

Past Years: Chapter 2 Permutation and Combination

May/June 2002

- 5 The digits of the number 1223678 can be rearranged to give many different 7-digit numbers. Find how many different 7-digit numbers can be made if
- (i) there are no restrictions on the order of the digits, [2]
 - (ii) the digits 1, 3, 7 (in any order) are next to each other, [3]
 - (iii) these 7-digit numbers are even. [3]

May/June 2003

- 5 A committee of 5 people is to be chosen from 6 men and 4 women. In how many ways can this be done
- (i) if there must be 3 men and 2 women on the committee, [2]
 - (ii) if there must be more men than women on the committee, [3]
 - (iii) if there must be 3 men and 2 women, and one particular woman refuses to be on the committee with one particular man? [3]

May/June 2004

- 5 (a) The menu for a meal in a restaurant is as follows.

<p style="text-align: center;"><i>Starter Course</i></p> <p style="text-align: center;"><i>Melon</i> or <i>Soup</i> or <i>Smoked Salmon</i></p> <p style="text-align: center;"><i>Main Course</i></p> <p style="text-align: center;"><i>Chicken</i> or <i>Steak</i> or <i>Lamb Cutlets</i> or <i>Vegetable Curry</i> or <i>Fish</i></p> <p style="text-align: center;"><i>Dessert Course</i></p> <p style="text-align: center;"><i>Cheesecake</i> or <i>Ice Cream</i> or <i>Apple Pie</i></p> <p style="text-align: center;"><i>All the main courses are served with salad and either new potatoes or french fries.</i></p>
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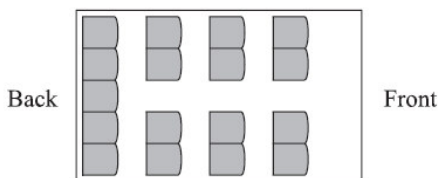
- (i) How many different three-course meals are there? [2]
 - (ii) How many different choices are there if customers may choose only two of the three courses? [3]
- (b) In how many ways can a group of 14 people eating at the restaurant be divided between three tables seating 5, 5 and 4? [3]

May/June 2005

- 7 (a) A football team consists of 3 players who play in a defence position, 3 players who play in a midfield position and 5 players who play in a forward position. Three players are chosen to collect a gold medal for the team. Find in how many ways this can be done
- (i) if the captain, who is a midfield player, must be included, together with one defence and one forward player, [2]
 - (ii) if exactly one forward player must be included, together with any two others. [2]
- (b) Find how many different arrangements there are of the nine letters in the words GOLD MEDAL
- (i) if there are no restrictions on the order of the letters, [2]
 - (ii) if the two letters D come first and the two letters L come last. [2]

May/June 2006

4



The diagram shows the seating plan for passengers in a minibus, which has 17 seats arranged in 4 rows. The back row has 5 seats and the other 3 rows have 2 seats on each side. 11 passengers get on the minibus.

- (i) How many possible seating arrangements are there for the 11 passengers? [2]
 - (ii) How many possible seating arrangements are there if 5 particular people sit in the back row? [3]
- Of the 11 passengers, 5 are unmarried and the other 6 consist of 3 married couples.
- (iii) In how many ways can 5 of the 11 passengers on the bus be chosen if there must be 2 married couples and 1 other person, who may or may not be married? [3]

May/June 2007

- 5 (i) Find the number of ways in which all twelve letters of the word REFRIGERATOR can be arranged
- (a) if there are no restrictions, [2]
 - (b) if the Rs must all be together. [2]
- (ii) How many different selections of four letters from the twelve letters of the word REFRIGERATOR contain no Rs and two Es? [3]

May/June 2008

- 3 Issam has 11 different CDs, of which 6 are pop music, 3 are jazz and 2 are classical.
- (i) How many different arrangements of all 11 CDs on a shelf are there if the jazz CDs are all next to each other? [3]
 - (ii) Issam makes a selection of 2 pop music CDs, 2 jazz CDs and 1 classical CD. How many different possible selections can be made? [3]

May/June 2009

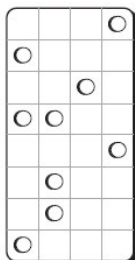
- 4 A choir consists of 13 sopranos, 12 altos, 6 tenors and 7 basses. A group consisting of 10 sopranos, 9 altos, 4 tenors and 4 basses is to be chosen from the choir.
- (i) In how many different ways can the group be chosen? [2]
 - (ii) In how many ways can the 10 chosen sopranos be arranged in a line if the 6 tallest stand next to each other? [3]
 - (iii) The 4 tenors and 4 basses in the group stand in a single line with all the tenors next to each other and all the basses next to each other. How many possible arrangements are there if three of the tenors refuse to stand next to any of the basses? [3]

