OUNDLE

School

ACADEMIC SCHOLARSHIP 2012

MATHEMATICS

PAPER 2

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 π 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.

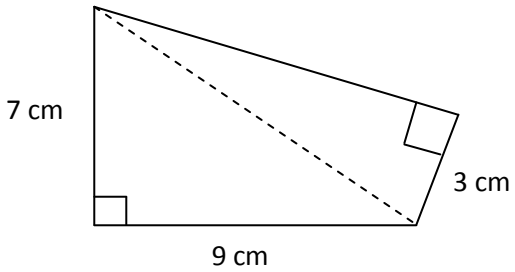
1. If the numbers from 2012 down to 1 are written as a single sequence of digits

201220112010.....1,

a) What will be the 2012th digit in the sequence?

b) How many digits will the sequence contain in total? [8]

2. Calculate the area of the quadrilateral shown:



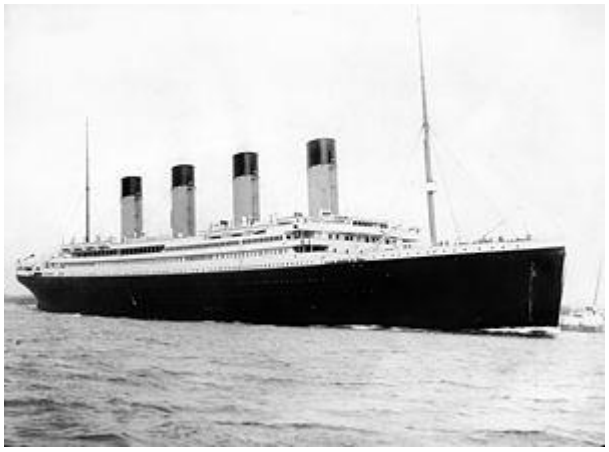
[8]

3. I am getting very excited because I am starting to get better at my favourite computer game WiiZap. I have now won 62 out of the 92 games I have played. What percentage success rate is this? If I carry on winning all the games I play, how many more games will I need to play to get up to 70% success rate? How many to get up to 80%? [8]

4. The jigsaw we did over Easter had 92 edge pieces (including corners), and the dimensions of the puzzle were in the ratio 3:5. How many pieces did the jigsaw have altogether?
[*The illustration shows a 9-piece jigsaw, of which 8 are edge-pieces.*]

[8]

5. This year marks the centenary of the sinking of *Titanic* on her maiden voyage from Queenstown in Ireland to New York.



a) The *Titanic* cost £1.5 million and took 3 years to build. Taking a year to be 365 days, work out the cost per day of building the ship.

b) The ship was equipped to carry a maximum of 3547 people and 64 lifeboats. However, the ship only carried 20 lifeboats on her maiden voyage, which could take on average take 60 passengers each. If the ship had been full what percentage would have been able to be taken in the lifeboats?

c) The ship was travelling at 22.5 knots when it hit the iceberg. 1 knot is defined as 1.852 km/h. If 1 mile = 1.609 km, find the speed of the ship in miles per hour and the time in days, hours and minutes that it would have taken to complete the 3324 mile voyage from Queenstown, Ireland, to New York. [12]

6. The Olympic logo as shown, consists of two rows of circles. None of the circles in each row intersect with each other, but they intersect with the circles in the row above as shown.

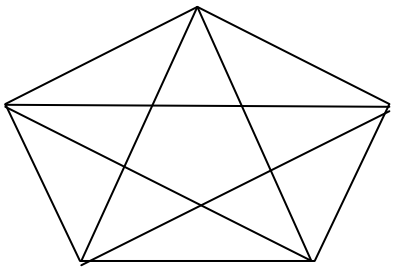
In the new "Graphics Olympics" they plan to start with the same logo this year, but next time (in 2016) they are going to add a row of four circles above the upper row of three, intersecting with the "three row" as before. Then in 2020, they will add a row of five rings above that, intersecting as before, each time adding another row, one ring longer than the previous one.

Notice that the current set of rings has a total of 8 intersections.

How many intersections will the Graphics Olympics have

i) in 2016? ii) in 2020? iii) in 2024? iv) in 2040? [10]

7. A convex pentagon has 5 diagonals (as shown).



[A *diagonal* of a polygon is a line joining two vertices which passes through the interior of the polygon.]
Find:

a) the number of diagonals of a hexagon (6 sides);
b) the number of diagonals of a decagon (10 sides);
c) the number of sides of the convex polygon which has 5150 diagonals. [12]

8. *ABCD* is a square of side 2 units. *E* is the midpoint of *AB*. The lines *DE* and *AC* meet at *H*. Find the area of quadrilateral *BEHC*. [8]

9. When the current is flowing downstream, it takes me 20 minutes to row with the current from Achurch to Beeford, but it takes 45 minutes to row back against the current. If I row at 3 mph, how far is it from Achurch to Beeford, and how fast is the current? [10]

10. Despite the wettest recorded April ever, the UK is currently experiencing a drought, and consequently there is a ban on the use of hosepipes to water peoples' gardens. This is because we are told that the amount of water used by a hosepipe in one hour is equivalent to the amount of water used on average by a family of four over the course of a weekend. The internal radius of our garden hose is 0.7 cm, and the water comes out at 1.9 m/s.

a) Find the amount of water used by our hosepipe in one hour.
b) If the statistic above is true and a weekend consists of two days, find the amount of water per day used by someone in the UK. [8]

11. A 3 litre jug contains 2 litres of pure olive oil. I also have a 2 litre jug which is filled to the top with vinegar. I wish to mix the two but only using the two jugs.

a) If I pour 1 litre of vinegar into the oil, mix it thoroughly and then pour 1 litre of the mixture back, find the amount of oil in the smaller jug.

[I call this process a "double-mix": pouring 1 litre from the smaller jug into the larger, and then 1 litre back mixing thoroughly each time.]

b) I now do two more "double-mixes". How much oil will now be in the smaller jug?

c) Use you answers to make a prediction of the amount of oil in the smaller jug after ten "double-mixes".

[*You should work in fractions throughout this question.*] [12]

12. In celebration of the Olympics we are making a huge flag of the logo shown. Each of the circles is going to have a radius of 2 metres, and also the two points where any two circles intersect are 2 metres apart.

Find the total area which will be in the intersections of two circles.

[16]

END OF EXAMINATION