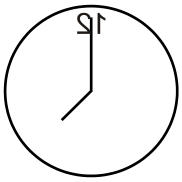
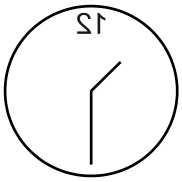
Transformations (Junior UKMT)

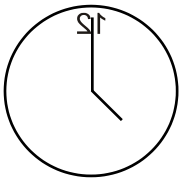
These questions must be attempted ***without a calculator***

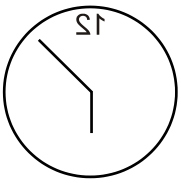
Topics covered in the questions below may not necessarily be from the topic of the title.

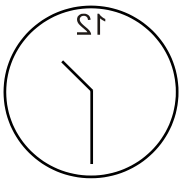
1. If you looked in a mirror at an accurate clock at 1:30 pm, which of the following would you see?

A 

B 

C 

D 

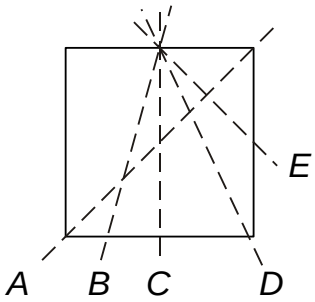
E 

2. Beatrix takes a sheet of paper (shown below on the left), folds the sheet in half 4 times and punches a hole all the way through the folded sheet, as shown. She then unfolds the sheet.

How many holes are there now in the unfolded sheet?

A 4 B 6 C 8 D 12 E 16

3. Along which line should an upright mirror be placed so that the part of the square on one side of the mirror and its reflection form an octagon?



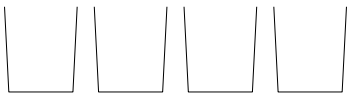
A B C D E

4. Which of the following could be the image of UKMT when seen reflected in a mirror?

A ∩ ʞ ʍ ⊥ B T M K U C U ʞ M T D ∩ ʞ ʍ ⊥ E ⊥ ʍ ʞ ∩

5. The diagram shows four empty glasses with their bases at the bottom. One move consists of turning exactly three of the four glasses upside-down.

What is the smallest number of moves needed before all of the glasses have their bases at the top?



A 3 B 4 C 7 D 11 E 13

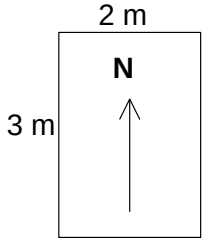
6. A robot, which is initially facing North, is programmed to travel 5m then turn through 10°, travel 5m then turn through 20°, travel 5m then turn through 30°, and so on. Each move consists of moving 5m in a straight line and then turning clockwise through an angle which increases by 10° at each move.

How far has it travelled by the time it is first facing due East at the end of a move?

A 9 m B 40 m C 45 m D 50 m E 90 m

7. My rabbit Nibbles lives in a movable pen and helps to keep the grass short. The pen is rectangular and measures 3 m by 2 m, as shown in the diagram, where the arrow indicates North. On successive days, the pen is moved 1 m East, 2 m South, 1 m West and 2 m North.

What is the total area, in square metres, of the region of grass which Nibbles can nibble?



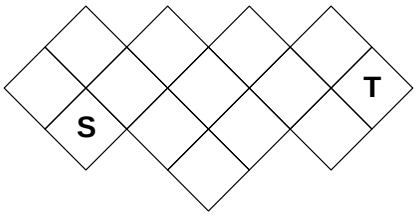
A 6 B 12 C 15 D 18 E 24

8. The diagram shows a poster which Beatrix has (this way up!) on her wall. When Beatrix was standing on her head, looking in a mirror on the opposite wall at the poster on the wall behind her, how many letters could still be read in the normal way?

A 2 B 3 C 4 D 5 E 7

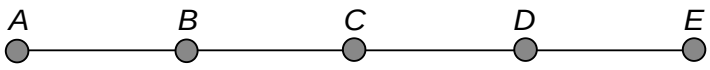
9. The board for the game *Rorrim* is shown. In the game, a counter has to be moved from the starting square, **S**, to the target square, **T**, in the smallest possible number of moves. To make a move, one of the lines of the board is chosen as a mirror and the counter is moved to the square which is the reflection of its present square in that mirror.

What is the smallest number of moves required to reach square **T** from square **S**?



A 3 B 4 C 5 D 6 E 7

10. The diagram shows a rod with five equally spaced points *A*, *B*, *C*, *D* and *E* marked on it.



The rod is rotated three times through 180 degrees, first about *A*, then about *B* and finally about *E*.

Which point finishes in the same position as it was at the start?

A *A* B *B* C *C* D *D* E *E*

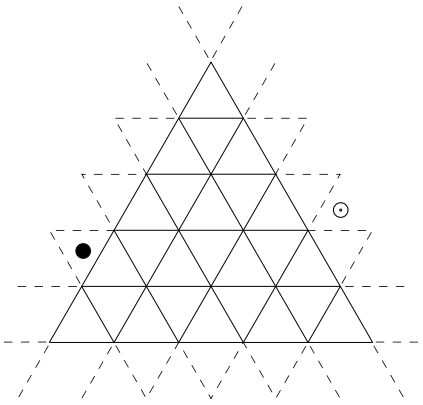
11. A piece of paper in the shape of a polygon is folded in half along a line of symmetry. The resulting shape is also folded in half, again along a line of symmetry. The final shape is a triangle.

How many possibilities are there for the number of sides of the original polygon?

A 3 B 4 C 5 D 6 E 7

12. In the game illustrated here, the black counter ● has to be moved from its "starting position" to its "target position" (shown here as circle ⊙). The aim is to achieve this in the smallest number of "moves". To make a "move", you have to choose one of fifteen marked lines as your "mirror" and move the counter ● to the position which is reflected of its present position in that "mirror".

What is the smallest number of "moves" required to reach the target position?



A 2 B 3 C 4 D 5 E Starting from ● it is impossible to reach ⊙