Cambridge IGCSE

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/61**

Paper 6 (Extended) **May/June 2019**

1 hour 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Graphics Calculator

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
Do not use staples, paper clips, glue or correction fluid.
You may use an HB pencil for any diagrams or graphs.
DO **NOT** WRITE IN ANY BARCODES.

Answer both parts **A** (Questions 1 to 5) and **B** (Questions 6 to 8).
You must show all the relevant working to gain full marks for correct methods, including sketches.
In this paper you will also be assessed on your ability to provide full reasons and communicate your mathematics clearly and precisely.
At the end of the examination, fasten all your work securely together.
The total number of marks for this paper is 40.

This document consists of **12** printed pages.

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Answer **both** parts **A** and **B**.

A INVESTIGATION (QUESTIONS 1 to 5)

GAMES IN A COMPETITION (20 marks)

You are advised to spend no more than 45 minutes on this part.

This investigation looks at the numbers of games played in two kinds of competition.

1 In a *knock-out* competition each team plays a game against one of the other teams.
The teams that win these games play in the second round.
The teams that win in the second round play in the third round and so on.

(a) (i) There are two teams in the last round, called the final.
The round before the final is called the semi-finals.
The round before the semi-finals is called the quarter-finals.

Write down the number of teams in the quarter-finals.

.....

(ii) There are 32 teams in a competition.

Find the number of rounds.

.....

(iii) There are 7 rounds in a competition.

Find the number of teams.

.....

(b) Use your answers to **question 1(a)** to help you complete the table.

Number of rounds (r)	1	2	3	4	5	6	7	8
Number of teams (t)	2							256

(c) **(i)** Find a formula for t, the number of teams, in terms of r, the number of rounds.

.....

(ii) Use your formula to calculate the number of teams in a competition with 15 rounds.

.....

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2 The number of teams in a *knock-out* competition should be a number in the sequence in **question 1**.

The number 11 is not in the sequence.

When there are 11 teams, a first round is played to reduce the number of teams to 8.
In this first round, only 6 teams play, giving 3 winners.
The remaining 5 teams go through to the second round without playing.

(a) There are 25 teams in a *knock-out* competition.

(i) Find the number of rounds.

.....

(ii) Find the total number of games.

.....

(b) Find the total number of games when there are 36 teams.

.....

(c) What is the connection between the number of teams and the number of games?

.....

3 In a *league* competition every team must play each of the other teams once.

Example
There are three teams, A, B and C in the competition.
Three different games are played.

These are: A against B A against C B against C

These are written as: AB AC BC

(a) Complete this table.

Number of teams (n)	2	3	4	5	6	7	8
Number of games (g)	1	3					28

(b) When there are n teams in the competition the number of games played is g, where

$$g = an^2 + bn.$$

Find the value of a and the value of b.
Write down the formula for g in terms of n.

.....

(c) Show that your formula in **part (b)** gives the correct result for 8 teams.

4 There are now 8 teams in this competition, A, B, C, D, E, F, G and H.
Every team plays one game each week.
Note that AB is the same as BA.

Complete the table to show the games for the first three weeks.
There are many ways of doing this. You only need to show one way.

	Game 1	Game 2	Game 3	Game 4
Week 1	AB	DG		CH
Week 2	AC			
Week 3				

5 There are more than two teams in each competition.

(a) It is possible to have the **same number of games** in both a *knock-out* competition and a *league* competition.

Find a possible number of games and the number of teams in each competition.

Number of games .....

Number of teams in *knock-out* .....

Number of teams in *league* .....

(b) It is possible to have half the number of games in a *knock-out* competition as in a *league* competition. There is the **same number of teams** in each competition.

Find the number of teams and the number of games in each competition.

Number of teams .....

Number of games in *knock-out* .....

Number of games in *league* .....

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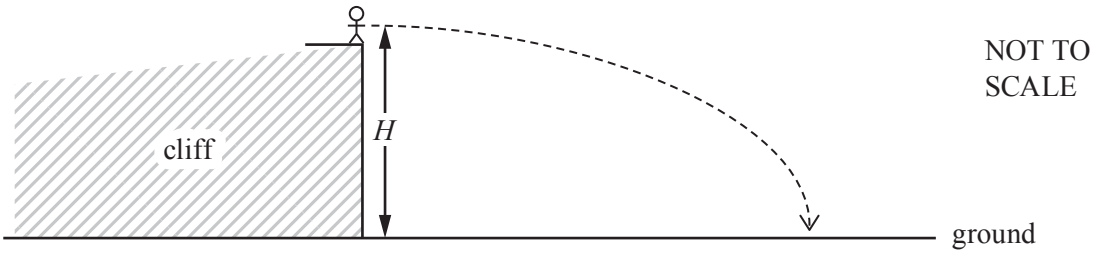
B MODELLING (QUESTIONS 6 to 8)

THROWING STONES (20 marks)

You are advised to spend no more than 45 minutes on this part.

This part looks at modelling the path of a stone thrown from a vertical cliff onto horizontal ground.



A stone is thrown horizontally from the top of the cliff at height H metres above the horizontal ground.
The model of its height, h metres, at time, t seconds, is

$$h = H - 4.9t^2.$$

6 **(a)** Charlie stands on the top of the cliff.
He throws a stone horizontally at a height of 122.5 m above the horizontal ground.

