TOPICAL PAST PAPER QUESTIONS WORKBOOK

PapaCambridge

AS & A Level Mathematics (9709) Paper 5

[Probability & Statistics 1]

Exam Series: May 2015 – May 2022

Format Type A:
Answers to all questions are provided as an appendix

PapaCambridge

Chapter 2

Permutations and combinations

79. 9709_m22_qp_52 Q: 5

A group of 12 people consists of 3 boys, 4 girls and 5 adults.

(a) In how many ways can a team of 5 people be chosen from the group if exactly one adult is included?   [2]

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(b) In how many ways can a team of 5 people be chosen from the group if the team includes at least 2 boys and at least 1 girl?   [4]

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The same group of 12 people stand in a line.

(c) How many different arrangements are there in which the 3 boys stand together and an adult is at each end of the line? [4]

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80. 9709_s22_qp_51 Q: 1

(a) Find the number of different arrangements of the 8 letters in the word DECEIVED in which all three Es are together and the two Ds are together. [2]

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(b) Find the number of different arrangements of the 8 letters in the word DECEIVED in which the three Es are not all together. [4]

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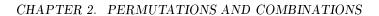
81. 9709_s22_qp_51 Q: 2

There are 6 men and 8 women in a Book Club. The committee of the club consists of five of its members. Mr Lan and Mrs Lan are members of the club.

(a) In how many different ways can the committee be selected if exactly one of Mr Lan and Mrs Lan must be on the committee? [2]

(b) In how many different ways can the committee be selected if Mrs Lan must be on the committee and there must be more women than men on the committee? [4]

82. 9709_s22_qp_52 Q: 6

(a) Find the number of different arrangements of the 9 letters in the word CROCODILE. [1]

(b) Find the number of different arrangements of the 9 letters in the word CROCODILE in which there is a C at each end and the two Os are not together. [3]

(c) Four letters are selected from the 9 letters in the word CROCODILE.

Find the number of selections in which the number of Cs is not the same as the number of Os.

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(d) Find the number of ways in which the 9 letters in the word CROCODILE can be divided into three groups, each containing three letters, if the two Cs must be in different groups. [3]

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83. 9709_s22_qp_53 Q: 7

A group of 15 friends visit an adventure park. The group consists of four families.

- Mr and Mrs Kenny and their four children
- Mr and Mrs Lizo and their three children
- Mrs Martin and her child
- Mr and Mrs Nantes

The group travel to the park in three cars, one containing 6 people, one containing 5 people and one containing 4 people. The cars are driven by Mr Lizo, Mrs Martin and Mr Nantes respectively.

(a) In how many different ways can the remaining 12 members of the group be divided between the three cars?   [3]

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The group enter the park by walking through a gate one at a time.

(b) In how many different orders can the 15 friends go through the gate if Mr Lizo goes first and each family stays together?   [3]

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In the park, the group enter a competition which requires a team of 4 adults and 3 children.

(c) In how many ways can the team be chosen from the group of 15 so that the 3 children are all from different families? [2]

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(d) In how many ways can the team be chosen so that at least one of Mr Kenny or Mr Lizo is included? [3]

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84. 9709_m21_qp_52 Q: 6

(a) Find the total number of different arrangements of the 11 letters in the word CATERPILLAR.

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(b) Find the total number of different arrangements of the 11 letters in the word CATERPILLAR in which there is an R at the beginning and an R at the end, and the two As are not together.   [4]

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(c) Find the total number of different selections of 6 letters from the 11 letters of the word CATERPILLAR that contain both Rs and at least one A and at least one L. [4]

85. 9709_s21_qp_51 Q: 1

A bag contains 12 marbles, each of a different size. 8 of the marbles are red and 4 of the marbles are blue.

How many different selections of 5 marbles contain at least 4 marbles of the same colour?   [4]

86. 9709_s21_qp_53 Q: 6

(a) How many different arrangements are there of the 11 letters in the word REQUIREMENT?   [2]

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(b) How many different arrangements are there of the 11 letters in the word REQUIREMENT in which the two Rs are together and the three Es are together?   [1]

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(c) How many different arrangements are there of the 11 letters in the word REQUIREMENT in which there are exactly three letters between the two Rs?   [3]

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Five of the 11 letters in the word REQUIREMENT are selected.

