Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

2215383014

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/62**

Paper 6 (Extended) **October/November 2014**

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 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.

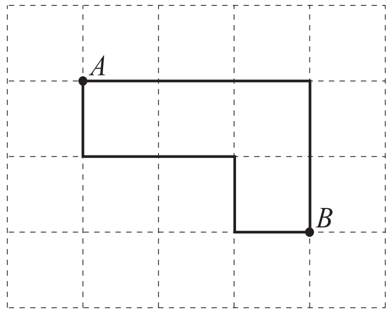
This document consists of **11** printed pages and **1** blank page.

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

A INVESTIGATION TAXICAB GEOMETRY (20 marks)

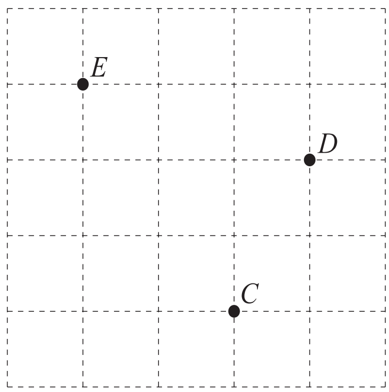
You are advised to spend no more than 45 minutes on this part.

A taxicab has to travel from A to B. In taxicab geometry, to go from A to B, you must only go along gridlines and take a shortest route.



The diagram shows two of the possible shortest routes from A to B.
The taxicab distance AB is 5.

1 (a)

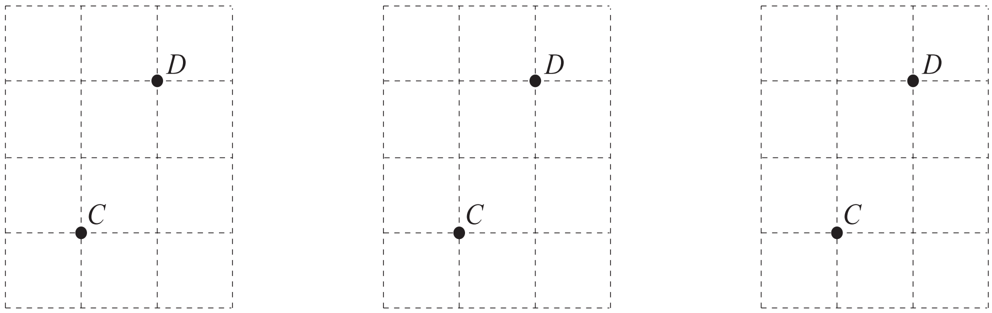


For this grid, write down the taxicab distance CD and the taxicab distance DE.

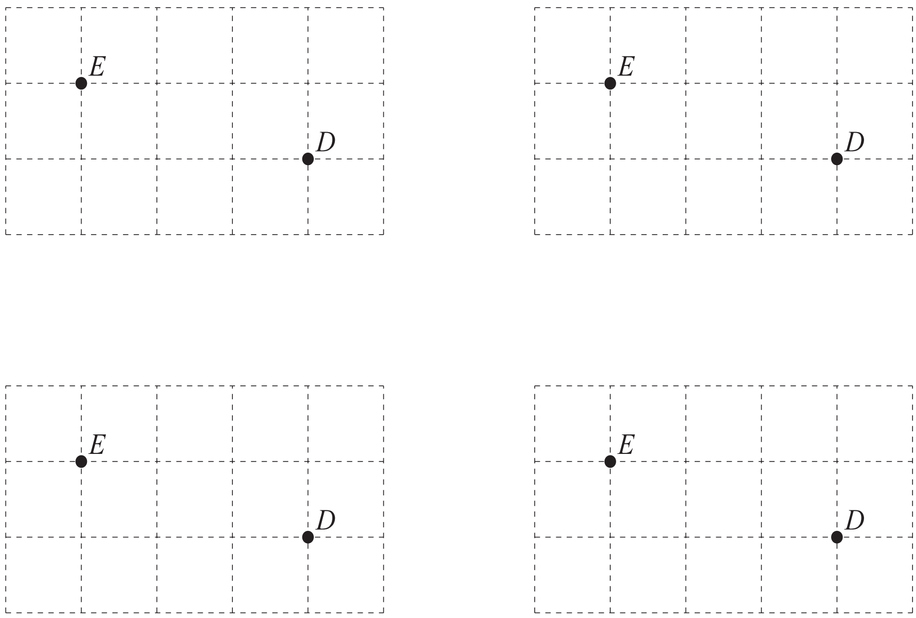
Taxicab distance CD ....

