Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

5654958878

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/61**

Paper 6 (Extended) **May/June 2016**

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** and **B**.
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.

DC (LK/FD) 115851/4

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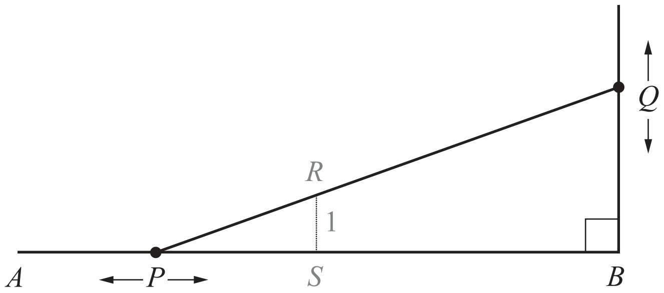
[Turn over

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

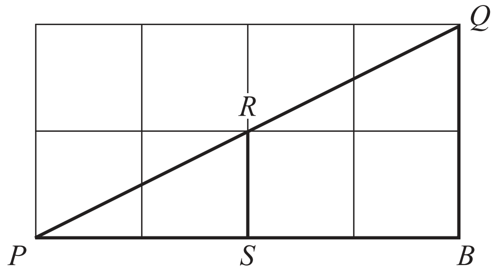
A INVESTIGATION MOVING TRIANGLES (20 marks)

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



This investigation is about finding the connection between AP and BQ as P and Q move.
All triangles are right-angled and RS is one unit.
In **questions 1**, **2** and **3**, P is at A.

1



Triangle PBQ is an enlargement of triangle PSR, with P as the centre of the enlargement.

(a) Write down the scale factor of the enlargement in the diagram.

....

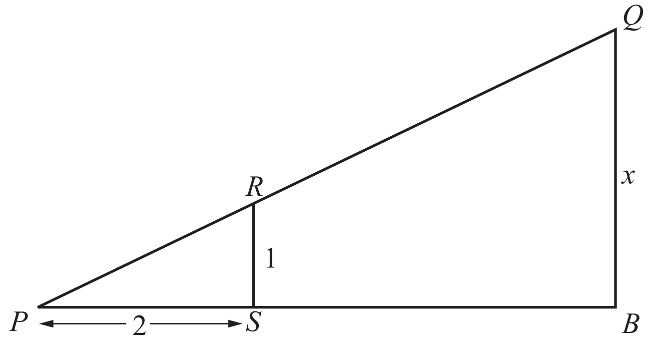
(b) Complete the table for enlarging triangle PSR.

Scale factor	Length of PS	Length of PB
3	4	
	6	30
7		14

(c) Use **one** word to complete this statement.

PSR and PBQ are .... triangles because one is an enlargement of the other.

2



NOT TO SCALE

(a) Show that $x = 10$ when $PB = 20$.

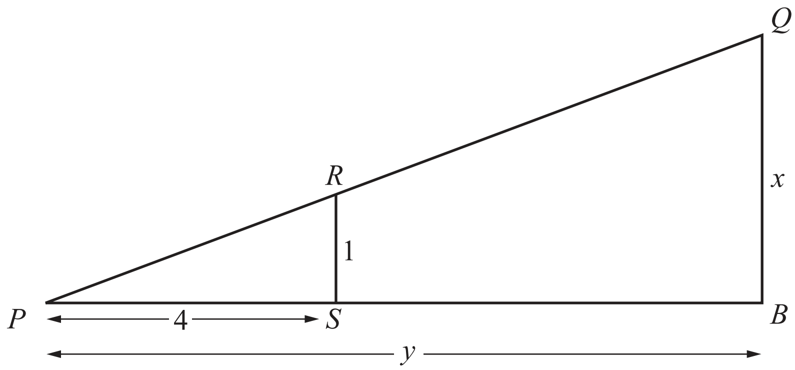
(b) Find the value of x when $PB = 16$.

....

(c) Find an expression for x when $PB = y$.

