ST EDWARD'S
OXFORD

13+ SCHOLARSHIP EXAMINATION
2012

MATHEMATICS
Paper 2

1 hour

Name: _____

There are 60 marks available.

Calculators are allowed.

Write all answers, including your workings, in this booklet.

You should answer **all questions** in Section A and choose **2 questions** in Section B. If you do all of the questions in Section B, we will take the best two.

Each question in Section A is worth 10 marks; each question in Section B is worth 15 marks.

In all of these questions, we are looking for how you *communicate mathematically* – you will be asked to talk about some of your answers in your interview.

Section A: answer all questions in this section.

1) a) James adds a sequence of 4 consecutive whole numbers together and gets the answer 170. What is the smallest number in the sequence?

b) He then adds a sequence of 7 consecutive whole numbers together and gets the answer 14. What was the first number in the sequence?

c)James then adds a sequence of n consecutive whole numbers together. He calls the smallest number in the sequence x and the total is 610.

Given that the total for the sum 1+2+3+…+ n can be written as $\dfrac{n \times (n+1)}{2}$,

create an equation for x in terms of n. Simplify this equation as much as possible.

If n is 20, what is x?

Continue answer to question 1 here.

2)   Alice, Bob, Charlie and Dianne each make the following statements:

Alice: I am telling the truth.
Bob: Alice is telling the truth.
Charlie: Bob is telling the truth.
Dianne: Charlie is lying.

Only one of the 4 people is telling the truth. Which one? Explain your answer.

b) They now make the following statements:

Alice: Bob is lying.
Bob: Charlie is lying.
Charlie: I like dogs.
Dianne: 2+2=4.

Now two of the four people are telling the truth: which two? Explain your answer.

c) They are now joined by Egbert. They each make the following statements:

> **Alice:** I like cats.
> **Bob:** Charlie is lying.
> **Charlie**: Alice is lying.
> **Dianne**: Alice likes dogs.
> **Egbert:** Alice likes dogs.

Now three of the five people are telling the truth: which ones? Explain your answer.

3)   a) The perimeter of a square is equal to its area. How long is one side?

b) The width of a rectangle is 5 cm longer than its height. The perimeter is 50cm. How wide is the rectangle?

c) I draw a rectangle. Does the perimeter of the shape change if I cut out another rectangle from the edge e.g.

Explain your answer.

Section B: Choose two questions from this section.

4) Tedflip is a game which is played on a board with 9 circles, arranged in 3 rows of 3. The circles can be black or white.
To play you are given the starting pattern and the target pattern, and you must try to get from one to the other following the rules:

In each "move" you can flip either an entire row or an entire column.

When you "flip" a row, it means every black circle on that row becomes white, and every white circle on that row becomes black. Similarly when you "flip" a column, each circle in the column changes colour.

For example, if you are given the starting and target patterns

Start: ●○● Target: ○○○
       ○●○   ○○○
       ●○●   ○○○

a sequences of three moves to achieve the target is:

●○● flip   ○●○ flip   ○○○ flip   ○○○
○●○ first ○●○ middle ○○○ third ○○○
●○● row   ●○● column ●●● row   ○○○
     ⟹   ⟹   ⟹
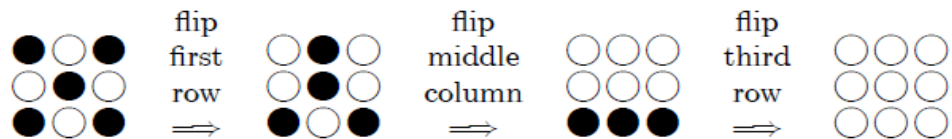
There are many other sequences of moves which also have the same result.
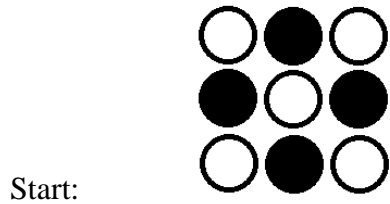
a) In a game, the start and target patterns are:
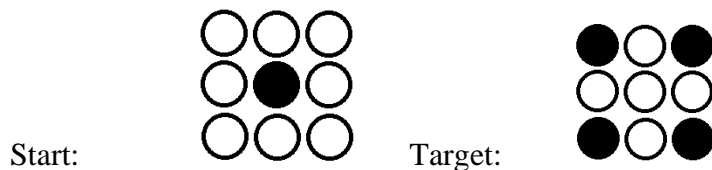
Start: ○○○   Target: ●○●
       ○●○   ○○○
       ○○○   ●○●

Find a sequence which would complete the game.
You do not have to use all the grids.

