Vertical Motion Under Gravity 2

Specification: AQA 7357: R3, Q2, Q3, OT3 · Edexcel 9MA0: 8.3, 7.2, 7.3, OT3

HOMEWORK Consolidation

1 A ball is projected vertically upwards from the ground with speed 22.4 m s^{-1}. Find the total time for which it is more than 20 m above the ground.
AQA R3, Q3 · Edexcel 8.3, 7.3

2 A ball is projected vertically upwards from a point O with speed 9.8 m s^{-1}.
(a) Find its greatest height above O.
(b) Show that it never reaches a point 5 m above O.
AQA R3, Q3 · Edexcel 8.3, 7.3

3 Ball A is dropped from rest from the top of a tower 45 m high. At the same instant ball B is projected vertically upwards with speed 18 m s^{-1} from the foot of the tower, directly below A. Find
(a) the time at which they meet
(b) their height above the ground then
(c) whether B is moving up or down when they meet.
AQA R3, Q3 · Edexcel 8.3, 7.3

4 A stone is dropped from rest from the top of a building 20 m high. One second later a second stone is thrown vertically downwards from the same point with speed 19.6 m s^{-1}. Find
(a) the time, measured from when the first stone is dropped, at which the second stone catches it
(b) how far below the top they are then
(c) whether they meet before reaching the ground.
AQA R3, Q3 · Edexcel 8.3, 7.3

5 Particle P is projected vertically upwards from a point O with speed 24.5 m s^{-1}. Two seconds later particle Q is projected vertically upwards from O with the same speed. Find the time, measured from when P is projected, at which they meet, and their height above O then.
AQA R3, Q3 · Edexcel 8.3, 7.3

6 A ball is projected vertically upwards from a point O with speed 14 m s^{-1}. Find the length of time for which it is more than 7.5 m above O.
AQA R3, Q3 · Edexcel 8.3, 7.3

7 A ball is dropped from rest from a height of 3.6 m above horizontal ground. Each time it hits the ground it rebounds with three-quarters of the speed with which it hits the ground. Find the greatest height reached
(a) after the first bounce
(b) after the second bounce.
AQA R3, Q3 · Edexcel 8.3, 7.3

8 A ball is dropped from rest from a height of 4.9 m onto a horizontal floor and rebounds with half the speed with which it hits the floor. Take up as positive.
(a) Sketch the velocity–time graph from release until the ball hits the floor for the second time.
(b) Find the time from release until the second impact.
AQA R3, Q2 · Edexcel 8.3, 7.2

9 A ball is projected vertically upwards with speed 9.8 m s^{-1} from a point 24.5 m above the ground. Take up as positive.
(a) Find the time of flight.
(b) Sketch the velocity–time graph from projection until the ball hits the ground.
(c) Use the graph to find the greatest height above the ground.
AQA R3, Q2 · Edexcel 8.3, 7.2

10 A ball is projected vertically upwards from O with speed u m s^{-1}. It is at least h metres above O for a total time of T seconds.
(a) Show that $u^2 = 2gh + \tfrac{1}{4}g^2T^2$.
(b) Find u when the ball is at least 10 m above O for 2 s.
AQA R3, Q3 · Edexcel 8.3, 7.3 (show that)

11 *AQA-style*. Particle P is released from rest at a point 36 m above the ground. At the same instant particle Q is projected vertically upwards with speed 15 m s^{-1} from the point on the ground directly below P. Use $g = 9.81$ m s^{-2} and give your answers to 3 s.f.
(a) Show that the particles collide 2.4 s after they start to move. [2 marks]
(b) Find the height above the ground at which they collide. [2 marks]
(c) Find the speed of each particle just before they collide. [2 marks]
(d) State one modelling assumption you have made. [1 mark]
AQA R3 (g to varying accuracy) · Edexcel 8.3 · AQA-style

12 *Edexcel-style*. A ball is released from rest at a point 6.4 m above a horizontal floor. The ball hits the floor and rebounds vertically with half the speed with which it hit the floor. Modelling the ball as a particle moving freely under gravity, find
(a) the speed with which the ball first hits the floor, (2)
(b) the greatest height above the floor reached after the bounce, (2)
(c) the time from release until the ball hits the floor for the second time. (2)
AQA R3, Q3 · Edexcel 8.3, 7.3 · Edexcel-style