....

3



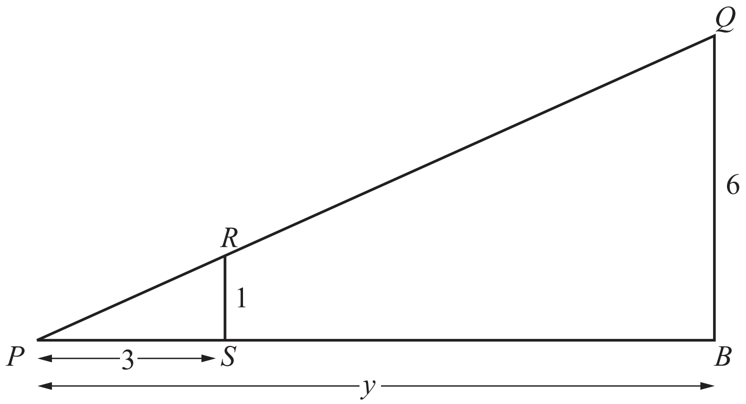
NOT TO SCALE

For this triangle, find an expression for x when $PB = y$.

....

4 These diagrams show P starting at A and then moving towards B.

(a)



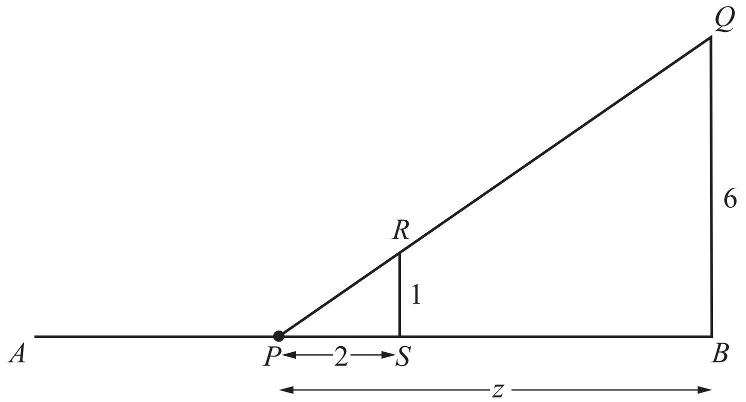
NOT TO SCALE

In this diagram P is at A.

Find the value of y.

....

(b)



NOT TO SCALE

In this diagram, P and S have moved towards B.
PS is one unit less than in **part (a)**.

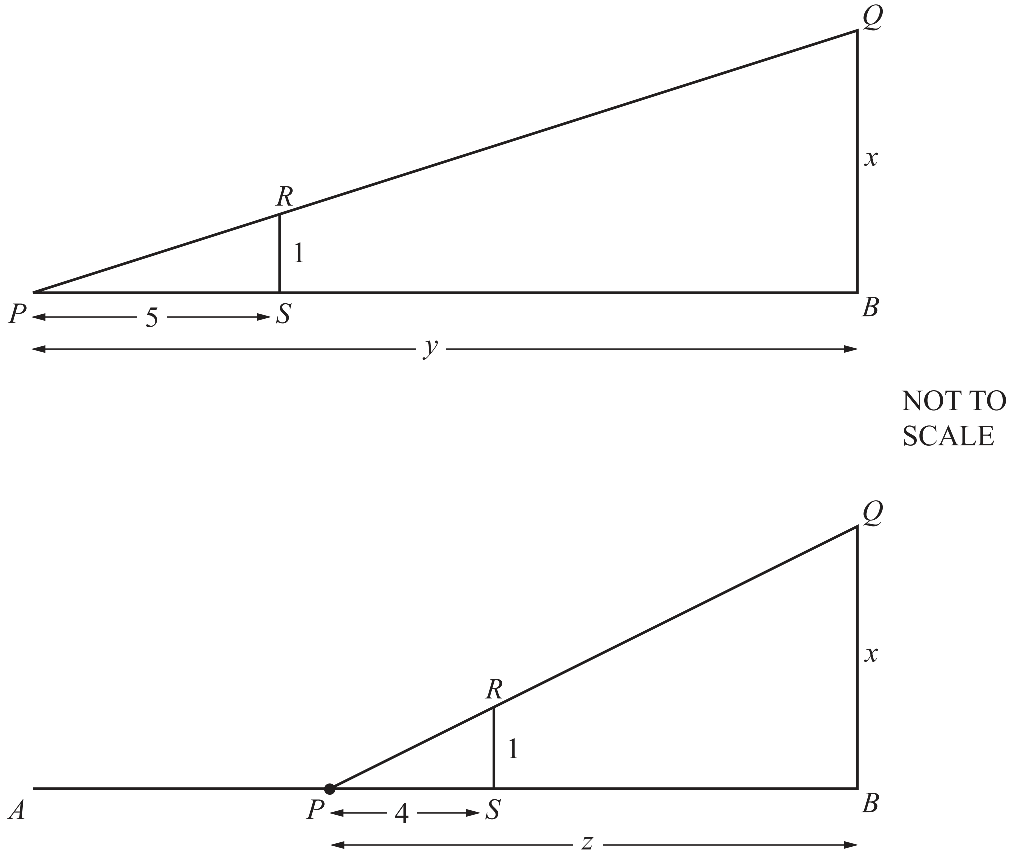
Find the value of z.

