# WELLINGTON COLLEGE

# 16+ ENTRANCE EXAMINATION

# MATHEMATICS

Time available: 40 minutes.

There are 40 marks available in total. The marks available for each question are indicated in the right-hand margin.

Special Instructions:

- You may not use a calculator in this exam. Leave answers as fractions where appropriate.
- Write all your answers in this booklet; you may request rough paper if you wish but it is perfectly acceptable to write your answers in this booklet.
- Show your working; unsupported answers may not gain full credit.

Surname: _____

Forename: _____

Current School: _____

Date of birth: _____

1. Simplify $\dfrac{(x+2)^2 - (x-1)^2}{4x+2}$ [4]

2. I have a box and a bag, each containing marbles.
   If I moved four marbles from the box to the bag, there would be twice as many marbles in the bag as in the box.
   If I moved six marbles from the bag to the box, there would be twice as many marbles in the box as in the bag.
   How many marbles are in the box? [4]

3. I cut a semicircle from some pattered paper but realise I have cut it upside down – so cut the largest semicircle that will fit upside down inside the original, as pictured.
What is the ratio of the area of the small semicircle to the area of the large semicircle? [4]
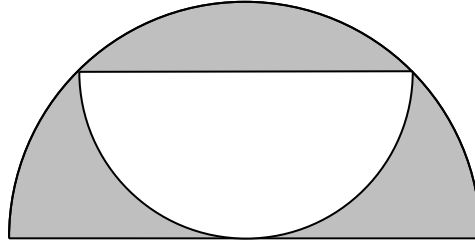


4. A rectangular-based pyramid has base 4 cm by 6 cm and slanted-edge length 7 cm.
Find its volume.
You may use the fact that the volume of a pyramid is given by

$$\tfrac{1}{3} \times \left(\text{base area}\right) \times \left(\text{perpendicular height}\right)$$ [4]
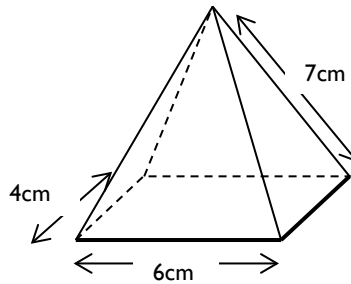
5. Find the coordinates of the points of intersection of the line $y = 2x - 6$ with the curve $y = x^2 - 6x + 1$. [4]

6. Two students are reciting the Greek alphabet, which has – in total – 24 letters.
Unfortunately, neither has learnt it properly, but they both know that the first letter is Alpha.
Alan has only remembered 16 letters.
Betty has only remembered 20 letters.
They start reciting at the same time and say their lists of letters at the same rate – one letter per second.
After how many seconds will they next say Alpha simultaneously for the second time? [4]

7.  I have a group of people who want to take part in a quiz.
    If I had one more person, I could split them into groups of 5.
    If I had two more people, I could split them into groups of 6.
    Given that I have more than fifty people, what is the smallest number of people I could have?     [4]

8.  A sequence of numbers is generated as follows:
     - if the current term is odd, add 1 and halve the result.
     - if the current term is even, double it and add 3.

    For example, if we started with 113, the sequence would begin:
        113, 57, 29, 15, 8, 19, 10, 23, 12, 27, 14, …
    Notice that once we have produced an even number, the term after next is also even, and has increased by two.
    Prove that this will happen any term we produce an even number.

9.  I have a bag containing some red counters and some blue counters.
    I draw one counter, and then draw another, having first replacing the first counter.
    The probability that I draw two red counters is $\frac{1}{9}$.
    I have another go, except this time, I do not replace the first counter before drawing the
    second. The probability that I draw two red counters is $\frac{1}{10}$.
    Let $r$ be the number of red counters, and $n$ be the total number of counters.
    Find $r$ and $n$. [8]