Taxicab distance DE ....

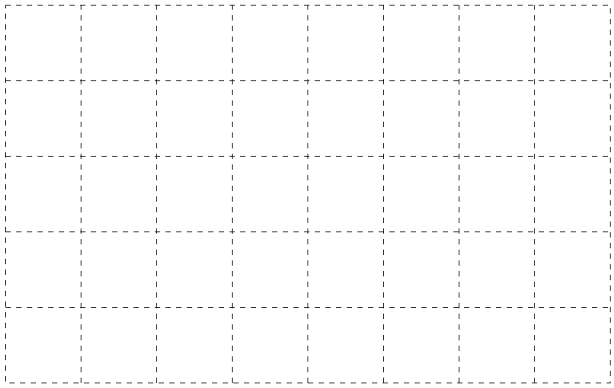
(b) On the grids below, show the three possible shortest routes from *C* to *D*.
Remember, you must only go along gridlines.



(c) On the grids below, show all of the possible shortest routes from *D* to *E*.
Draw one route on each grid.

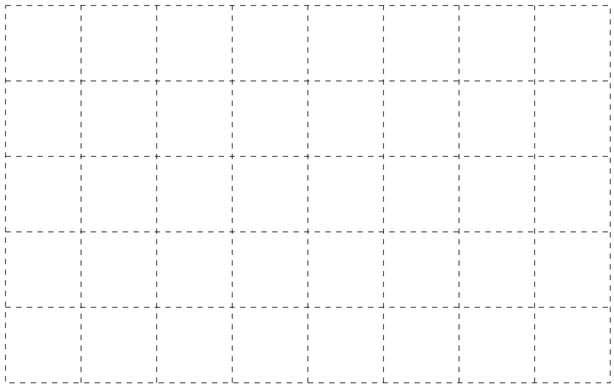


(d) **(i)** On the grid below, plot two points with taxicab distance equal to 5 and only one possible shortest route between them.

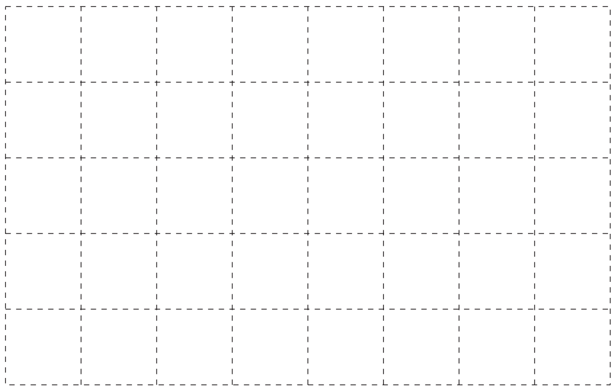


(ii) On the answer grid below, plot two points with taxicab distance **not** equal to 6 and exactly six possible shortest routes between them.
You may use the first grid for your working.

