

## Algebra 2 (Intermediate UKMT)

These questions must be attempted without a calculator

Topics covered in the questions below may not necessarily be from the topic of the title.

1. If the answers to the calculations shown below are placed in order of size, which will be in the middle?

A  $19 + 97$       B  $19 - 97$       C  $19 \times 97$       D  $19 \div 97$       E  $19^{97}$

2. Each person's *birthday product* is obtained by multiplying the day of the month in which they were born by the number of the month in which they were born, and then multiplying the answer by the year in which they were born. Here are five English queens and their birthdays.

Which of them has the same birthday product as someone born on 5 February 1998?

A Mary 1, 18 February 1518    B Elizabeth 1, 7 September 1533    C Anne, 6 February 1665  
D Victoria, 24 May 1819      E Elizabeth 11, 21 April 1926

3. How is the number *ten million one hundred thousand and one* written?

A 1001001      B 11000001      C 101000001      D 1010001      E 10100001

4. Trinni is fascinated by triangle numbers (1, 3, 6, 10, 15, 21, etc.) and recently, coming across a clock, she found that she could rearrange the twelve numbers 1, 2, 3, ... 12 around the face so that each adjacent pair added up to a triangle number.

She left the 12 in its usual place; what number did she put where the 6 would usually be?

A 1                  B 4                  C 5                  D 10                  E 11

5. If  $p$ ,  $q$  and  $p - q$  are all positive integers, which of the following is least?

A  $\frac{q^2}{p^2}$       B  $\frac{p^2}{q^2}$       C  $\frac{q}{p}$       D  $\sqrt{\frac{q}{p}}$       E  $\sqrt{\frac{p}{q}}$

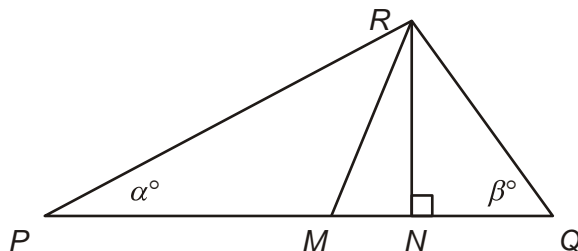
6. As  $n$  takes each positive integer value in turn (that is  $n = 1$ ,  $n = 2$ ,  $n = 3$ , and so on) how many different values are obtained for the remainder when  $n^2$  is divided by  $n + 4$ ?

A 1      B 8      C 9      D 16      E Infinitely many

7. Which of the following is equal to  $(1 + x + y)^2 - (1 - x - y)^2$  for all values of  $x$  and  $y$ ?

- A  $4x$       B  $2(x^2 + y^2)$       C  $0$       D  $4xy$       E  $4(x + y)$

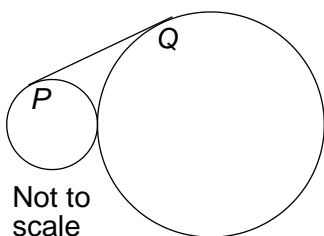
8. In triangle  $PQR$ ,  $\angle QPR = \alpha^\circ$ , and  $\angle PQR = \beta^\circ$ , where  $\alpha < \beta$ . The line  $RM$  bisects  $\angle PRQ$  and  $RN$  is the perpendicular from  $R$  to the line  $PQ$ . What is the size, in degrees, of  $\angle MRN$ ?



- A  $\frac{180 - (\alpha + \beta)}{2}$       B  $\frac{\beta - \alpha}{2}$       C  $\frac{\alpha + 2\beta}{2}$       D  $\frac{360 - \alpha - 2\beta}{2}$       E  $\frac{\alpha + \beta}{2}$

9. Two circles with radii 1 cm and 4 cm touch. The point  $P$  is on the smaller circle,  $Q$  is on the larger circle and  $PQ$  is a tangent to both circles.

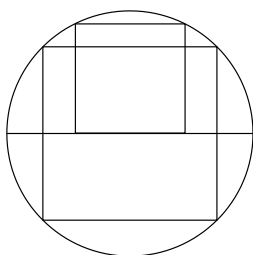
What is the length of  $PQ$ ?



- A  $\sqrt{17}$  cm      B 3 cm      C  $2\sqrt{3}$  cm      D  $3\sqrt{2}$  cm      E 4 cm

10. The diagram shows a square of area  $x$  square units inscribed inside a semicircle and a larger square of area  $y$  square units inscribed inside a circle.

What is the ratio  $x : y$ ?



- A  $1:\sqrt{2}$       B 1:2      C 2:5      D 1:3      E  $\sqrt{3}:4$