1. Three Mathematics books, five English books, four Science books and a dictionary are to be placed on a student's shelf so that the books of each subject remain together.

    (a) In how many different ways can the books be arranged?

    (4)

    (b) In how many of these will the dictionary be next to the Mathematics books?

    (3)
    (Total 7 marks)

2. There are six boys and five girls in a school tennis club. A team of two boys and two girls will be selected to represent the school in a tennis competition.

    (a) In how many different ways can the team be selected?

    (3)

    (b) Tim is the youngest boy in the club and Anna is the youngest girl. In how many different ways can the team be selected if it must include both of them?

    (2)

    (c) What is the probability that the team includes both Tim and Anna?

    (1)

    (d) Fred is the oldest boy in the club. Given that Fred is selected for the team, what is the probability that the team includes Tim or Anna, but not both?

    (4)
    (Total 10 marks)

3. A room has nine desks arranged in three rows of three desks. Three students sit in the room. If the students randomly choose a desk find the probability that two out of the front three desks are chosen.

    (Total 5 marks)

2. [Maximum mark: 5]

A team of four is to be chosen from a group of four boys and four girls.

(a) Find the number of different possible teams that could be chosen. [3]

(b) Find the number of different possible teams that could be chosen, given that the team must include at least one girl and at least one boy. [2]

9. [Maximum mark: 6]

Twelve students are to take an exam in advanced combinatorics.
The exam room is set out in three rows of four desks, with the invigilator at the front of the room, as shown in the following diagram.

INVIGILATOR

Desk 1   Desk 2   Desk 3   Desk 4

Desk 5   Desk 6   Desk 7   Desk 8

Desk 9   Desk 10   Desk 11   Desk 12

(a) Find the number of ways the twelve students may be arranged in the exam hall. [1]

Two of the students, Helen and Nicky, are suspected of cheating in a previous exam.

(b) Find the number of ways the students may be arranged if Helen and Nicky must sit so that one is directly behind the other (with no desk in between). For example Desk 5 and Desk 9. [2]

(c) Find the number of ways the students may be arranged if Helen and Nicky must not sit next to each other in the same row. [3]

4. [Maximum mark: 5]

Three girls and four boys are seated randomly on a straight bench. Find the probability that the girls sit together and the boys sit together.

8. [Maximum mark: 6]

In a trial examination session a candidate at a school has to take 18 examination papers including the physics paper, the chemistry paper and the biology paper. No two of these three papers may be taken consecutively. There is no restriction on the order in which the other examination papers may be taken.

Find the number of different orders in which these 18 examination papers may be taken.