MATHSAURUS

A Level Mathematics Year 2 Exam Questions by Topic
Chapter 21: Projectiles

These questions are taken from the Specimen Exam materials and the real 2018 papers for the new syllabus AS and A-level mathematics courses and arranged by chapter of the textbooks by Goldie et al (available here: `https://amzn.to/39umfr5` and `https://amzn.to/3hE8kBL`). There are a mixture of questions from OCR A, OCR B (MEI) and Edexcel. Although the style of questions varies a little across the exam boards the content of the syllabus is almost identical so these are suitable for students preparing for any exam board.

Free problem sets for all other chapters, as well as video solutions, full past papers and other content for GCSE and A-level maths can be found at:

`https://mathsaurus.com/`

OCR B MEI Sample Paper 1 Question 7:

7 **In this question take $g = 10$.**

A small stone is projected from a point O with a speed of 26 m s^{-1} at an angle θ above the horizontal. The initial velocity and part of the path of the stone are shown in Fig. 7. You are given that $\sin\theta = \frac{12}{13}$. After t seconds the horizontal and vertical displacements of the stone from O are x metres and y metres.

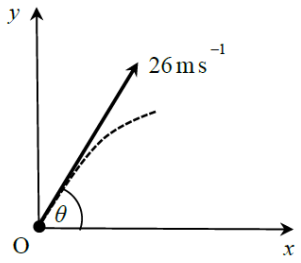


Fig. 7

(i) Using the standard model for projectile motion,

- show that $y = 24t - 5t^2$,
- find an expression for x in terms of t. **[4]**

The stone passes through a point A which is 16 m above the level of O.

(ii) Find the two possible horizontal distances of A from O. **[4]**

Suppose that a toy balloon is projected from O with the same initial velocity as the small stone.

(iii) Suggest two ways in which the standard model could be adapted. **[2]**

OCR B MEI 2018 Paper 1 Question 9:

9 A pebble is thrown horizontally at $14\,\text{m s}^{-1}$ from a window which is 5 m above horizontal ground. The pebble goes over a fence 2 m high d m away from the window as shown in Fig. 9. The origin is on the ground directly below the window with the x-axis horizontal in the direction in which the pebble is thrown and the y-axis vertically upwards.

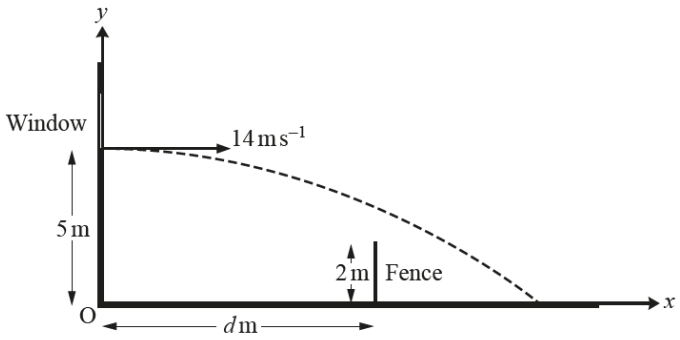


Fig. 9

(i) Find the time the pebble takes to reach the ground. **[3]**

(ii) Find the cartesian equation of the trajectory of the pebble. **[4]**

(iii) Find the range of possible values for d. **[3]**

Edexcel 2018 Paper 3 Question 10:

10.

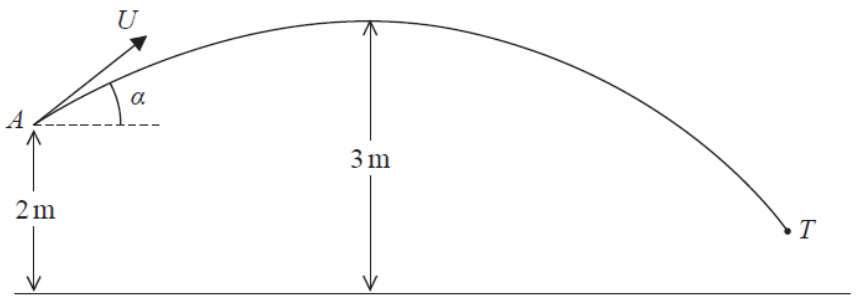


Figure 4

A boy throws a ball at a target. At the instant when the ball leaves the boy's hand at the point A, the ball is 2 m above horizontal ground and is moving with speed U at an angle α above the horizontal.

In the subsequent motion, the highest point reached by the ball is 3 m above the ground. The target is modelled as being the point T, as shown in Figure 4.
The ball is modelled as a particle moving freely under gravity.