Oct/Nov 2001

- 2 (a) A competition involves listing *in order* the best 6 features of a certain car. There are 10 features to choose from (e.g. power steering, air bags, air conditioning etc.). Peter makes a list of 6 features. How many different lists could Peter make? [2]
- (b) The word MOBILE consists of the three consonants M, B, L and the three vowels O, I, E. How many different arrangements of all the letters of the word MOBILE are possible if the vowels must be next to each other? [3]

Oct/Nov 2002

- 4 In a certain hotel, the lock on the door to each room can be opened by inserting a key card. The key card can be inserted only one way round. The card has a pattern of holes punched in it. The card has 4 columns, and each column can have either 1 hole, 2 holes, 3 holes or 4 holes punched in it. Each column has 8 different positions for the holes. The diagram illustrates one particular key card with 3 holes punched in the first column, 3 in the second, 1 in the third and 2 in the fourth.



- (i) Show that the number of different ways in which a column could have exactly 2 holes is 28. [1]
- (ii) Find how many different patterns of holes can be punched in a column. [4]
- (iii) How many different possible key cards are there? [2]

Oct/Nov 2003

- 6 (a) A collection of 18 books contains one Harry Potter book. Linda is going to choose 6 of these books to take on holiday.
- (i) In how many ways can she choose 6 books? [1]
 - (ii) How many of these choices will include the Harry Potter book? [2]
- (b) In how many ways can 5 boys and 3 girls stand in a straight line
- (i) if there are no restrictions, [1]
 - (ii) if the boys stand next to each other? [4]

Oct/Nov 2004

- 1 The word ARGENTINA includes the four consonants R, G, N, T and the three vowels A, E, I.
- (i) Find the number of different arrangements using all nine letters. [2]
 - (ii) How many of these arrangements have a consonant at the beginning, then a vowel, then another consonant, and so on alternately? [3]

Oct/Nov 2005

- 3 A staff car park at a school has 13 parking spaces in a row. There are 9 cars to be parked.
- (i) How many different arrangements are there for parking the 9 cars and leaving 4 empty spaces? [2]
 - (ii) How many different arrangements are there if the 4 empty spaces are next to each other? [3]
 - (iii) If the parking is random, find the probability that there will **not** be 4 empty spaces next to each other. [2]

Oct/Nov 2006

- 6 Six men and three women are standing in a supermarket queue.
- (i) How many possible arrangements are there if there are no restrictions on order? [2]
 - (ii) How many possible arrangements are there if no two of the women are standing next to each other? [4]
 - (iii) Three of the people in the queue are chosen to take part in a customer survey. How many different choices are possible if at least one woman must be included? [3]

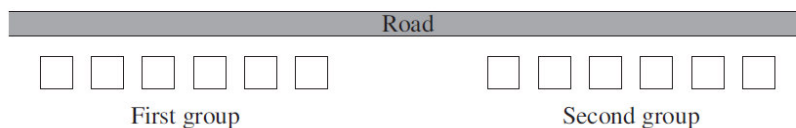
Oct/Nov 2007

- 3 The six digits 4, 5, 6, 7, 7, 7 can be arranged to give many different 6-digit numbers.
- (i) How many different 6-digit numbers can be made? [2]
 - (ii) How many of these 6-digit numbers start with an odd digit and end with an odd digit? [4]

Oct/Nov 2008

- 4 A builder is planning to build 12 houses along one side of a road. He will build 2 houses in style *A*, 2 houses in style *B*, 3 houses in style *C*, 4 houses in style *D* and 1 house in style *E*.
- (i) Find the number of possible arrangements of these 12 houses. [2]

(ii)



The 12 houses will be in two groups of 6 (see diagram). Find the number of possible arrangements if all the houses in styles *A* and *D* are in the first group and all the houses in styles *B*, *C* and *E* are in the second group. [3]

- (iii) Four of the 12 houses will be selected for a survey. Exactly one house must be in style *B* and exactly one house in style *C*. Find the number of ways in which these four houses can be selected. [2]

Oct/Nov 2009/11

- 5 (a) Find how many numbers between 5000 and 6000 can be formed from the digits 1, 2, 3, 4, 5 and 6
- (i) if no digits are repeated, [2]
 - (ii) if repeated digits are allowed. [2]
- (b) Find the number of ways of choosing a school team of 5 pupils from 6 boys and 8 girls
- (i) if there are more girls than boys in the team, [4]
 - (ii) if three of the boys are cousins and are either all in the team or all not in the team. [3]