....

(c) Using your answers to **part (a)** and **part (b)**, work out the value of AP.

....

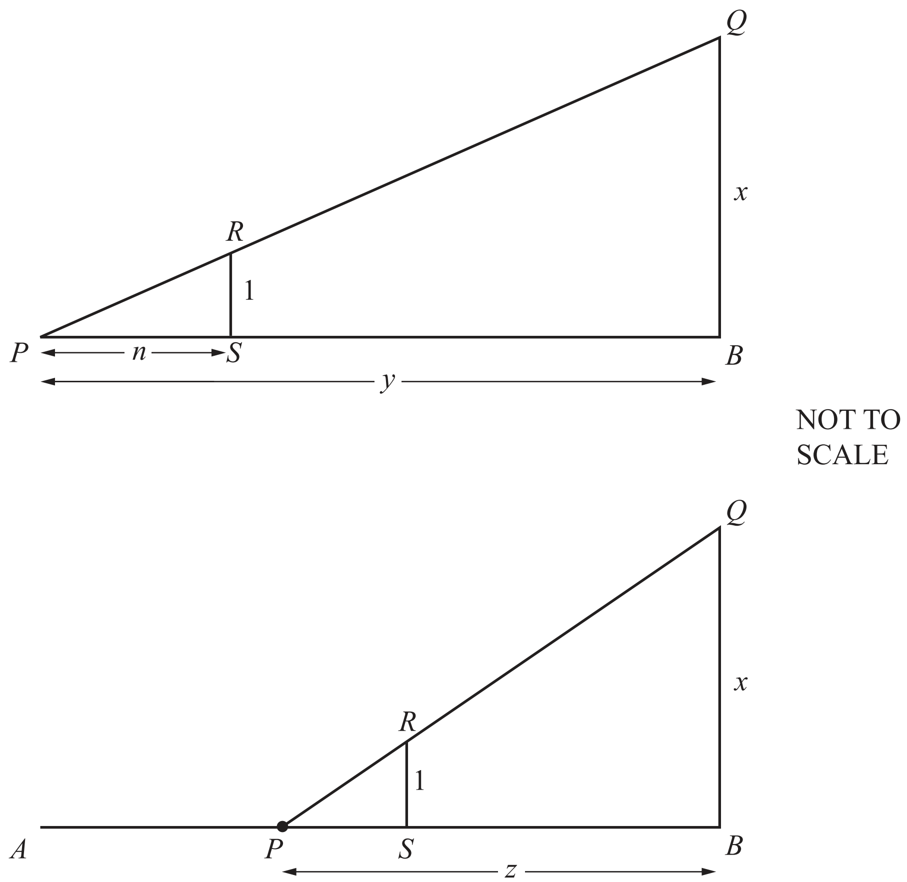
5



These diagrams show P starting at A and moving towards B.
In the second diagram, PS has decreased by one unit.

