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CAMBRIDGE INTERNATIONAL MATHEMATICS

0607/62

Paper 6 Investigation and Modelling (Extended)

October/November 2020

1 hour 40 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer both part **A** (Questions 1 to 4) and part **B** (Questions 5 to 9).
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a graphic display calculator where appropriate.
- You may use tracing paper.
- You must show all necessary working clearly, including sketches, to gain full marks for correct methods.
- In this paper you will be awarded marks for providing full reasons, examples and steps in your working to communicate your mathematics clearly and precisely.

INFORMATION

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Blank pages are indicated.

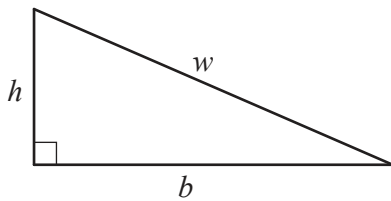
2

Answer **both** parts **A** and **B**.**A INVESTIGATION (QUESTIONS 1 to 4)****AREA OF RIGHT-ANGLED TRIANGLES (30 marks)**

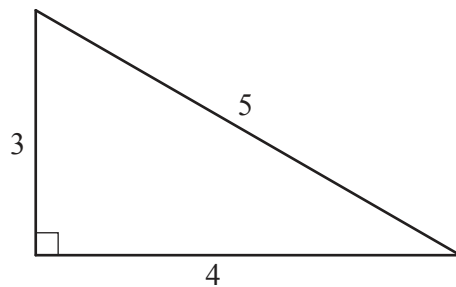
You are advised to spend no more than 50 minutes on this part.

This investigation looks at finding the area of a right-angled triangle using its perimeter.

In this investigation all lengths are in centimetres.



w is the hypotenuse of the triangle,
 b is the base of the triangle,
 h is the height of the triangle.

Perimeter, P , of this triangle. $P = b + h + w$ Area, A , of this triangle. $A = \frac{1}{2}bh$ **1 (a)**NOT TO
SCALE**(i)** Find the perimeter of this triangle.

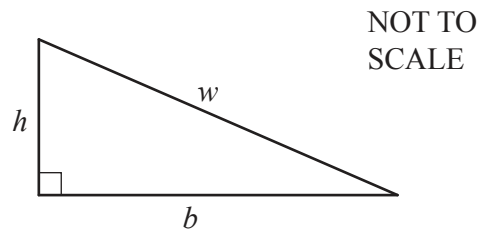
..... [1]

(ii) Find the area of this triangle.

..... [1]

3

(b)



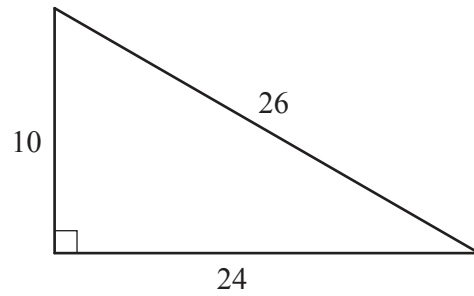
Complete the table for right-angled triangles with sides b , h and w .

b	h	w	Perimeter, P	Area, A
12	5	13	30	30
84	13	85		
24		25	56	84
60	11		132	

[3]

4

2 (a)

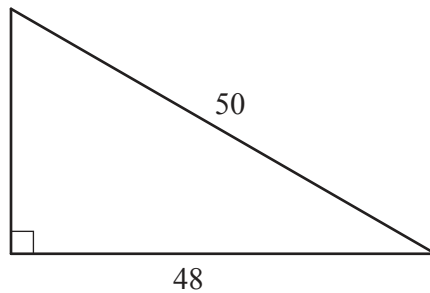
NOT TO
SCALE

This triangle has perimeter $P = 60$.

Show that the calculation $\frac{60}{2} \times \left(\frac{60}{2} - 26 \right)$ gives the correct area for this triangle.

[3]

(b)

NOT TO
SCALE

This triangle has perimeter $P = 112$.

Show that the calculation $\frac{112}{2} \times \left(\frac{112}{2} - 50 \right)$ gives the correct area for this triangle.

