VERTICAL MOTION UNDER GRAVITY

AS Unit 2: Applied Mathematics A

Section B: Mechanics

WJEC past paper questions: 2010 – 2017

Total marks available 70 (approximately 1 hours 25 minutes)

1. A boy throws a ball vertically upwards from a point A with an initial speed of 18.2ms^{-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 2.5s after it was thrown. State clearly the direction of motion of the ball at this time. (3)

   (January 10)

2. A pebble is projected vertically downwards with speed 2.1ms^{-1} from the top of a well, which is 15.4m 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)

   (Summer 10)

3. A ball is dropped from rest from a point above a smooth horizontal floor. The ball falls vertically for 0.8s before it hits the floor and bounces to a height of 0.9m above the floor.
   a) Calculate the speed of the ball when it first hits the floor. (3)
   b) Find the coefficient of restitution between the floor and the ball. Give your answer correct to three significant figures. (5)

   (January 11)

4. A stone is thrown vertically **downwards** from the top of a cliff with an initial velocity of 1ms^{-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)

   (Summer 11)

5. A stone is thrown vertically upwards with a speed of 14.7ms^{-1} from a point A which is 49m 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)

   (January 12)

6. A skydiver drops from rest from a hot air balloon and falls vertically under gravity for 5s before his parachute opens. After the parachute has opened, his speed of descent reduces with uniform retardation for a further 10s until his speed is $4ms^{-1}$. He then continues to travel at a constant speed of $4ms^{-1}$ 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 of the skydiver's descent. (4)
   c) Determine the height of the skydiver above the ground when he drops from the hot air ballon. (3)

   (Summer 12)

7. A particle is projected vertically upwards with an initial speed of $15ms^{-1}$ from a point A, which is 1.2m 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 $15ms^{-1}$. 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)

   (January 13)

8. An object is projected vertically upwards with speed $u ms^{-1}$ from a point A which is 2.8m above horizontal ground. The object reaches its greatest height of 18.225m 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)

   (Summer 13)

9. A pebble is projected vertically upwards with a speed of $7ms^{-1}$ 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)

   (January 14)

10. An object is projected vertically downwards from a point A with an initial speed of $2.1ms^{-1}$ towards a horizontal surface. The point A is at a height of 4m 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 $5.2ms^{-1}$. (5)
   b) Determine the smallest number of bounces after which the speed of the object immediately after rebound is less than $1ms^{-1}$. (2)

   (Summer 15)