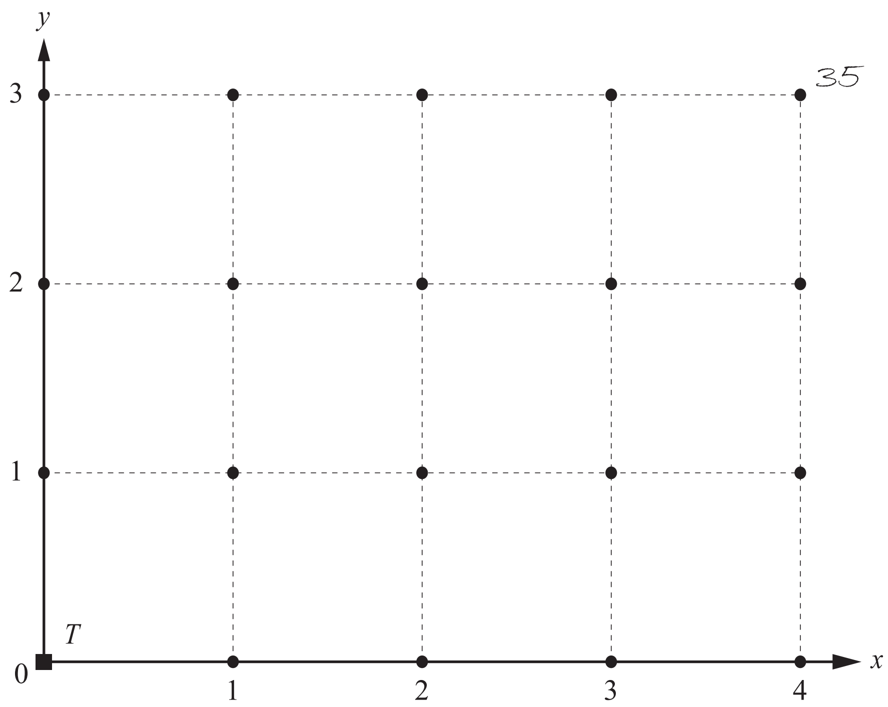
Working grid



Answer grid



2 The taxicab is based at T, (0, 0) on the grid.
Possible destinations are marked •.
There are 35 possible shortest routes from T to (4, 3).



(a) Write beside each destination on the x-axis and the y-axis, the **number** of shortest routes from T.

(b) There are three shortest routes from T to destination (1, 2).
Each shortest route goes through either (0, 2) or (1, 1).

Explain how the number of shortest routes to (0, 2) and to (1, 1) can be used to find the number of shortest routes to (1, 2).

....

....

(c) Write beside each destination on the grid the **number** of shortest routes from T.

(d) There are 120 shortest routes from T to destination (7, 3).

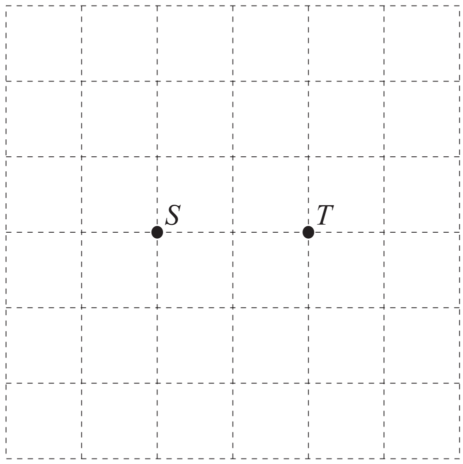
How many shortest routes are there from T to (6, 3) and what is this taxicab distance?

Number of shortest routes ....

Taxicab distance ....

3 In this question, all taxicab distances are integers.

(a) On the 6 by 6 grid below, plot the seven points where the taxicab distance from S is equal to the taxicab distance from T.



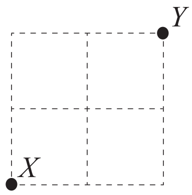
(b) V and W are on the same horizontal gridline. The taxicab distance VW is 9.

How many points have a taxicab distance from V that is equal to the taxicab distance from W?

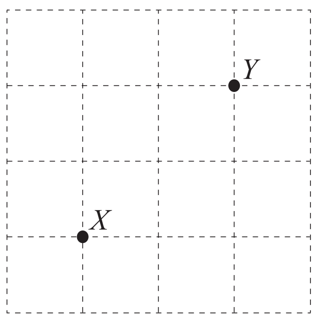
....

(c) X and Y are at opposite corners of a 2 by 2 square. On each of the following grids, plot all the points where the taxicab distance from X is equal to the taxicab distance from Y.

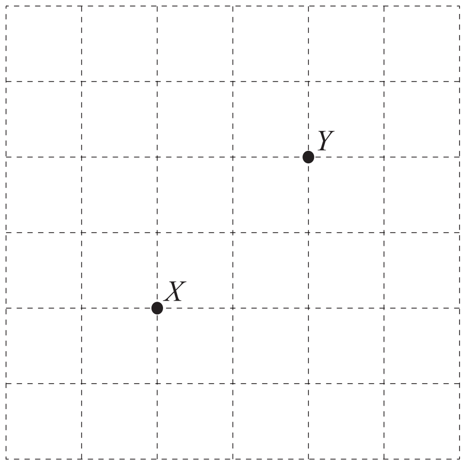
(i) 2 by 2 grid



(ii) 4 by 4 grid



(iii) 6 by 6 grid



(iv) X and Y are on an n by n grid, when n is an even number.

Find an expression, in terms of n, for the number of points where the taxicab distance from X is equal to the taxicab distance from Y.

....

