Stage 3 ★
Mixed Selection 1 - Solutions

1. **Net result**
   When the shape is folded up, imagine *X* is on top. This means *B* is on the left hand face and *C* is on the right hand face.

   This means *A* is on the back face and *D* is on the front face. This leaves *E* on the bottom face, so opposite *X*.

2. **Cubic vision**
   We can see the greatest number of cubes when looking at three faces at once.

   We count the cubes on each face, giving $3 \times 11^2 = 363$ cubes, but we have to subtract from this the cubes along the three edges that have been counted twice, and then add back for the cube at the corner for which three faces are visible.

   The final quantity is $363 - (3 \times 11) + 1 = 331$ cubes.

3. **Dicey directions**
   The table shows the number of the face in contact with the table at the various stages described, and also the numbers on the three faces of the die that are visible from the viewpoint in the question.

	Start	1st move	2nd move	3rd move	4th move
In contact with the table	5	1	2	3	5
Facing South	3	3	3	5	4
Facing East	1	2	6	6	6
Facing Up	2	6	5	4	2

   As the '6' face is now facing East, the '1' face will be facing West.

4. Painted purple

The solution depends on how the cube is painted.

If you paint the large cube so that two of the small corner cubes have their three painted faces all painted the same colour, then 12 of the small cubes will have at least one red face and also at least one blue face.

If you paint the large cube so that no small corner cube has all three of its painted faces painted the same colour, then 16 small cubes will have at least one red face and one blue face.

5. Sugary diversion

The ant climbs up the cube (adding 1cm), walks across the top of the cube on the same path as he would have done if the cube wasn't there, then climbs back down to the table (adding another 1cm), so the total extra distance is 2cm.

These problems are adapted from UKMT Mathematical Challenge problems (ukmt.org.uk).