RADLEY

Scholarship Examination

MATHEMATICS II

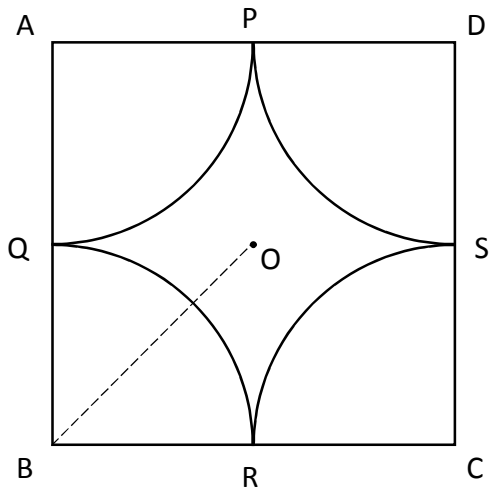
March 2016

Time allowed – 1 hour

Show all working

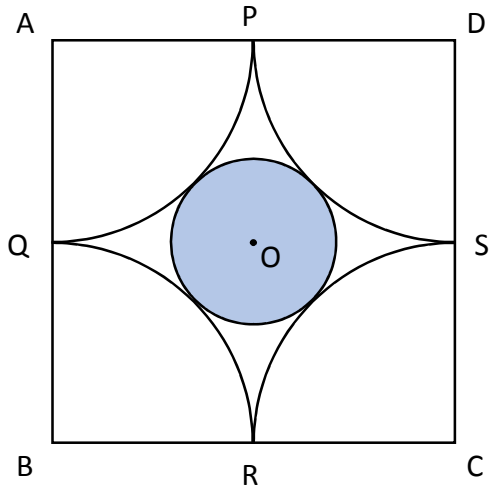
Calculators can be used

1.



ABCD is a square with centre O, and sides of length 2 cm. A four-pointed star, PQRS, is drawn inside the square by taking the midpoints of each of the sides, and joining them with quarter circles, as in the diagram above.

a. Calculate the length BO, leaving your answer as a square root.



A circle, centre O, is drawn inside the star, touching the star in four places, as in the diagram above.

b. Calculate the area of the circle, leaving your answer in terms of $\sqrt{2}$ and π.

2. In the sales the price of everything is reduced by 30%.

   a. Find the sale price of a coat with a pre-sale price of £234.

   b. Find the pre-sale price of a coat with a sale price of £302.40.

   In the 'Final Reduction' all the sale prices are reduced by a further 30% on the sale price.

   c. Find the 'Final Reduction' price of a hat with a pre-sale price of £54.
   d. How much I have saved on the pre-sale price if I buy a pair of shoes with a 'Final Reduction' price of £76.44?
   e. Given that I saved £32.13 on the pre-sale price by buying a shirt at the 'Final Reduction' price, how much did I pay for the shirt?

3. In a shop an apple costs x pence, an orange costs y pence and a pear costs z pence.

   Write down equations in terms of x, y and z for the following statements.

   a. Two apples, one orange and three pears cost £1.99.

   b. Four apples, two oranges and a pear cost £2.13.

   c. By adding the two equations, find the cost of six apples, three oranges and four pears.

   d. Find the cost of eight apples, four oranges and seven pears.

   e. Find the cost of one pear.

4. A man wishes to travel 94 km. He splits the journey into two stages. He walks the first 16 km and the cycles the rest. His cycling speed is 12 km/h faster than his walking speed.

   Letting v km/h be his walking speed, write down expressions in terms of v for

   a. the time for which he walks

   b. the time for which he cycles

   The journey takes him 7½ hours.

   c. Write down an equation for v, and show that it simplifies to $(av-b)(5v+24)=0$

      where a and b are whole numbers that you should state.

   d. Write down his walking speed.

5. a. Calculate $\dfrac{2^4-1}{2^2-1}$

   b. Calculate $\dfrac{3^4-1}{3^2-1}$

   c. Calculate $\dfrac{4^4-1}{4^2-1}$

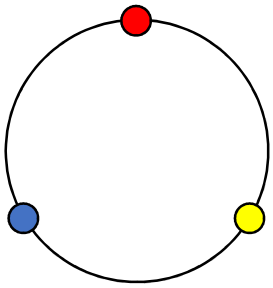
   d. Calculate $\dfrac{5^4-1}{5^2-1}$

   e. Calculate $\dfrac{10^4-1}{10^2-1}$

   f. Write down a formula which summarizes the above calculations.

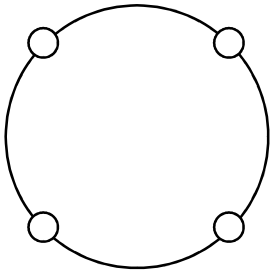
   g. Justify your answer.

6. I am designing a bangle. A bangle is a circular wire onto which some beads are threaded. The beads are identical in every respect apart from colour.



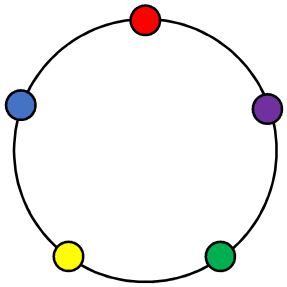
a. If I decide to use one red bead, one blue bead and one yellow bead, explain why all the bangles I can design with these three beads are the same.

I now decide to use four beads. In each of the following cases, decide how many bangles I can design.



b. One red bead, one blue bead, one yellow bead and one green bead.
c. Two red beads, one yellow bead, one green bead.
d. Two red beads, two yellow beads.
e. Three red beads, one yellow bead.

I now decide to design a bangle with five beads.



f. How many different bangles can I design if I use five beads, each of different colour?