



# OUNDLÉ

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School

Academic Scholarship 2013

## Mathematics

### Paper 2

Time Allowed: 2 hours

**Calculators WILL be needed for this paper**

#### Instructions to candidates:

- You are not expected to have time to do all the questions.
- You may answer the questions in any order.
- **Choose those questions which you think you can answer best.**
- **Remember to show your working and clearly show the method you are using.**
- Take  $\pi$  as either 3.14 or the value on your calculator.
- Answers should be given to 3 significant figures where appropriate.
- Some questions are longer than others.
- The number of marks for each question is shown in square brackets.



1. a) How many 2 digit prime numbers remain prime when their digits are reversed?  
 b) In how many different ways can 135 be written as the sum of two or more consecutive positive integers? [8]
2. Fifty-two members of a rugby club each bought a ticket to see Ulster in the Heineken Cup match at Ravenhill. An ordinary full-price ticket costs £45 and the discounted ticket price (for children, or pensioners) was £36. They spent £2043 altogether.  
 a) Explain why both the number of ordinary tickets and the number of discounted tickets must be odd.  
 b) Find the number of each ticket type that was purchased. [10]

3. The world's largest marathon, the Virgin London Marathon 2013, was held this year on 21<sup>st</sup> April 2013.



- a) The fastest woman this year was Priscah Jeptoo, with a time of 2 hrs 20 mins and 15 secs. Paula Radcliffe holds the womens record, set in 2003, with a time of 2 hrs 15 mins and 25 secs.  
 How much faster was Paula Radcliffe than Priscah Jeptoo, as a percentage?
  - b) In 2012 there were 36748 runners. This represents an increase of approx 545% on the number of runners in 1981, when the Marathon began. How many runners were there in 1981?
  - c) The London Marathon is 42.195 km long. What was the average speed of the fastest woman this year? Give your answer in metres per second. [12]
4. Two normal six-sided dice, one coloured red and one coloured blue, have been modified. On the blue dice the number 3 has been replaced by a 4, and on red dice the number 4 has been replaced by a 3. Both dice are thrown.
- a) What is the probability of rolling a 4 on the blue and a three on the red?
  - b) What is the probability that the total on the two dice is an odd number? [8]

5. My brother and I take turns to wash our parents car each week. I am very careful and take 30 minutes to complete the job but my brother rushes and finishes in 20 minutes. We are leaving early to attend a match this week so, even though it is my brother's turn, we decide to do it together.

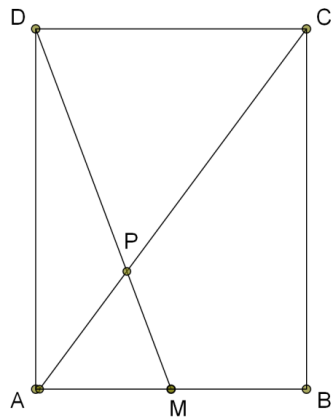


How long will the job take? [6]

6. In a parallelogram  $ABCD$ ,  $AB = 15\text{cm}$  and  $BC = 14\text{cm}$ . The foot  $H$  of the perpendicular from  $B$  to  $AD$  is between  $A$  and  $D$ . Find the length of the diagonal  $BD$  if  $BH = 12\text{cm}$ .  
(You will need to start by drawing a diagram which does not need to be to scale) [8]

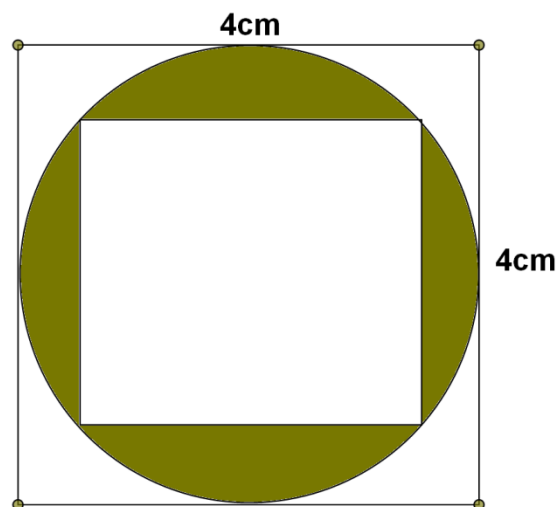
7. a) Calculate:  
 i)  $67^2$ .  
 ii)  $667^2$
- b) What is the largest number I can create consisting only of consecutive 6s followed by a 7 such that when I square it, the **sum of the digits** in its square is less than 2008? [8]

8. Rectangle  $ABCD$  is such that  $AB = CD = 6\text{cm}$  and  $BC = AD = 9\text{cm}$ .  $M$  is the midpoint of  $AB$  and the line  $DM$  meets the diagonal  $AC$  at a point  $P$ . By considering the triangles  $APM$  and  $DPC$ , work out the area of triangle  $DPC$ ?



[8]

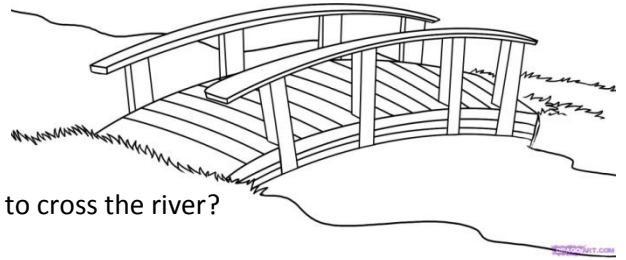
9. As shown in the diagram, a square of side  $4\text{cm}$  is inscribed by a circle which circumscribes a smaller square such that all 3 shapes are concentric (have the same centre). What is the area of the shaded region?



[10]

10. A group of four people has to cross a bridge. It is dark, and they have to light the path with a torch. No more than two people can cross the bridge simultaneously, and the group has only one torch. It takes different time for the people in the group to cross the bridge:

**Annie** crosses the bridge in 1 minute,  
**Bob** crosses the bridge in 2 minutes,  
**Caitlin** crosses the bridge in 5 minutes,  
**Dorothy** crosses the bridge in 10 minutes.



What is the shortest time that it will take for the group to cross the river?

(If 2 people go across the bridge, then they will take the time of the slowest)

[8]

11. Our decimal number system uses the base 10 but many other number systems exist which use different bases.

For instance, the decimal numbers

0	1	2	3	4	5	6	7	8	9	when counting in base 4 yield the numbers
0	1	2	3	10	11	12	13	20	21	

In our decimal system (base 10) the columns are units, tens, hundreds, thousands etc .

- a) What would the columns be in base 4 (use the values above to guide you)

The decimal calculation  $10 \times 6 = 60$  becomes the calculation  $22 \times 12 = 330$  in base 4.

- b) Rewrite the calculation below which is given in decimal, in base 4

$$17 \times 9 = 153$$

- c) Complete this calculation in which numbers are given in base 4, giving your answer in base 4:

$$123 \times 31 =$$

- d) Determine the number base in which the following calculations are done:

$$243 \times 2 = 1041$$

$$323 \times 3 = 1302$$

[14]