

1 A particle moves from A to B under constant acceleration.

The distance between A and B is s .

The speed at A is u . The speed at B is v .

The time taken is t .

The acceleration is a .

(a) Given $s = 50$ m, $u = 0$ ms⁻¹, $v = 20$ ms⁻¹. Find a and t .

(2)

(b) Given $s = 200$ m, $a = 2$ ms⁻², $v = 30$ ms⁻¹. Find t and u .

(2)

(c) Given $s = 85$ m, $t = 5$ s, $v = 20$ ms⁻¹. Find a and u .

(2)

(d) Given $s = 100 \text{ m}$, $a = 2 \text{ ms}^{-2}$, $t = 4 \text{ s}$. Find u and v .

(2)

(e) Given $v = 10 \text{ ms}^{-1}$, $a = 1.5 \text{ ms}^{-2}$, $t = 3 \text{ s}$. Find s and u .

(2)

(Total for question 1 is 10 marks)

- 2** A ball is projected vertically upwards with a speed of 20 m s^{-1} from a point h metres above the ground. The ball hits the ground 5 s later.

(a) Find the value of h .

(3)

(b) Find the speed of the ball as it hits the ground.

(3)

(Total for question 2 is 6 marks)

3 A car passes point A with a speed of 20 km/h. The car accelerates at a constant rate and 10 seconds later it passes point B with a speed of 70 km/h.

(a) Find the acceleration of the car in ms^{-1} .

(3)

(b) Find the distance AB.

(3)

(Total for question 3 is 6 marks)

4 A stone is dropped from a point 120 m from the ground.

(a) Find the time it takes for the stone to reach the ground.

(3)

(b) Find the speed at which the stone hits the ground.

(3)

(Total for question 4 is 6 marks)

- 5** A particle moves along a straight line, from point X to point Y, with constant acceleration. The distance XY is 120 m. The particle takes 8 seconds to move from X to Y and the speed of the particle at Y is double the speed of the particle at X.

(a) Find the speed of the particle at X.

(3)

(b) Find the acceleration of the particle.

(3)

(Total for question 5 is 6 marks)

- 6** A car passes point A with a speed of 5ms^{-1} . The car accelerates at a constant rate and 8 seconds later it passes point B with a speed of 20ms^{-1} .

(a) Find the acceleration of the car.

(3)

(b) Find the distance AB.

(3)

- (c) Find the time it takes the car to reach the midpoint of AB.

(4)

(Total for question 6 is 10 marks)

- 7 A train, moving with constant acceleration, passes through three points A, B and C, where $AB = 40\text{m}$ and $BC = 60\text{m}$. The train passes through A with a speed of 10ms^{-1} and 6 seconds later passes through C.

(a) Find the acceleration of the train.

(3)

(b) Find the speed at which the train passes through B.

(3)

- (c) Find the time it takes for the train to move between B and C.

(3)

(Total for question 7 is 9 marks)

8 A stone is projected vertically upwards with a speed 18ms^{-1} from a point 2 m above the ground.

(a) Find the greatest height reached by the stone.

(3)

(b) Find the speed at which the stone hits the ground.

(3)

- (c) Find the time between the instant the stone is projected and when it hits the ground.

(3)

(Total for question 8 is 9 marks)

- 9** A car passes three posts P, Q and R, on a straight horizontal road. The distance $PQ = 50\text{m}$. The distance $QR = 100\text{m}$. The car, moving with constant acceleration, takes 2 seconds to travel from P to Q and 3 seconds to travel from Q to R.

(a) Find the acceleration of the car.

(3)

(b) Find the speed of the car at the instant it passes Q.

(3)

(Total for question 9 is 6 marks)

10 A particle is projected vertically upwards from a point 1.5 m above the ground with a speed of 10ms^{-1} .

(a) Find the greatest height reached by the particle.

(3)

(b) Find the time for which the particle is more than 3 m above the ground.

