Hen Gwestiynau Arholiad

Rectilinear Motion

(Gaeaf 2006)

1. A small object, of mass 0·02kg at the top of a building 160 m high, is dropped from rest.

(a) Ignoring air resistance, calculate

(i) the speed of the object as it hits the ground,

(ii) the time taken for the object to reach the ground. [6]

(b) Assuming that the air resistance has magnitude 0·096 N, calculate

(i) the magnitude of the acceleration of the object,

(ii) the height of the object above the ground 4 s after it was dropped. [6]

(Haf 2006)

5. A particle is projected vertically upwards with speed 22·05 ms^{-1}.

(a) Calculate the time that elapses before the particle returns to the point of projection and the speed of the particle at that time. [4]

(b) Find the greatest height of the particle above the point of projection. [3]

(c) Determine the speed and direction of motion of the particle 3 s after projection. [4]

(Gaeaf 2007)

1. A pebble is projected vertically upwards with speed 10·5 ms^{-1} from a point *A* at the top of a cliff.

(a) Find the greatest height above *A* reached by the pebble. [3]

(b) The pebble reached the bottom of the cliff 5 s after being projected. Calculate the height of the cliff. [3]

(Haf 2007)

2. A ball is hit vertically up into the air from a point *A*, which is 1·75 m above the ground. The ball hits the ground for the first time after 2·5 s. Ignoring air resistance,

(a) show that the initial speed of the ball is 11·55 ms^{-1}, [2]

(b) find the greatest height above the ground reached by the ball, [3]

(c) calculate the speed of the ball as it hits the ground, [3]

(d) calculate the speed of the ball immediately after the first bounce if the coefficient of restitution between the ball and the ground is 0·8. [2]

(Haf 2008)

2. A stone is projected vertically upwards from a point A at the top of a tower 70 m high. It reaches the highest point of its path after 2·5 s.

(a) Show that the speed of projection of the stone is $24{\cdot}5\,\text{ms}^{-1}$. [2]

(b) Find the height of the stone above A 4 s after projection. [3]

(c) Calculate the speed of the stone when it reaches the ground. [3]

(Gaeaf 2009)

1. A train travels along a straight horizontal track with constant acceleration. Points A, B and C are on the track with B between A and C. The distance AB is 1200 m and the distance BC is 2500 m. As the train passes B, its speed is $26\,\text{ms}^{-1}$. The train takes 60 s to travel from A to B.

(a) Find the speed of the train as it passes A. [3]

(b) Determine the acceleration of the train. [3]

(c) Calculate the speed of the train as it passes C, giving your answer correct to one decimal place. [3]

(Haf 2009)

1. A boy throws a pebble from the top of a cliff 70·2 m high with an initial velocity of $14{\cdot}7\ \text{ms}^{-1}$ vertically upwards.

(a) Calculate the speed of the pebble 2 s after it has been thrown. [3]

(b) Calculate the speed of the pebble when it hits the ground at the foot of the cliff. [3]

(c) For how long is the pebble at least 3·969 m above the top of the cliff? [4]

(Gaeaf 2010)

1. A boy throws a ball vertically upwards from a point A with an initial speed of $18{\cdot}2\,\text{ms}^{-1}$.

(a) Find the greatest height above A reached by the ball. [3]

(b) Calculate the time taken for the ball to return to point A. [3]

(c) Find the speed of the ball 2·5 s after it was thrown. State clearly the direction of motion of the ball at this time. [3]

(Haf 2010)

1. A pebble is projected vertically downwards with speed $2{\cdot}1\ \text{ms}^{-1}$ from the top of a well, which is 15·4 m deep.

(a) Calculate the speed of the pebble when it hits the bottom of the well. [3]

(b) Find the time taken by the pebble to reach the bottom of the well. [3]

(Haf 2011)

1. A stone is thrown vertically **downwards** from the top of a cliff with an initial velocity of $1\,\text{ms}^{-1}$ and hits the sea 2·5 seconds later.

(a) Find the speed with which the stone hits the sea. [3]

(b) Calculate the height of the cliff. [3]

3. The points A, B and C lie, in that order, on a straight horizontal road. A car travels on the road with constant acceleration $a\,\text{ms}^{-2}$. When the car is at A, its speed is $u\,\text{ms}^{-1}$. The distance AB is 10 m and the car takes 2 s to travel from A to B. The car takes 7 s to travel from A to C and its speed at C is $17\,\text{ms}^{-1}$.

(a) Find the value of u and the value of a. [7]

(b) Draw a velocity-time graph for the motion of the car between A and C. [2]

(c) Calculate the distance AC. [2]

(Gaeaf 2012)

4. A stone is thrown vertically upwards with a speed of $14{\cdot}7\,\text{ms}^{-1}$ from a point A which is 49 m above the ground.

