Pearson Edexcel A Level Mathematics 9MA0

Mechanics – Application of Kinematcs

Time allowed: 45 **minutes**

School: www.CasperYC.club

Name:

Teacher:

Question	Points	Score
1	12	
2	16	
3	8	
4	14	
Total:	50	

How I can achieve better:

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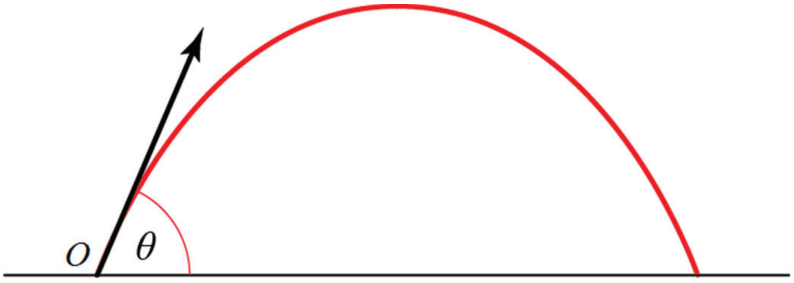
1. A ball is launched from the origin with speed 1 m/s. Its velocity vector makes an angle θ above the horizontal. It travels over flat ground and is modelled as a particle moving freely under gravity. (In this question, take $g = 10\ \text{m/s}^2$)



(a) Find the horizontal and vertical displacements of the particle at time t seconds. You should give your answer in terms of θ and t. [4]

(b) Show that the horizontal distance travelled by the particle before it hits the ground is $\dfrac{\sin(2\theta)}{10}$. [5]

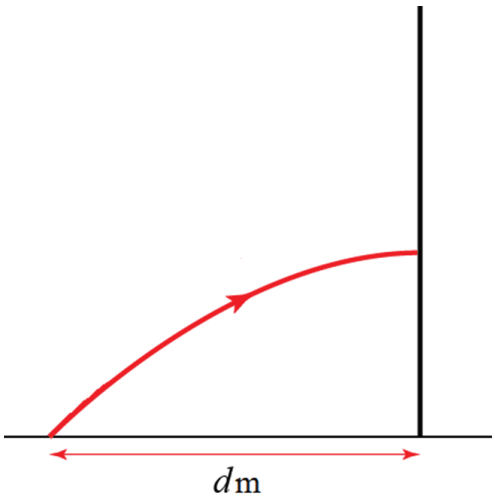
(c) Find the value θ for which the horizontal distance travelled is a maximum. [2]

(d) Describe one limitation of this model. [1]

Total: 12

(Q1 continued . . .)

2. A ball, modelled as a particle moving freely under gravity, is launched at 2 m/s from the origin at angle 45° above the horizontal. (In this question, take $g = 10\ \text{m/s}^2$)



(a) Find the coordinates of the particle when it is at its maximum height. [10]

On another occasion, the projectile is again is launched at 2 m/s from the origin at angle 45° above the horizontal. It travels a horizontal distance d m before hitting a vertical wall and then falling straight to the ground.

(b) Find the maximum height attained if $d = 0.1$. Give your answer in cm. [5]

(c) Describe a possible limitation of this model. [1]

Total: 16

(Q2 continued . . .)

3. A projectile is launched at 8 m/s from the origin at a 60° angle to the horizontal. [8]

   Find the length of time for which the particle is at least 2 m above its launch point.

   (In this question, take $g = 9.8\ \text{m/s}^2$)

4. An archer shoots an arrow at 10 m/s from the origin and hits a target at $(10, -5)$ m. The initial velocity of the arrow is at an angle θ above the horizontal. The arrow is modelled as a particle moving freely under gravity. (In this question, take $g = 10\ \text{m/s}^2$.)

   (a) Show that [11]

   $$(\tan(\theta) - 1)^2 = 1.$$

   (b) Find the possible values of θ. [3]

Total: 14