Using the method of **question 4**, show that $AP = BQ$.

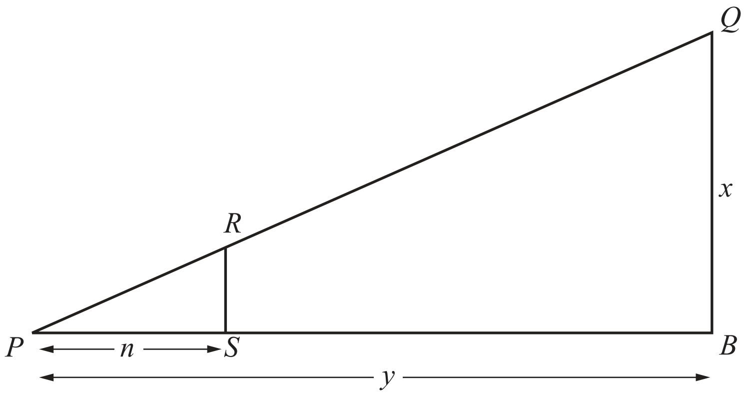
6



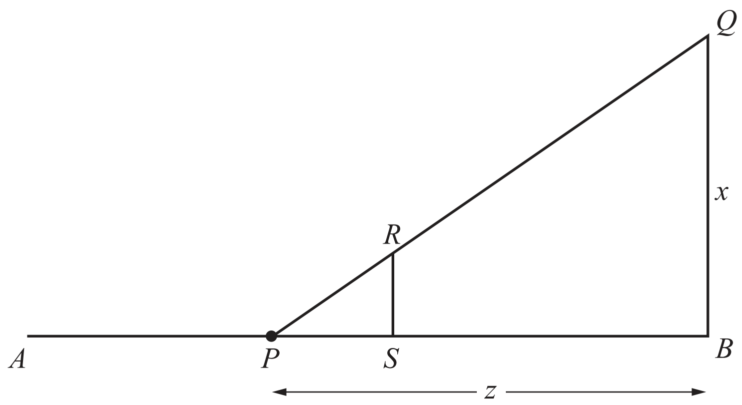
These diagrams show P starting at A and moving towards B.
In the second diagram, PS has decreased by one unit.

Show that $AP = BQ$.

7 In this question, RS is no longer one unit.
P starts at A and moves towards B.
In the second diagram, PS has decreased by one unit.



NOT TO SCALE



(a) When $RS = 2$, find an expression for AP in terms of x.

....

(b) When $RS = m$, find an expression for AP in terms of x and m.

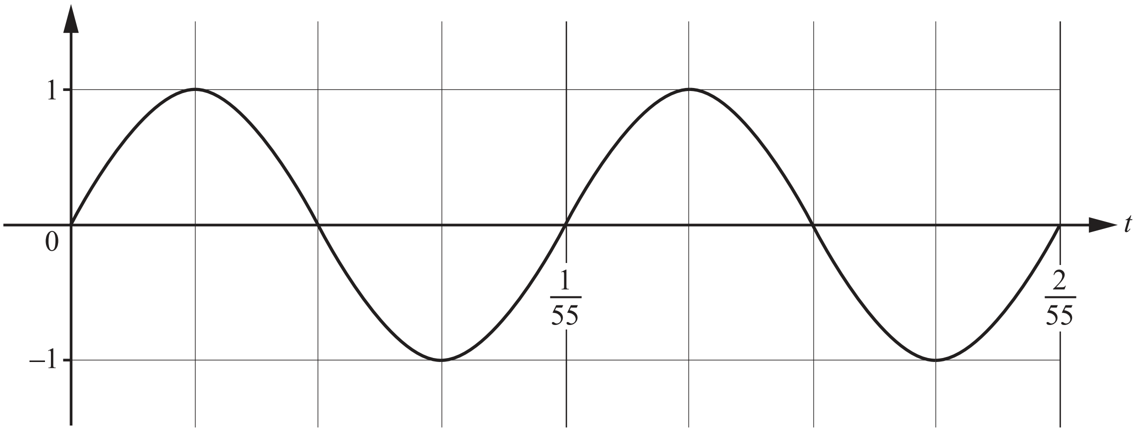
....