[3]

3 (a) Complete the table.

b	h	w	P	A	Calculation
24	10	26	60	120	$\frac{60}{2} \times \left(\frac{60}{2} - 26\right) = 120$
12	9	15	36	54	$\frac{36}{2} \times \left(\frac{36}{2} - 15\right) = 54$
48		50	112		$\frac{112}{2} \times \left(\frac{112}{2} - 50\right) =$
15	8	17		60	$= 60$
21		29	70	210	$=$
	12	37		210	$=$

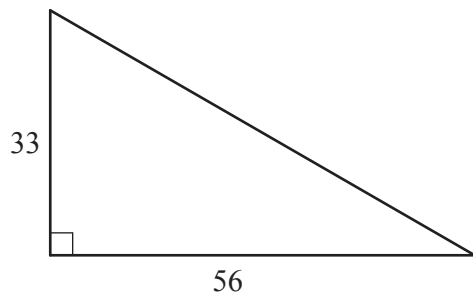
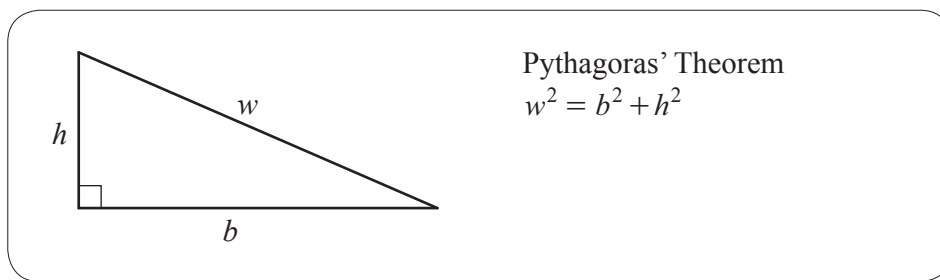
[4]

(b) Write an expression for the area of a right-angled triangle in terms of P and w .

..... [1]

6

(c)

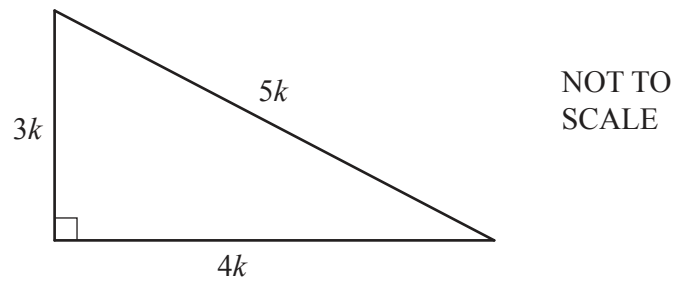
NOT TO
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Use your expression from **part (b)** to find the area of this triangle.

..... [4]

7

(d)



Show that your expression from **part (b)** works for right-angled triangles with sides $3k$, $4k$ and $5k$.

[2]

8

4 (a) An isosceles right-angled triangle has sides x , x and 10.

- (i) Use **Question 3(b)** to find an expression for the area of this triangle.
Give your answer in its simplest form.

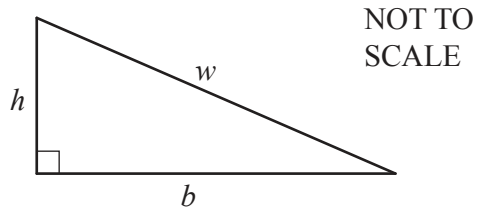
..... [2]

- (ii) Use your answer to **part (i)** and the formula for the area of a triangle, to find the exact value of x .

..... [2]

9

(b)



- (i) By writing $u = b + h$ and using your expression from **Question 3(b)**, find an expression, in terms of u and w , for the area of any right-angled triangle.

[3]

- (ii) Use Pythagoras' theorem to show that your expression from **part (i)** gives $\frac{1}{2}bh$ for all right-angled triangles.

[1]

B MODELLING (QUESTIONS 5 to 9)**HOT AIR BALLOON FLIGHT (30 marks)**

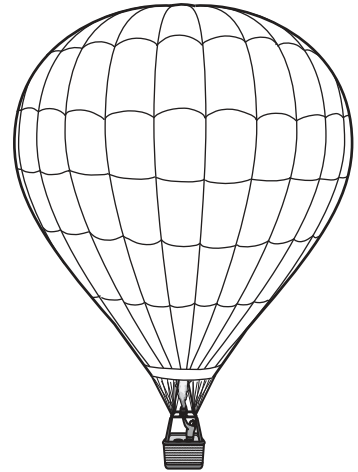
You are advised to spend no more than 50 minutes on this part.

This task is about the flight of a hot air balloon.

A balloon travels in the direction of the wind.
The pilot can make the balloon rise or descend.

A journey is in four parts.

- Part 1 Lift-off. The balloon leaves the ground and rises.
- Part 2 The flight.
- Part 3 The balloon descends quickly.
- Part 4 The balloon descends slowly and lands.