B MODELLING **THROWING A BALL (20 marks)**

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

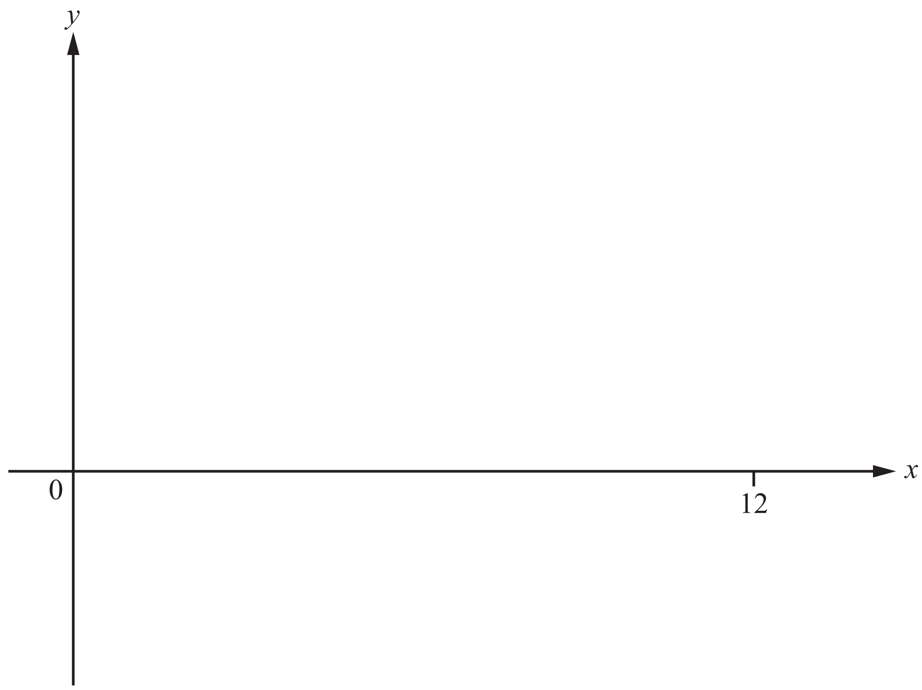
When a ball is thrown the model of its path is $y = ax^2 + bx + c$.

y is the vertical height in metres of the ball above the horizontal ground.
x is the horizontal distance in metres that the ball has travelled from where it was thrown.
a, b and c are constants.

1 **(a)** A ball is thrown from (0, 0).

The model of the ball's path is $y = -\frac{1}{8}x^2 + \frac{5}{4}x$.

(i) On the diagram, sketch the graph of this equation for $0 \leqslant x \leqslant 12$.



(ii) How far does the ball travel horizontally before hitting the ground?

....

(iii) What is the greatest height that the ball reaches?

....

(iv) A vertical fence, 2 m high, stands on the horizontal ground 6 m from where the ball was thrown.

How far above this fence is the ball when it is 6 m from where it was thrown?

....

(v) There are two positions where a 2 m high fence could be built so that the ball just passes over the top. One position is 2 m from where the ball was thrown.

Find the other position.

....

(b) The ball is now thrown from 1.5 m above the ground.
Use this information to modify the model in **part (a)**.

....

2 A second ball is thrown from (0, 0).
It passes through the points (3, 1.2) and (5, 0).

(a) Use these co-ordinates to write down three equations in a, b and c.

....

....

....

(b) Solve your equations to find values for a, b and c, and write down the equation of the path of this second ball.

$a =$ ....

$b =$ ....

$c =$ ....

....

(c) A vertical fence, 2 m high, stands on the horizontal ground 2 m from where this second ball was thrown.

Will this second ball hit the fence? Explain your answer.

....

....

3 A ball is thrown from (0, 0).
It just passes over a fence, k metres from (0, 0) and hits the ground at (X, 0).

A general model of its path is $$y = \frac{Hx(x - X)}{k(k - X)}.$$

H is the height of the fence in metres.
X is the horizontal distance, in metres, that the ball travels before hitting the ground.

(a) **(i)** Using the information in **question 1(a)** show that this general model gives $y = -\frac{1}{8}x^2 + \frac{5}{4}x$.

(ii) Explain why this general model does not give the equation of the ball's path in **question 1(b)**.

....

....

(b) A ball is thrown from (0, 0).
It just passes over a 2 m high fence that is 8 m from (0, 0) and hits the ground at (12, 0).

(i) Use the general model to find the equation of the ball's path.

....

(ii) Find the position where another 2 m high fence could be built so that the ball just passes over the top.

....

(c) A ball is thrown from (0, 0).
It just passes over two 2.5 m high fences.
The fences are built so that one is twice as far from (0, 0) as the other.
One fence is 10 m from (0, 0).

(i) Find the two possible horizontal distances that the ball can travel before it hits the ground.

....

(ii) Find the equation for each path of this ball.

....

....

(iii) What is the greatest height that the ball reaches?

....

BLANK PAGE