B MODELLING **MUSICAL NOTES (20 Marks)**

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

This task is about the connection between musical notes.
A musical note is made by a sound wave which is modelled by a sine function.

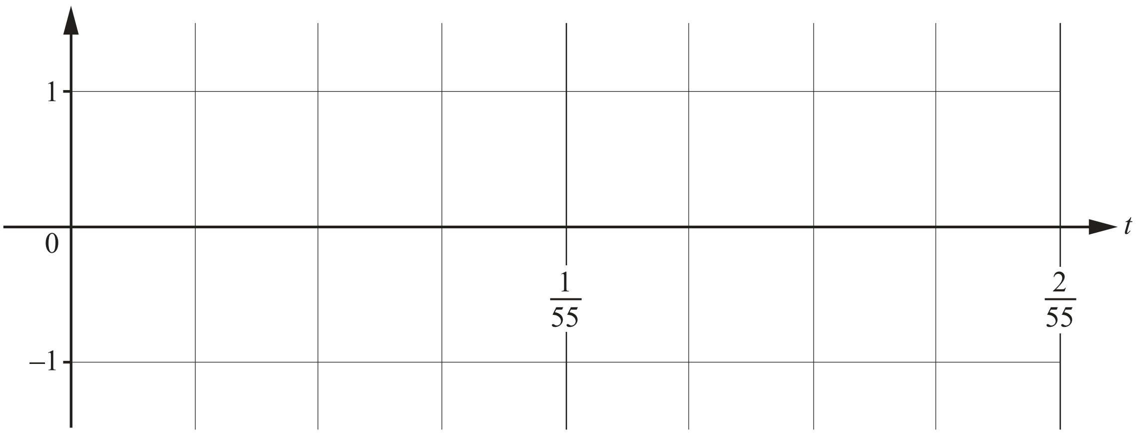
Here is the sine wave for the note A_1, where the time, t, is measured in seconds.



Each note has a different frequency, which is measured in Hertz (Hz).
The frequency of the note A_1 is 55 Hz because the sine wave repeats 55 times per second.

1 The frequency of the note A_2 is two times the frequency of the note A_1.

On the grid below, sketch the sine wave for the note A_2 for $0 \leqslant t \leqslant \frac{2}{55}$.



2 The 12 notes in a musical scale are A, A#, B, C, C#, D, D#, E, F, F#, G, G#.
The notes on a piano repeat this scale.
Notes in the same scale have the same subscript. (For example, A_2, $C\#_2$ and F_2 are all in the same scale.)

The frequency, f Hz, of each note on a piano is modelled by the function

$$f(n) = 27.5 \times 2^{\frac{n}{12}} \qquad \text{where } n \text{ is an integer from 0 to 87.}$$

n	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14		87
Note	A_0	$A\#_0$	B_0	C_0	$C\#_0$	D_0	$D\#_0$	E_0	F_0	$F\#_0$	G_0	$G\#_0$	A_1	$A\#_1$	B_1		

(a) When $n = 0$ the frequency of the note is 27.5 . This is the note A_0.

(i) Work out the frequency of the note when $n = 3$.

....

(ii) Write down the note when $n = 15$.

....

(iii) Work out the frequency of the note E_0.

....

(b) Write down all the values of n that give the note A on this piano.

....

(c) Which note has the highest frequency on this piano?
Calculate this frequency.