○○○   ○○○   ○○○   ○○○
○○○   ○○○   ○○○   ○○○
○○○   ○○○   ○○○   ○○○
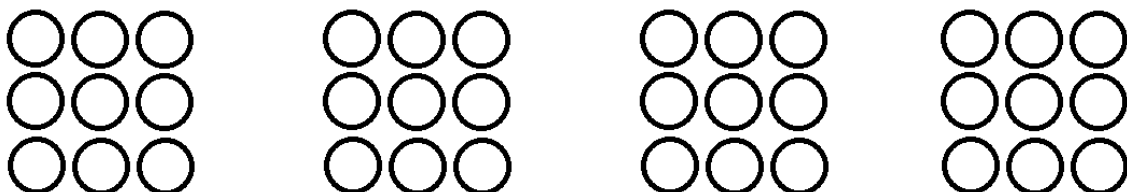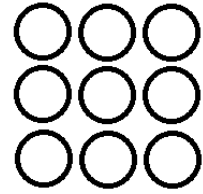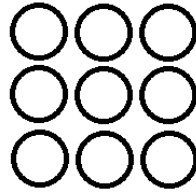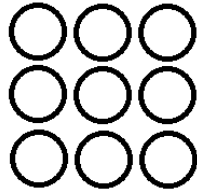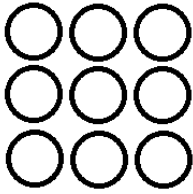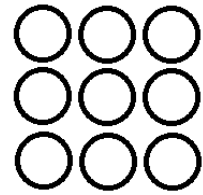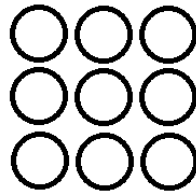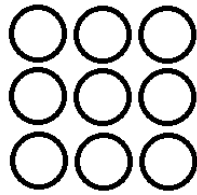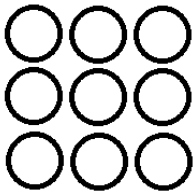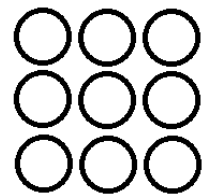
b) In a game, the start and target patterns are:
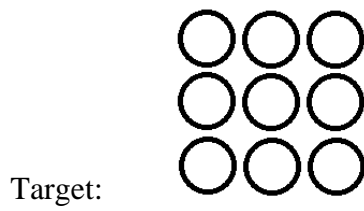
Start:

Target:

Find *two different* ways to complete the game.
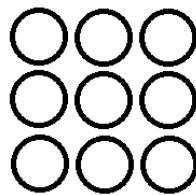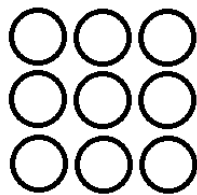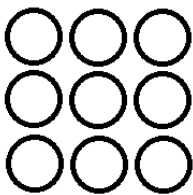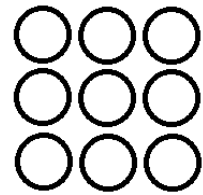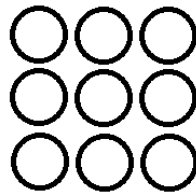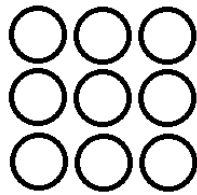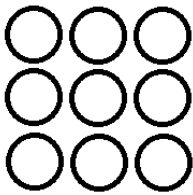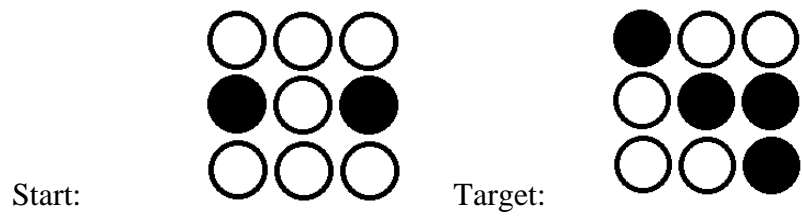
Way 1:
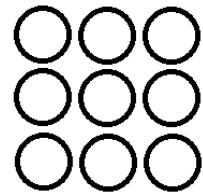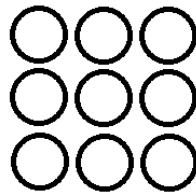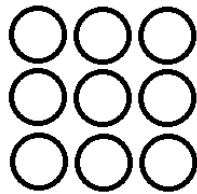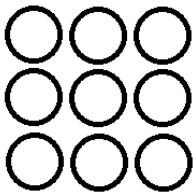
Way 2:
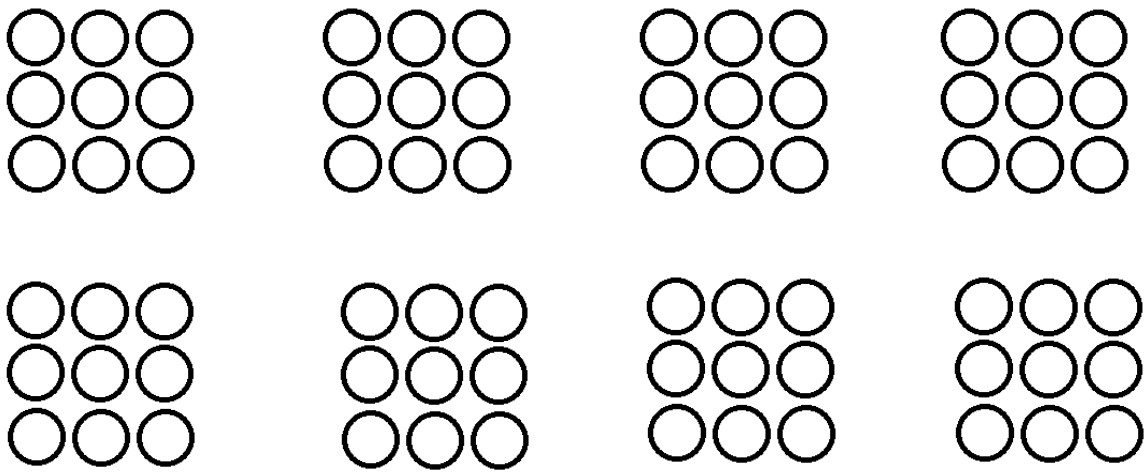
c) In a game, the start and target patterns are:

Start:

Target:

What sequence would complete the game? You do not have to use all the grids.

5) It has been suggested that we replace all money with 3p and 5p coins.

The shops think this is a good idea since most totals can be made:

e.g. 11p = one 5p coin and two 3p coins
     31p = two 5p coins and seven 3p coins

Unfortunately some totals can't be made, for example 4p.
Which totals **can't** be made?
Is there a largest total that cannot be made?
How do you know?

6) In a school lottery, there are four balls with the numbers 1 to 4 on them.
They are put in a bag and two balls are drawn.
To play you pick two numbers.
If you get the correct two numbers (in any order) you win.

a) What is the probability of winning?

b) To make things harder, the school decides there should be *six* balls, with the numbers
1 to 6 on them.
Two balls are drawn.
To play you still pick two numbers and if you get the correct two numbers (in any
order) you win.
What is the probability of winning now?

c) The rules change again.
   There are still six balls but now *four* balls are drawn from the bag.
   To play you pick four numbers.
   If you get all four correct (in any order) you win.
   What is the probability of winning now?

d) Could you suggest a reason for this result? (Hint: think about the balls you aren't choosing)