Using the model,

(a) show that $U^2 = \dfrac{2g}{\sin^2 \alpha}$.

(2)

The point T is at a horizontal distance of 20 m from A and is at a height of 0.75 m above the ground. The ball reaches T without hitting the ground.

(b) Find the size of the angle α

(9)

(c) State one limitation of the model that could affect your answer to part (b).

(1)

(d) Find the time taken for the ball to travel from A to T.

(3)

Edexcel Sample Paper 3 Question 10:

10.

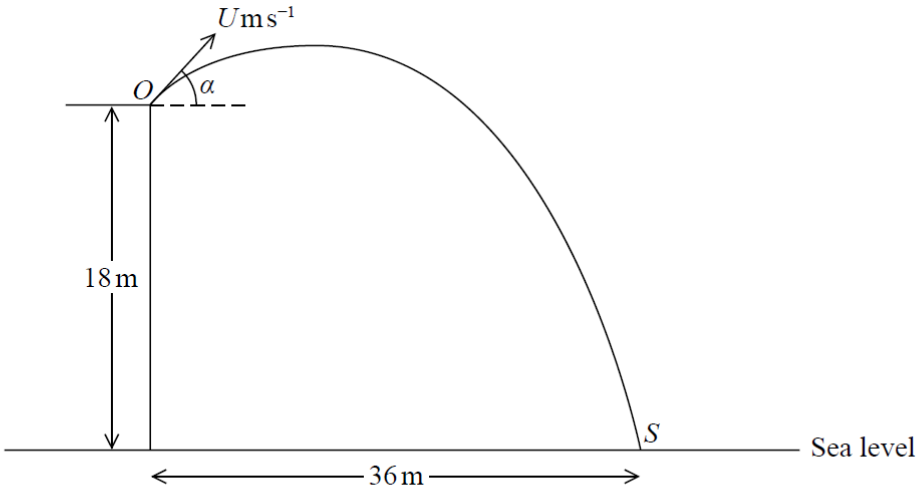


Figure 2

A boy throws a stone with speed $U\,\mathrm{m\,s^{-1}}$ from a point O at the top of a vertical cliff.
The point O is 18 m above sea level.

The stone is thrown at an angle α above the horizontal, where $\tan\alpha = \frac{3}{4}$.

The stone hits the sea at the point S which is at a horizontal distance of 36 m from the foot of the cliff, as shown in Figure 2.
The stone is modelled as a particle moving freely under gravity with $g = 10\,\mathrm{m\,s^{-2}}$

Find

(a) the value of U,

(6)

(b) the speed of the stone when it is 10.8 m above sea level, giving your answer to 2 significant figures.

(5)

(c) Suggest two improvements that could be made to the model.

(2)

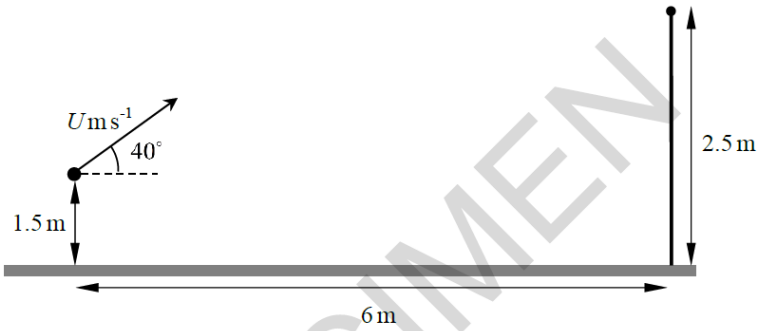
OCR A Sample Paper 3 Question 12:

12 A girl is practising netball. She throws the ball from a height of 1.5 m above horizontal ground and aims to get the ball through a hoop. The hoop is 2.5 m vertically above the ground and is 6 m horizontally from the point of projection.

The situation is modelled as follows.

- The initial velocity of the ball has magnitude $U\,\text{m s}^{-1}$.
- The angle of projection is 40°.
- The ball is modelled as a particle.
- The hoop is modelled as a point.

This is shown on the diagram below.



(i) For $U = 10$, find

(a) the greatest height above the ground reached by the ball, **[5]**

(b) the distance between the ball and the hoop when the ball is vertically above the hoop. **[4]**

(ii) Calculate the value of U which allows her to hit the hoop. **[3]**

(iii) How appropriate is this model for predicting the path of the ball when it is thrown by the girl? **[1]**

(iv) Suggest one improvement that might be made to this model. **[1]**