(3)

(Total for question 10 is 6 marks)

- 11** A train accelerates from rest at station A to a velocity of 32ms^{-1} . It maintains this speed for 72 seconds, until it decelerates uniformly to station B. The total journey time is 112 seconds and the magnitudes of the acceleration and deceleration are equal.

(a) Find the time it takes the train to accelerate from rest to 32ms^{-1} .

(2)

(b) Sketch a velocity-time graph for the motion of the train between station A and station B.

(2)

(c) Calculate the distance between the two stations.

(3)

(Total for question 11 is 7 marks)

- 12** A train moves along a straight horizontal track between two stations, A and B. The train starts from rest and moves with acceleration of 0.6ms^{-2} for 40 seconds. The train moves at constant velocity before decelerating at a rate of 0.4ms^{-2} until it reaches B. The total distance between the two station is 4 km.

(a) Sketch a velocity-time graph for the motion of the train between A and B.

(3)

(b) Find the total time taken by the train to travel from A to B.

(4)

(Total for question 12 is 7 marks)

- 13** A particle, moving in a straight line, decelerates uniformly, from a speed $5U\text{ms}^{-1}$, for 6 seconds which reduces its speed to $2U\text{ms}^{-1}$. It maintains this speed for a further 16 seconds before decelerating uniformly to rest in a further 2 seconds.

(a) Sketch a velocity-time graph for this information.

(2)

(b) Find an expression for each of the decelerations in terms of U .

(4)

(c) Given the total distance is 220m, find the value of U.

(6)

(Total for question 13 is 12 marks)

- 14** A car starts from rest and accelerates at a constant rate to the speed of $V \text{ ms}^{-1}$ in 6 seconds. The car maintains this speed for 50 seconds before decelerating to rest. The magnitude of the deceleration is 1.5 times this magnitude of the acceleration.

(a) Show the total time taken for the journey is 60 seconds.

(3)

(b) Sketch a velocity-time graph for this information.

(3)

- (c) Given the total distance is 1320m, find the value of V .

(3)

(Total for question 14 is 9 marks)

- 15** A man stands on a ledge and throws a ball into the air so that, at the instant when the ball leaves his hand, the ball is 4 m above the ground and is moving vertically upwards with speed 8 ms^{-1} . The motion of the ball is modelled as that of a particle moving freely under gravity and the acceleration due to gravity is modelled as being of constant magnitude 10 ms^{-2} . The ball hits the ground T seconds after leaving the man's hand.
Using the model, find the value of T .

(Total for question 15 is 5 marks)

- 16** A train travels along a straight horizontal track between two stations, A and B . Tom models the motion of the train. In the model, the train starts from rest at A and moves with constant acceleration 0.4 m s^{-2} for 70 s. The train then moves at constant velocity before it moves with a constant deceleration of 0.5 m s^{-2} , coming to rest at B .

(a) Sketch a velocity-time graph for the motion of the train according to the model.

(2)

(b) The total distance between the two stations is 3360 m. Use the model to find the total time taken by the train to travel from A to B .

(4)

- (c) Suggest one improvement that could be made to the model of the motion of the train to make the model more realistic.

(1)

(Total for question 16 is 7 marks)

- 17** A ball is thrown into the air. The motion of the ball is modelled so that at the instant the ball is thrown it is 5 m off the ground and moving vertically upwards with a speed of 12 ms^{-1} . The ball is modelled as a particle moving freely under gravity. The acceleration due to gravity is modelled as being 10 m s^{-2} .

(a) Sketch a velocity-time graph for the motion of the ball for $0 \leq t \leq T$.

(2)

(b) Using this model, find the time taken for the ball to reach its maximum height.

(2)

(c) Find the value of T .

(3)

(d) How would this new value of T compare with the value found, using the initial model, in part (c)?

(1)

(e) Suggest one further refinement to the model, apart from air resistance, to make the model more realistic.

(1)

(Total for question 17 is 9 marks)