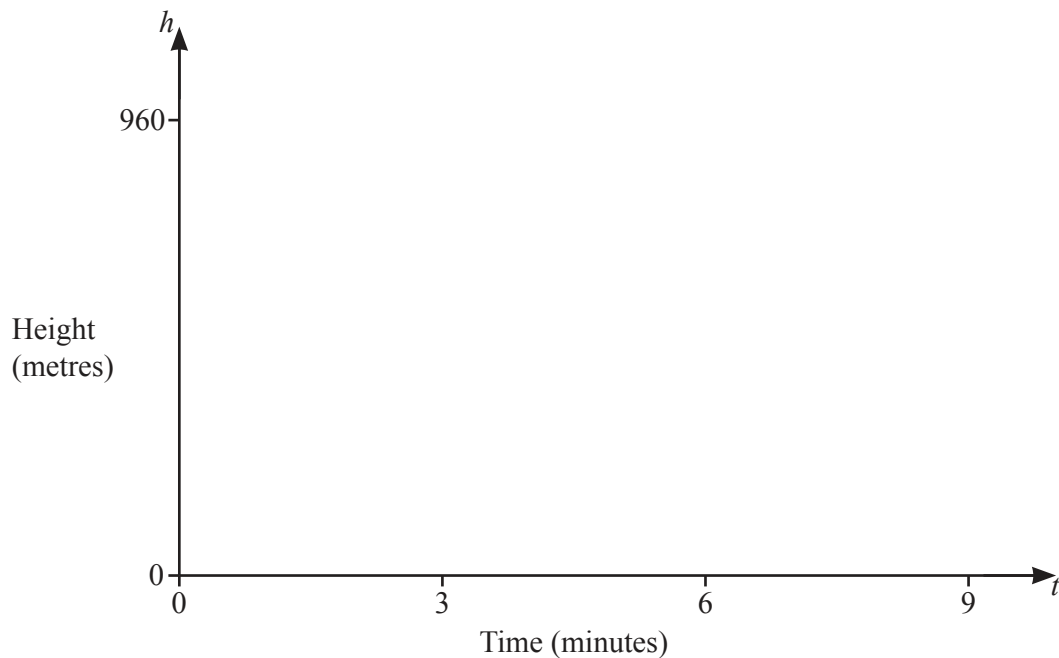


5 This journey is at sunrise.

For Part 1, a model for the height of the balloon above the ground (h metres), t minutes after lift-off, is

$$h = 480(1 - \cos(20t)^\circ) \quad \text{for } 0 \leq t \leq 9.$$

(a) On the diagram, sketch the graph of h for $0 \leq t \leq 9$.



[2]

11

- (b)** Find the height of the balloon 3 minutes after lift-off.

..... [1]

- (c)** Find the increase in height between 3 minutes and 6 minutes after lift-off.

..... [2]

- (d)** Find the average speed at which the balloon is rising between 3 minutes and 6 minutes after lift-off.
Give your answer in metres per second.

..... [3]

- (e)** Part 1 is complete 9 minutes after lift-off.

Use the model for h in terms of t to show that the height of the balloon at this time is 960 m.

