$= \left(\sqrt{2 \cdot 9.8 \cdot 12.5} =\right) 15.7\,\text{m s}^{-1}$; ***[2]***

*Award **[2]** for a bald correct answer.*

(b)



straight line to water surface;

clear decrease after hitting surface;

constant non-zero speed reached *smaller* than maximum; *(speed must be less than maximum velocity)* ***[3]***