GRAPHS OF MOTION 18 FEBRUARY 2014

Lesson Description

In this lesson we:

- Will do calculations from graphs of motion representing vertical projectile motion

Summary

The motion of a projectile can be represented using graphs of motion. These graphs can be position vs time, velocity vs time or acceleration vs time graphs.

When an object is accelerating a position versus time graph will be a curved line. If the velocity is constant then the graph will be a straight line.

When an object is experiencing constant acceleration a velocity versus time graph will be a straight line. The gradient of a position versus time graph gives the velocity of an object.

The gradient of a velocity versus time graph gives the acceleration of an object, while the area under the graph gives the displacement of an object.

Due to projected objects only experiencing acceleration due gravity, the acceleration versus time graph will be a horizontal line parallel to the time axis.

The area under the acceleration versus time graph gives the velocity of an object.

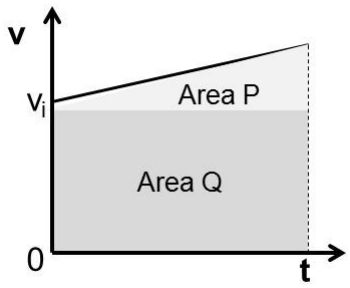
Test Yourself

Select the most correct answer from the options given. Write down only the correct letter

Question 1

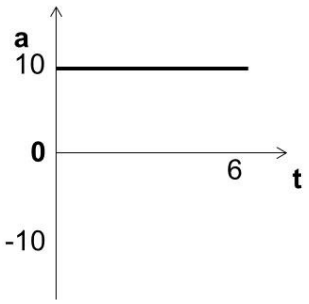
The equation of motion $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ can be represented by the accompanying velocity – time graph. The quantity $\frac{1}{2} a \Delta t^2$ in the equation is….

A. Area P + area Q
B. Area P
C. Area Q
D. Area Q – area P

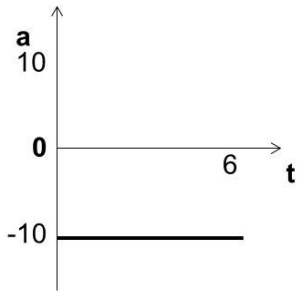


Question 2

Which one of the following acceleration – time graphs best represents the motion of a stone which is projected upwards and is then caught at the same height after 6s? Take up as the positive direction.



A.



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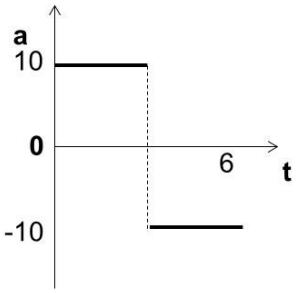

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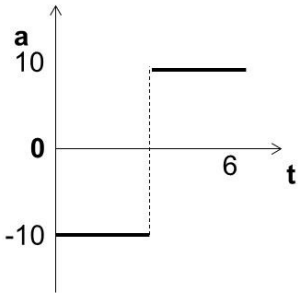


D.

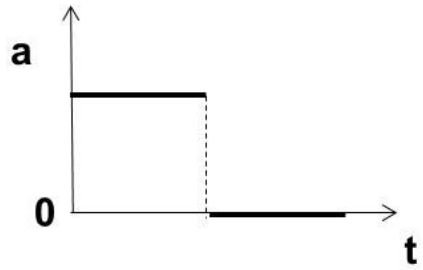
Question 3

A ball is projected vertically upwards with a velocity of v_i m.s^{-1}. If air resistance can be ignored, the time, in seconds, that the ball takes to reach its maximum height is:

A. $\frac{v_i}{a}$
B. $\frac{a}{v_i}$
C. $\frac{2a}{v_i}$
D. $\frac{2v_i}{a}$

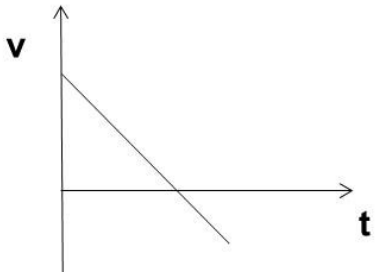
Question 4 and 5 refer to the following:

The accompanying acceleration graph applies to the motion of a lift moving upwards from rest.

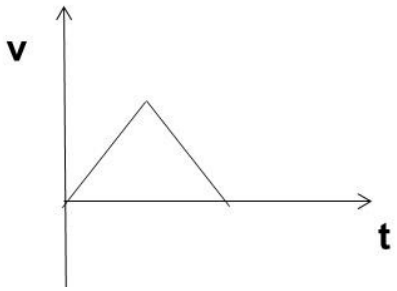


Question 4

The velocity – time graph for the lift is best represented by:



A.