Write down the model for the height of his stone.

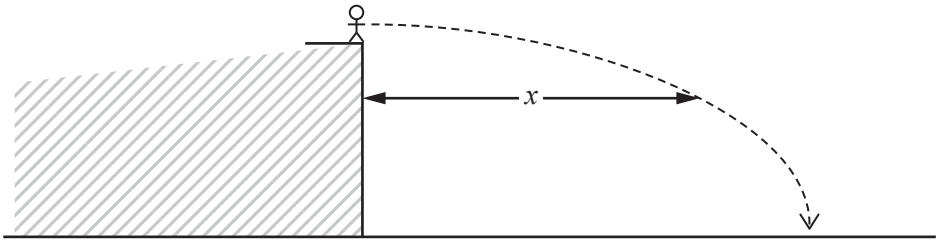
.....

(b) Sketch the model in **part (a)** on the axes below, for $0 \leqslant t \leqslant 5$.

(c) Write down the number of seconds that the stone takes to hit the ground.

.....

(d)



NOT TO SCALE

A stone is thrown horizontally, with speed v, from the top of the cliff.
At time t seconds the stone is x metres from the cliff.

A model for the horizontal distance is $x = vt$.

(i) Write down the units of v.

.....

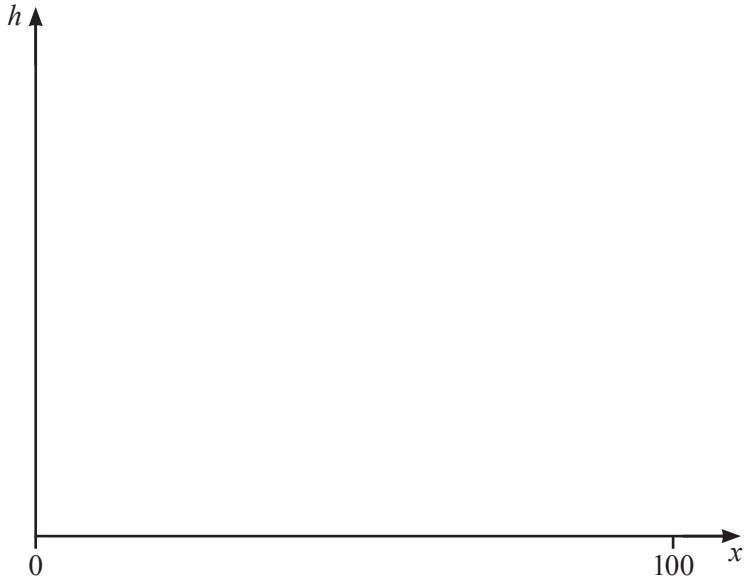
(ii) When Charlie throws his stone, $v = 20$.
Find the value of x when this stone hits the ground.

.....

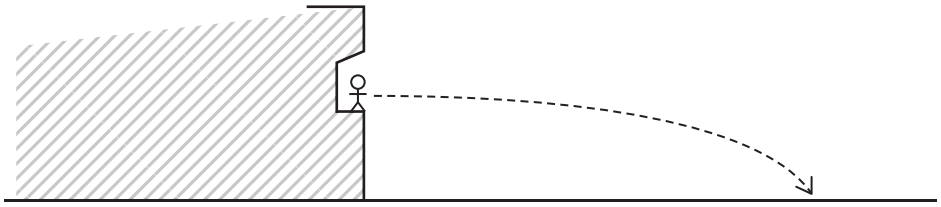
(e) **(i)** When $v = 20$, use the models in **part (a)** and **part (d)** to show that

$$400h = 49\,000 - 4.9x^2.$$

(ii) Sketch the graph of $400h = 49000 - 4.9x^2$, for $0 \leqslant x \leqslant 100$.



7 Belinda stands on a ledge on the cliff.



She throws a stone horizontally, with $v = 28.3$.

A model of the height of her stone is $h = 61.25 - 4.9\frac{x^2}{800}$.

(a) Write down the height from which Belinda throws her stone.

.....

(b) On the axes in **question 6(e)(ii)**, sketch the graph of $h = 61.25 - 4.9\frac{x^2}{800}$, for $0 \leqslant x \leqslant 100$.

(c) Using the model in **question 6(d)**, calculate the time Belinda's stone takes to hit the ground.

.....

8 Jayden is standing next to Charlie and Mackenzie is standing next to Belinda.
Jayden throws a stone horizontally towards a point which is 50 m horizontally from the base of the cliff.

(a) The model of the height of Jayden's stone is

$$h = 122.5 - 4.9\left(\frac{kx}{16}\right)^2.$$

Jayden's stone hits the point.

Find the value of k.

.....

(b) Find the horizontal distance from the cliff to where Jayden's stone crosses the path of Belinda's stone.

.....

Questions 8(c) and 8(d) are printed on the next page.

(c) Belinda's stone does not hit the point.

Use the model for the height of Belinda's stone in **question 7**, to calculate how far down the cliff she should move so that when she throws her stone it hits the point.

.....

(d) Mackenzie throws a stone horizontally and hits the point.

Find the speed with which Mackenzie throws this stone.

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