(a) Find the time taken for the stone to reach the ground. [3]

(b) Calculate the speed of the stone when it hits the ground. [3]

(Haf 2012)

7. A skydiver drops from rest from a hot air balloon and falls vertically under gravity for 5 s before his parachute opens. After the parachute has opened, his speed of descent reduces with uniform retardation for a further 10 s until his speed is $4\,\text{ms}^{-1}$. He then continues to travel at a constant speed of $4\,\text{ms}^{-1}$ until he reaches the ground 2 minutes after he left the hot air balloon.

(a) Calculate the speed of the skydiver just before his parachute opens. [3]

(b) Draw a sketch of the velocity-time graph for the skydiver's descent. [4]

(c) Determine the height of the skydiver above the ground when he drops from the hot air balloon. [3]

(Gaeaf 2013)

1. A car moves with constant acceleration along a straight horizontal road. It passes the point O with speed $12\,\text{ms}^{-1}$. It then passes point A, 4 seconds later, with speed $32\,\text{ms}^{-1}$.

(a) Show that the acceleration of the car is $5\,\text{ms}^{-2}$. [3]

(b) Determine the distance OA. [3]

(c) The point M is the midpoint of OA. Calculate the speed of the car as it passes M. Give your answer correct to one decimal place. [3]

3. A particle is projected vertically upwards with an initial speed of $15\,\text{ms}^{-1}$ from a point A, which is 1·2 m above horizontal ground.

(a) Determine the time taken for the particle to reach the ground. Give your answer correct to one decimal place. [4]

(b) Suppose a heavier particle is projected vertically upwards from the same point A and with the same initial speed of $15\,\text{ms}^{-1}$. Would the time taken for the particle to reach the ground be greater, the same, or less than your answer in *(a)*?
Give a reason for your answer. [1]

(Haf 2013)

3. An object is projected vertically upwards with speed $u\,\text{ms}^{-1}$ from a point A which is 2·8 m above horizontal ground. The object reaches its greatest height of 18·225 m above A before falling to the ground.

(a) Show that the value of u is 18·9. [3]

(b) Find the time between the object being projected and the object hitting the ground. [4]

(Gaeaf 2014)

2. A pebble is projected vertically upwards with a speed of $7\,\text{ms}^{-1}$ from the top of a cliff. It hits the ground at the bottom of the cliff 4 seconds later.

(a) Calculate the time for the pebble to reach its maximum height. [3]

(b) Determine the height of the cliff. [3]

(Haf 2015)

8. An object is projected vertically downwards from a point A with an initial speed of $2{\cdot}1\,\text{ms}^{-1}$ towards a horizontal surface. The point A is at a height of 4 m above the surface. The coefficient of restitution between the object and the surface is $\frac{4}{7}$.

(a) Show that the speed of the object immediately after it has rebounded from the surface is $5{\cdot}2\,\text{ms}^{-1}$. [5]

(b) Determine the smallest number of bounces after which the speed of the object immediately after rebound is less than $1\,\text{ms}^{-1}$. [2]

(Haf 2016)

8. A car is travelling along a straight road ABC with uniform acceleration $a\,\text{ms}^{-2}$. The distance AC is 460 m. The time taken by the car to travel from A to B is 6 s and the time taken to travel from B to C is 14 s. At A the speed of the car is $u\,\text{ms}^{-1}$ and at B, the speed of the car is $17\,\text{ms}^{-1}$. Find the value of a and the value of u. [7]

(Haf 2017)

4. A car of mass 800 kg is travelling on a horizontal road. It experiences a resistance to motion which is constant throughout the journey. The car accelerates from rest under a constant tractive force of 300 N exerted by its engine. After 50 seconds, the car reaches a speed of $15\,\text{ms}^{-1}$.

(a) Determine the magnitude of the acceleration of the car. [3]

(b) Calculate the magnitude of the constant resistance to motion. [3]

(c) When the car reaches the speed of $15\,\text{ms}^{-1}$, the engine is switched off and the car is brought to rest by a constant braking force. The total distance covered by the car for the **whole** journey is 500 m. Find the constant force exerted by the brakes. [7]

(Haf 2018)

6. A raindrop A falls freely from rest from the top of a cliff. After it has fallen a distance 0·1 m, a second raindrop B begins to fall from rest from the top of the same cliff. The height of the cliff is 40 m.

(a) Find the velocity of A at the instant B begins to fall. [3]

(b) Find the velocity of A at the instant it reaches the ground. [2]

(c) Calculate the distance between the raindrops when the first raindrop A hits the ground. [7]