Year 1 Applied - Exam Questions SUVATS

Q1.
At time $t = 0$, a small stone is thrown vertically upwards with speed 14.7 m s^{-1} from a point A.

At time $t = T$ seconds, the stone passes through A, moving downwards. The stone is modelled as a particle moving freely under gravity throughout its motion.

Using the model,

(a) find the value of T,

(2)

(b) find the total distance travelled by the stone in the first 4 seconds of its motion.

(4)

(c) State one refinement that could be made to the model, apart from air resistance, that would make the model more realistic.

(1)

(Total for question = 7 marks)

Q2.

A cyclist is moving along a straight horizontal road and passes a point A. Five seconds later, at the instant when she is moving with speed 10 ms^{-1}, she passes the point B. She moves with constant acceleration from A to B.

Given that AB = 40m, find

(a) the acceleration of the cyclist as she moves from A to B,

(4)

(b) the time it takes her to travel from A to the midpoint of AB.

(5)

(Total for question = 9 marks)

Q3.
At time $t = 0$, a particle is projected vertically upwards with speed u from a point A. The particle moves freely under gravity. At time T the particle is at its maximum height H above A.

(a) Find T in terms of u and g.

(2)

(b) Show that $H = \frac{u^2}{2g}$

(2)

The point A is at a height $3H$ above the ground.

(c) Find, in terms of T, the total time from the instant of projection to the instant when the particle hits the ground.

(4)

(Total 8 marks)

Q4.

A stone is projected vertically upwards from a point A with speed u m s^{-1}. After projection the stone moves freely under gravity until it returns to A. The time between the instant that the stone is projected and the instant that it returns to A is $3\frac{4}{7}$ seconds.

Modelling the stone as a particle,

(a) show that u = 17 $\frac{1}{2}$,

(3)

(b) find the greatest height above A reached by the stone,

(2)

(c) find the length of time for which the stone is at least 6 $\frac{3}{5}$ m above A.

(6)

(Total 11 marks)

Q5.
At time $t = 0$ a ball is projected vertically upwards from a point O and rises to a maximum height of 40 m above O. The ball is modelled as a particle moving freely under gravity.

(a) Show that the speed of projection is 28 m s^{-1}.

(3)

(b) Find the times, in seconds, when the ball is 33.6 m above O.

(5)

(Total 8 marks)

Q6.

A ball is thrown vertically upwards with speed u m s^{-1} from a point P at height h metres above the ground. The ball hits the ground 0.75 s later. The speed of the ball immediately before it hits the ground is 6.45 m s^{-1}. The ball is modelled as a particle.

(a) Show that $u = 0.9$

(3)

(b) Find the height above P to which the ball rises before it starts to fall towards the ground again.

(2)

(c) Find the value of h.

(3)

(Total 8 marks)

Q7.

A car moves along a horizontal straight road, passing two points *A* and *B*. At *A* the speed of the car is 15 m s^{-1}. When the driver passes *A*, he sees a warning sign *W* ahead of him, 120 m away. He immediately applies the brakes and the car decelerates with uniform deceleration, reaching *W* with speed 5 m s^{-1}. At *W*, the driver sees that the road is clear. He then immediately accelerates the car with uniform acceleration for 16 s to reach a speed of *V* m s^{-1} ($V > 15$). He then maintains the car at a constant speed of *V* m s^{-1}. Moving at this constant speed, the car passes *B* after a further 22 *s*.

(a) Sketch, in the space below, a speed-time graph to illustrate the motion of the car as it moves from *A* to *B*.

(3)

(b) Find the time taken for the car to move from *A* to *B*.

(3)

The distance from *A* to *B* is 1 km.

(c) Find the value of *V*.

(5)

(Total 11 marks)

Q8.
A ball is projected vertically upwards with a speed of 14.7 m s^{-1} from a point which is 49 m above horizontal ground. Modelling the ball as a particle moving freely under gravity, find

(a) the greatest height, above the ground, reached by the ball,

(4)

(b) the speed with which the ball first strikes the ground,

(3)

(c) the total time from when the ball is projected to when it first strikes the ground.

(3)

(Total 10 marks)

Q9.

Unless otherwise indicated, wherever a numerical value of g is required, take $g = 9.8$ m s^{-2} and give your answer to either 2 significant figures or 3 significant figures.

A man throws a tennis ball into the air so that, at the instant when the ball leaves his hand, the ball is 2 m above the ground and is moving vertically upwards with speed 9 m s^{-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 m s^{-2}

The ball hits the ground T seconds after leaving the man's hand.

Using the model, find the value of T.

(4)

(Total for question = 4 marks)