

# Bonfire Night maths activities for A Level

A Level Math Revision · A Level Maths (Year 12 and Year 13) · 5 November · Student sheet

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_

The starter is non-calculator. A calculator is needed for the main activity. Take  $g = 9.8 \text{ m s}^{-2}$ .

## Starter (5 minutes)

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1. Find the sum of the first 10 terms of 3, 7, 11, ...
2. Find the sum to infinity of  $8 + 4 + 2 + \dots$
3. A spark is thrown straight up at  $14 \text{ m s}^{-1}$ . How long does it take to reach its highest point? ( $g = 9.8 \text{ m s}^{-2}$ )
4. Solve  $4.9t^2 - 19.6t = 0$ .

## Main activity (35 minutes)

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### Task A: The firework projectile

A firework is launched from ground level at  $35 \text{ m s}^{-1}$  at  $60^\circ$  above the horizontal. Model it as a particle moving freely under gravity.

- a. Find the time to reach the highest point and the greatest height, each to 3 significant figures.
- b. The firework explodes at its highest point. How far has it travelled horizontally? Give 3 significant figures.
- c. If it did not explode, how far from the launch point would it land? Give 3 significant figures.
- d. For how long is the firework at least 30 m above the ground? Give 3 significant figures.

### Task B: The rocket motor (Year 13)

A rocket rises vertically from the ground. Its velocity is  $v = 24t - 3t^2 \text{ m s}^{-1}$  for  $0 \leq t \leq 8$ .

- a. Find when the acceleration is zero, and the greatest velocity.
- b. Find the height of the rocket when  $t = 8$ .

### Task C: Remember, remember: series

A display fires 5 fireworks in the first minute, 8 in the second, 11 in the third, and so on.

- a. How many fireworks are fired in the 20th minute, and in the first 20 minutes altogether?
- b. The display has 1000 fireworks. After how many whole minutes have they all been fired?
- c. On 5 November one person shares a photo with 5 friends. The next day each of them shares it with 5 new people, and so on. How many people (not counting the first) have received it after 5 rounds?
- d. After how many rounds have more than one million people received it?

### Extension

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1. Show that the path of the firework in task A is  $y = \sqrt{3}x - (2/125)x^2$ .
2. The same firework is launched from the top of a 20 m high hill, at the same speed and angle. How long is it in the air, and how far away horizontally does it land? Give 3 significant figures.