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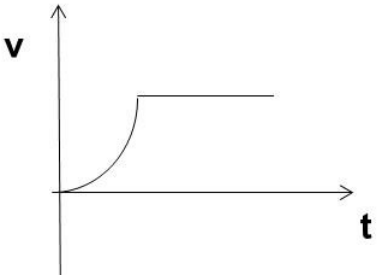

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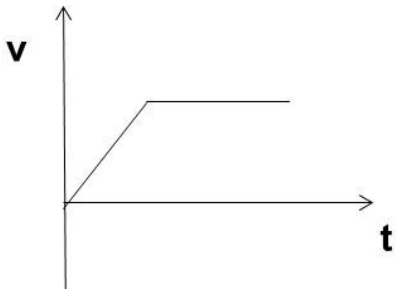
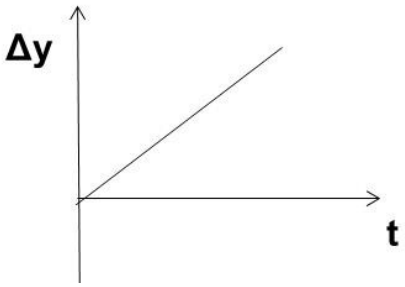


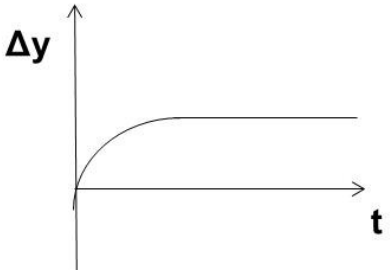
D.

Question 5

The displacement – time graph for the lift is best represented by:



A.



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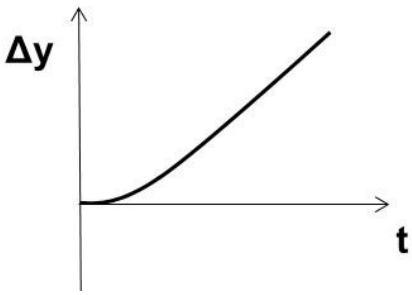

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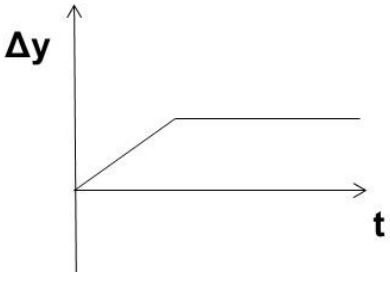


D.

Improve your skills

Question 1

*(Adapted from KZN June 2013 Paper 1 posted by **Stylour Mano Nzamour**)*

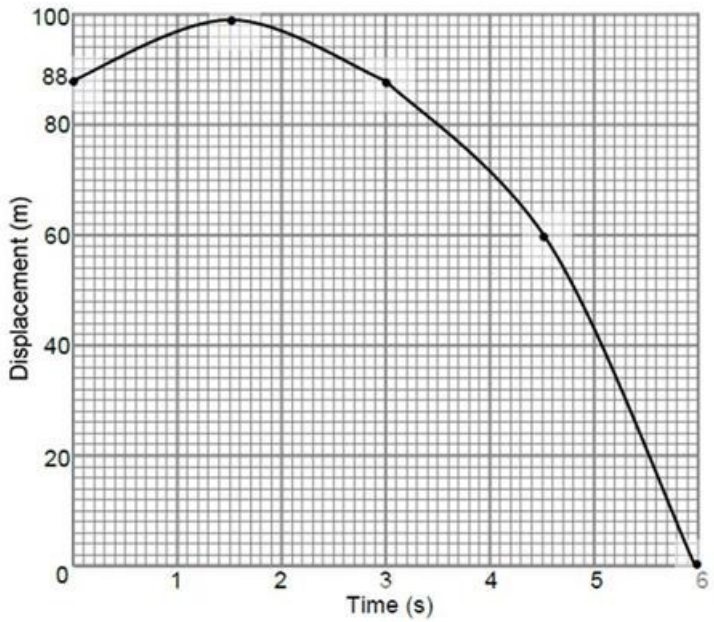
An object is projected vertically upwards at 8,70 $m.s^{-1}$ from the roof of a building of unknown height. On its way down the object passes a point P, located 34,80m above the ground. It takes the object 1,25s to strike the ground from point P. Take upward motion as positive.

1.1. Show that the magnitude of the velocity at point P is 21,72 $m.s^{-1}$
1.2. Calculate the height of the building
1.3. Draw a velocity versus time graph to represent the motion of this object

Question 2

(Adapted from Exemplar Exam 2008 – Paper 1)

A hot-air balloon is rising vertically at constant velocity. When the balloon is at a height of 88 m above the ground, a stone is released from it. The displacement-time graph below represents the motion of the stone from the moment it is released from the balloon until it strikes the ground. Ignore the effect of air resistance.



Use the information from the graph to answer the following questions:

2.1. Calculate the velocity of the hot-air balloon at the instant the stone is released.
2.2. Draw a sketch graph of velocity versus time for the motion of the stone from the moment it is released from the balloon until it strikes the ground. Indicate the respective values of the intercepts on your velocity-time graph.

Links

- Vertical projectile motion (example): http://www.youtube.com/watch?v=FIHAqffBpYI
- Vertical projectile motion (example): http://www.youtube.com/watch?v=wTgxulTx4Yk