

Name:

School:

Marks:

Instructions: Write your name and that of your school in the boxes above. For rough work, you may use your notebook. This question paper is also the answer script. Turn it in but not any rough work.

Each of the first 11 questions below requires only a short answer. Write your answer clearly in the box provided (after the † prompt). The last two questions—see overleaf—demand slightly longer answers. Attempt these only after you're finished with the first 11, for your responses to these may not even be looked at if your score on the first 11 is below a threshold.

In all likelihood, there are more questions than you can reasonably finish in the allotted time. Do as many as you can without feeling tense. This question paper will be posted on the web page of the workshop and you are encouraged to work them out at home later. The purpose of the quiz is to get you to think about the concepts covered in the lectures, not at all to grade you.

1. If 9 balls are placed randomly in 4 bins, the probability that some bin contains 3 balls is:
2. A partition is called *symmetric* if it is equal to its transpose. The smallest integer that has at least two symmetric partitions is:
3. A regular dodecahedron has 12 faces and 30 edges. The number of faces on any of its sides is
4. Let n be a positive integer. Let $A(n)$ denote the number of those partitions of n in which no part exceeds 4, and $B(n)$ the number of partitions of n with at most 5 parts. Which of the following is true?: (i) $A(n) = B(n)$, (ii) $A(n) \leq B(n)$, (iii) $A(n) \geq B(n)$
5. Suppose that ℓ and m are two straight lines such that $M_\ell \circ M_m = M_m \circ M_\ell$, i.e., the reflections in ℓ and m commute. What can be said about the angle between ℓ and m ?
6. A cube is placed with its centre at the origin of the coordinate system and with the positive x -, y -, and z -axes going respectively through the centres of the Front, Right and Up faces. The faces of the cube are all coloured differently.
 - (a) In how many different positions can the cube be so placed?
 - (b) What if the Front and Back faces are painted one colour, the Right and Left faces are painted another and the Up and Down faces a third colour?
7. Let A, B, C be three points such that $R_{A,90^\circ} \circ R_{B,90^\circ} = R_{C,180^\circ}$. (Here R denotes rotation.) What can be said about $\triangle ABC$? What kind of triangle is it?
8. A partition is called *even* if all its parts are even. For example, 6 has 3 even partitions: 6, 4 + 2, and 2 + 2 + 2. Given that $p(8) = 22$, $p(9) = 30$, and $p(10) = 42$ (where $p(n)$ is the number of partitions of n), the number of EVEN partitions of 18 is:
9. Let ℓ, m, n denote the side-lines BC, CA, AB of a given $\triangle ABC$. Let f denote the transformation given by $f = M_\ell \circ M_m \circ M_n$. What kind of geometric transformation is $f \circ f$?
10. We are given a 9×9 sudoku grid with only 3 cells empty and all other cells filled in consistently. Also assume that the puzzle has at least one solution. How many solutions can it have?
11. Let p be a point such that the three points $(1, 0, 0)$, $(0, 1, 0)$, and $(0, 0, 1)$ together with p form the vertices of a regular tetrahedron. List all possibilities for p .

12. In the space provided below, describe briefly (you may use pictures) how you would determine the centre of a rotation if you were given the position of a triangle before and after that rotation.

‡



13. Under a rotation of 120° about the ray from $(0,0,0)$ to $(1,1,1)$, to which point is $(x,0,0)$ mapped? Fill in your answer in the preceding box before giving in the box below the justification for it using quaternions.

‡

