

**MATHEMATICS CHALLENGE FOR YOUNG  
AUSTRALIANS  
JUNIOR: YEARS 7 and 8  
WARM UP PROBLEM 03**

**Pentagons**

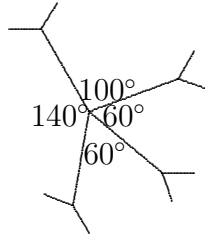
1. One side of a large sheet of white cardboard was painted red. From it were cut a large number of identical pentagons. Each one had all its sides 4 cm long – it was thus an equilateral pentagon.

The five angles of each one were  $60^\circ$ ,  $80^\circ$ ,  $100^\circ$ ,  $140^\circ$  and  $160^\circ$  (though not necessarily in that order).

Make an accurate drawing of one of the pentagons, labelling the angles.

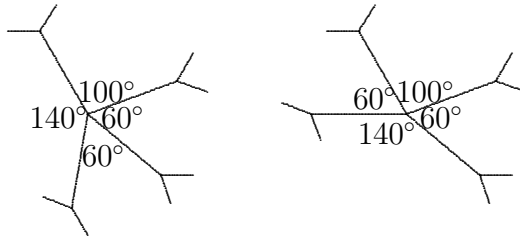
2. There are several ways in which I can make patterns with the pentagons so that they fill the space around a

point. For example:



List the ways in which  $60^\circ$ ,  $80^\circ$ ,  $100^\circ$ ,  $140^\circ$  and  $160^\circ$  can be combined to add to  $360^\circ$ . Each number may be used any number of times (or not at all). Order is not important. Thus for example, both  $(60^\circ, 60^\circ, 100^\circ, 140^\circ)$  and  $(60^\circ, 100^\circ, 60^\circ, 140^\circ)$  are the same combination.

3. When all the pentagons have red faces showing, sometimes it is possible to make more than one pattern (or arrangement) with the same combination of angles. For example:



How many such patterns (which have all red faces showing) are there for the combination  $60^\circ, 60^\circ, 80^\circ, 80^\circ, 80^\circ$ ?

4. Patterns can also be made where each pentagon may have either its red face or its white face showing. How many different patterns of this kind are there for the combination  $60^\circ, 60^\circ, 80^\circ, 80^\circ, 80^\circ$ ?

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