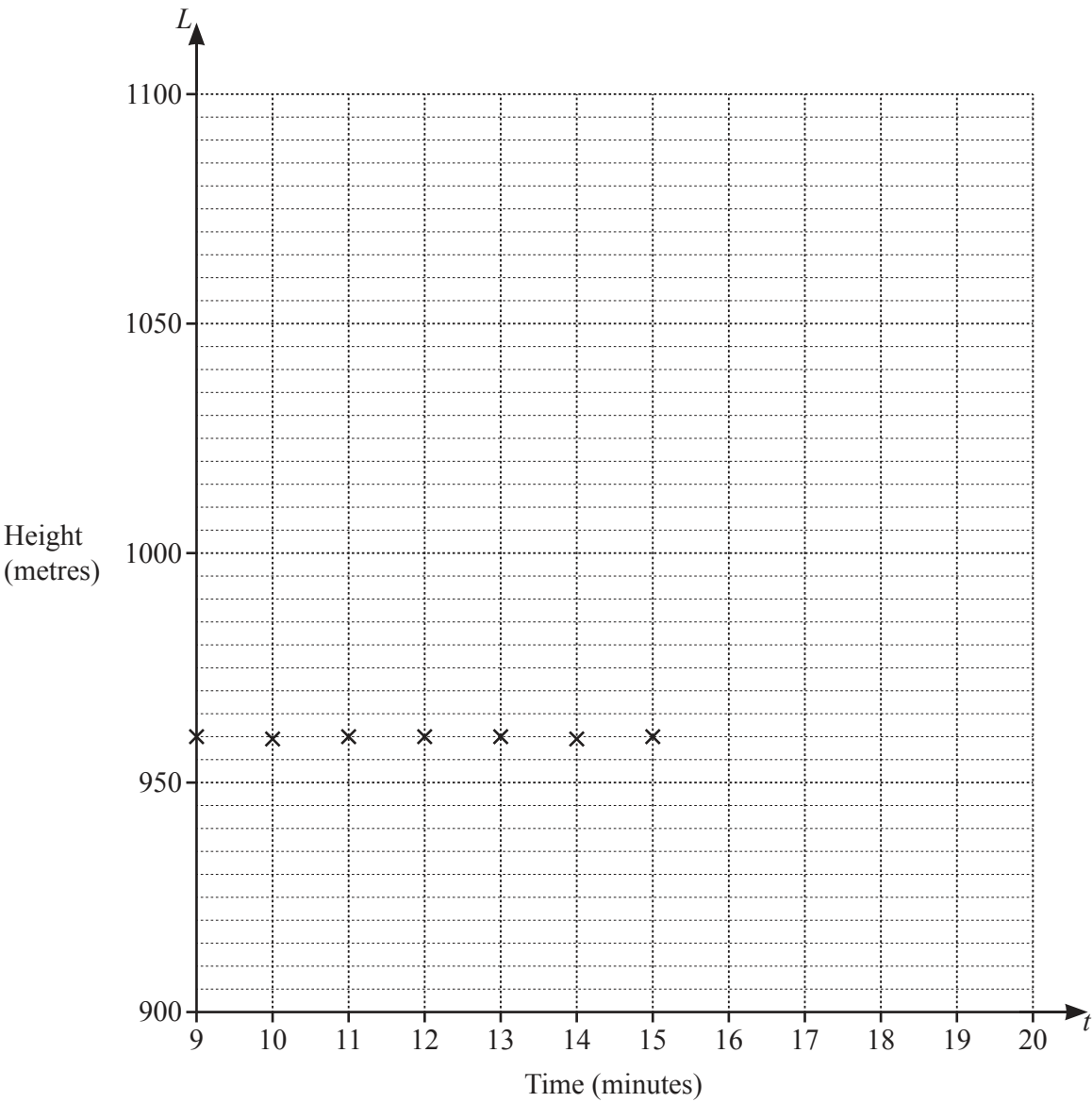
[1]

12

6 For Part 2, the table shows the height of the balloon above the ground (L metres), t minutes after lift-off.

Time (t minutes)	9	10	11	12	13	14	15	16	17	18	19	20
Height (L metres)	960	959	960	960	960	959	960	987	1014	1041	1068	1095

- (a) On the grid, complete the scatter diagram for these results.
The first seven points have been plotted for you.



[2]

13

- (b)** Between 15 minutes and 25 minutes after lift-off, the balloon rises at the same rate. It then travels at a constant height for 10 minutes.

Complete the list of linear functions to model L for Part 2.

- (i)** For $9 < t \leq 15$ $L =$
- (ii)** For $15 < t \leq 25$ $L =$
- (iii)** For $< t \leq$ $L =$

[5]

14

- 7 For Part 3, the balloon descends at a constant speed of 2.5 m/s until it is 180 m above the ground.

Find how many minutes it takes the balloon to travel from **lift-off** to the end of Part 3 of the journey.

..... [4]

- 8 For Part 4, a model for the height above the ground (d metres), t minutes after lift-off, is

$$d = \frac{450}{t - 40.125} - 60.$$

- (a) Find how many minutes after lift-off the balloon lands.

..... [3]

15

- (b)** Find the average speed of the balloon during Part 4 of the journey.
Give your answer in metres per minute.

..... [2]

Question 9 is printed on the next page.

9 Another journey is at sunset.

(a) The balloon completes Part 1 of the journey in 7.5 minutes.

At the end of Part 1, the height of the balloon above the ground is 960 m.

A model for Part 1 is $h = 480(1 - \cos(kt)^\circ)$ for $0 \leq t \leq 7.5$.

Find the value of k .

..... [2]

(b) In Part 2, the first 6 minutes of the journey are at a constant height of 960 m.

Then, the balloon rises 2 times as fast as in **Question 6(b)(ii)**.

Change the model in **Question 6(b)(ii)** so that it models this part of the journey.

..... [3]

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