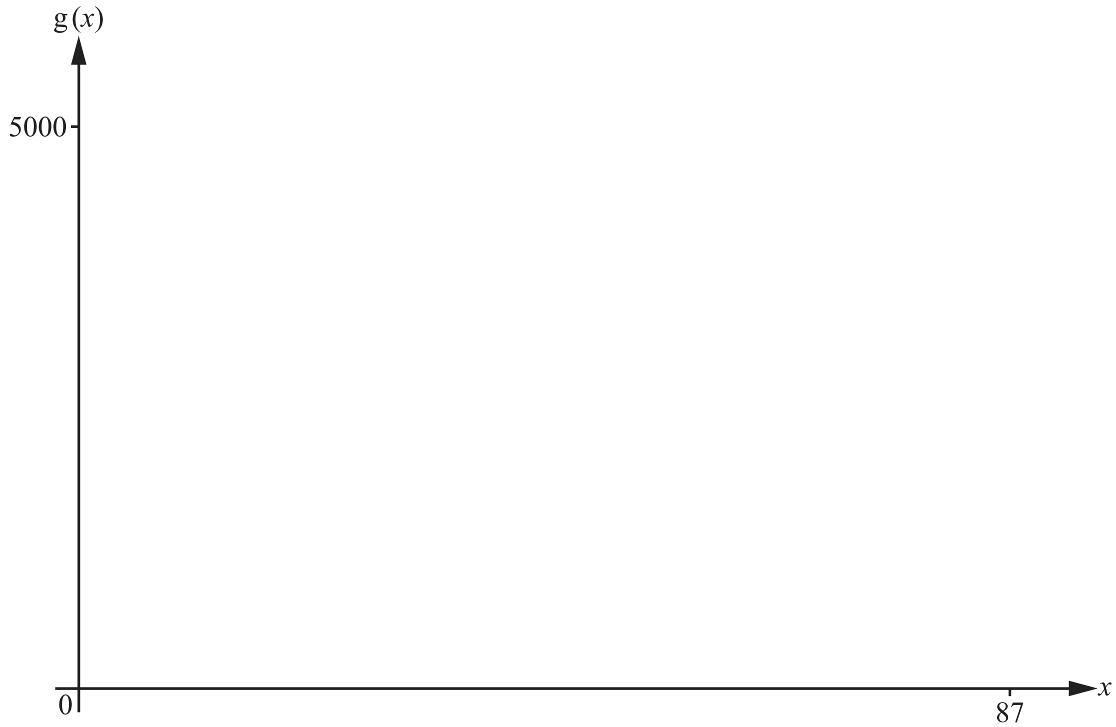
Note .... Frequency ....

3 k times the frequency of a note gives the frequency of the next note.
This means that $k\,\mathrm{f}(n) = \mathrm{f}(n+1)$.

Find the **exact** value of k.

....

4 **(a)** On the axes below, sketch the graph of $g(x) = 27.5 \times 2^{\frac{x}{12}}$ for $0 \leqslant x \leqslant 87$.



(b) Find the note which has frequency closest to 1400 Hz.

....

5 A different musical scale has 10 notes.

Q R S T U V W X Y Z

The frequency of each note is modelled by the function

$$\mathrm{h}(n) = a \times 2^{bn} \qquad \text{where } n \text{ is an integer from 0 to 29.}$$

When $n = 0$ the note is Q_0 and the frequency of this note is 600 Hz.
The frequency of the note Q_1 is 1200 Hz.

(a) Write down the value of a.

....

(b) Find the value of b.

....

(c) Show that $k\,\mathrm{h}(n) = \mathrm{h}(n+1)$ where k is a constant to be found.

Question 6 is printed on the next page.

6 In musical scales the frequency of the note P_1 is two times the frequency of the note P_0.

(a) A musical scale has 23 notes.
The frequency of the first note is 75 Hz.

Work out the frequency of the second note.

....

(b) The first note in another musical scale has a frequency of 100 Hz.
The second note has a frequency of 108 Hz.

Find the number of notes in this scale.

....