Oct/Nov 2009/12

- 2 Two unbiased tetrahedral dice each have four faces numbered 1, 2, 3 and 4. The two dice are thrown together and the sum of the numbers on the faces on which they land is noted. Find the expected number of occasions on which this sum is 7 or more when the dice are thrown together 200 times. [4]
- 4 (a) (i) Find how many different four-digit numbers can be made using only the digits 1, 3, 5 and 6 with no digit being repeated. [1]
- (ii) Find how many different odd numbers greater than 500 can be made using some or all of the digits 1, 3, 5 and 6 with no digit being repeated. [4]
- (b) Six cards numbered 1, 2, 3, 4, 5, 6 are arranged randomly in a line. Find the probability that the cards numbered 4 and 5 are **not** next to each other. [3]

May/June 2010/61

- 6 (i) Find the number of different ways that a set of 10 different mugs can be shared between Lucy and Monica if each receives an odd number of mugs. [3]
- (ii) Another set consists of 6 plastic mugs each of a different design and 3 china mugs each of a different design. Find in how many ways these 9 mugs can be arranged in a row if the china mugs are all separated from each other. [3]
- (iii) Another set consists of 3 identical red mugs, 4 identical blue mugs and 7 identical yellow mugs. These 14 mugs are placed in a row. Find how many different arrangements of the colours are possible if the red mugs are kept together. [3]

May/June 2010/62

- 7 Nine cards, each of a different colour, are to be arranged in a line.
- (i) How many different arrangements of the 9 cards are possible? [1]
- The 9 cards include a pink card and a green card.
- (ii) How many different arrangements do not have the pink card next to the green card? [3]
- Consider all possible choices of 3 cards from the 9 cards with the 3 cards being arranged in a line.
- (iii) How many different arrangements in total of 3 cards are possible? [2]
- (iv) How many of the arrangements of 3 cards in part (iii) contain the pink card? [2]
- (v) How many of the arrangements of 3 cards in part (iii) do not have the pink card next to the green card? [2]

May/June 2010/63

- 4 Three identical cans of cola, 2 identical cans of green tea and 2 identical cans of orange juice are arranged in a row. Calculate the number of arrangements if
- (i) the first and last cans in the row are the same type of drink, [3]
 - (ii) the 3 cans of cola are all next to each other and the 2 cans of green tea are not next to each other. [5]

Oct/Nov 2010/61

6



Pegs are to be placed in the four holes shown, one in each hole. The pegs come in different colours and pegs of the same colour are identical. Calculate how many different arrangements of coloured pegs in the four holes can be made using

- (i) 6 pegs, all of different colours, [1]
- (ii) 4 pegs consisting of 2 blue pegs, 1 orange peg and 1 yellow peg. [1]

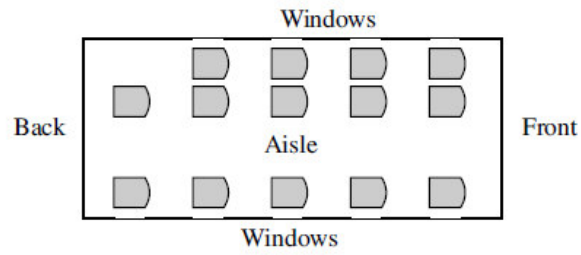
Beryl has 12 pegs consisting of 2 red, 2 blue, 2 green, 2 orange, 2 yellow and 2 black pegs. Calculate how many different arrangements of coloured pegs in the 4 holes Beryl can make using

- (iii) 4 different colours, [1]
- (iv) 3 different colours, [3]
- (v) any of her 12 pegs. [3]

Oct/Nov 2010/62

- 7 A committee of 6 people, which must contain at least 4 men and at least 1 woman, is to be chosen from 10 men and 9 women.
- (i) Find the number of possible committees that can be chosen. [3]
 - (ii) Find the probability that one particular man, Albert, and one particular woman, Tracey, are both on the committee. [2]
 - (iii) Find the number of possible committees that include either Albert or Tracey but not both. [3]
 - (iv) The committee that is chosen consists of 4 men and 2 women. They queue up randomly in a line for refreshments. Find the probability that the women are not next to each other in the queue. [3]

6



A small aeroplane has 14 seats for passengers. The seats are arranged in 4 rows of 3 seats and a back row of 2 seats (see diagram). 12 passengers board the aeroplane.

- (i) How many possible seating arrangements are there for the 12 passengers? Give your answer correct to 3 significant figures. [2]

These 12 passengers consist of 2 married couples (Mr and Mrs Lin and Mr and Mrs Brown), 5 students and 3 business people.

- (ii) The 3 business people sit in the front row. The 5 students each sit at a window seat. Mr and Mrs Lin sit in the same row on the same side of the aisle. Mr and Mrs Brown sit in another row on the same side of the aisle. How many possible seating arrangements are there? [4]
- (iii) If, instead, the 12 passengers are seated randomly, find the probability that Mrs Lin sits directly behind a student and Mrs Brown sits in the front row. [4]