(d) How many possible selections contain at least two Es and at least one R? [4]

87. 9709_w21_qp_52 Q: 2

A group of 6 people is to be chosen from 4 men and 11 women.

(a) In how many different ways can a group of 6 be chosen if it must contain exactly 1 man?   [2]

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Two of the 11 women are sisters Jane and Kate.

(b) In how many different ways can a group of 6 be chosen if Jane and Kate cannot both be in the group?   [3]

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88. 9709_w21_qp_52 Q: 4

(a) In how many different ways can the 9 letters of the word TELESCOPE be arranged? [2]

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(b) In how many different ways can the 9 letters of the word TELESCOPE be arranged so that there are exactly two letters between the T and the C? [4]

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89. 9709_w21_qp_53 Q: 1

The 26 members of the local sports club include Mr and Mrs Khan and their son Abad. The club is holding a party to celebrate Abad's birthday, but there is only room for 20 people to attend.

In how many ways can the 20 people be chosen from the 26 members of the club, given that Mr and Mrs Khan and Abad must be included? [2]

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90. 9709_m20_qp_52 Q: 1

The 40 members of a club include Ranuf and Saed. All 40 members will travel to a concert. 35 members will travel in a coach and the other 5 will travel in a car. Ranuf will be in the coach and Saed will be in the car.

In how many ways can the members who will travel in the coach be chosen?   [3]

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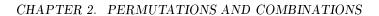
91. 9709_m20_qp_52 Q: 4

Richard has 3 blue candles, 2 red candles and 6 green candles. The candles are identical apart from their colours. He arranges the 11 candles in a line.

(a) Find the number of different arrangements of the 11 candles if there is a red candle at each end.

[2]

(b) Find the number of different arrangements of the 11 candles if all the blue candles are together and the red candles are not together. [4]

92. 9709_s20_qp_51 Q: 2

(a) Find the number of different arrangements that can be made from the 9 letters of the word JEWELLERY in which the three Es are together and the two Ls are together.   [2]

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(b) Find the number of different arrangements that can be made from the 9 letters of the word JEWELLERY in which the two Ls are not next to each other.   [4]

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93. 9709_s20_qp_51 Q: 4

In a music competition, there are 8 pianists, 4 guitarists and 6 violinists. 7 of these musicians will be selected to go through to the final.

How many different selections of 7 finalists can be made if there must be at least 2 pianists, at least 1 guitarist and more violinists than guitarists? [4]

94. 9709_s20_qp_52 Q: 6

(a) Find the number of different ways in which the 10 letters of the word SUMMERTIME can be arranged so that there is an E at the beginning and an E at the end.   [2]

(b) Find the number of different ways in which the 10 letters of the word SUMMERTIME can be arranged so that the Es are not together.   [4]

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(c) Four letters are selected from the 10 letters of the word SUMMERTIME. Find the number of different selections if the four letters include at least one M and exactly one E. [3]

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95. 9709_w20_qp_53 Q: 3

A committee of 6 people is to be chosen from 9 women and 5 men.

(a) Find the number of ways in which the 6 people can be chosen if there must be more women than men on the committee.   [3]

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The 9 women and 5 men include a sister and brother.

(b) Find the number of ways in which the committee can be chosen if the sister and brother cannot both be on the committee.   [3]

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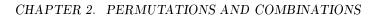
96. 9709_m19_qp_62 Q: 7

Find the number of different arrangements that can be made of all 9 letters in the word CAMERAMAN in each of the following cases.

(i) There are no restrictions. [2]

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(ii) The As occupy the 1st, 5th and 9th positions. [1]

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(iii) There is exactly one letter between the Ms. [4]

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Three letters are selected from the 9 letters of the word CAMERAMAN.

(iv) Find the number of different selections if the three letters include exactly one M and exactly one A. [1]

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(v) Find the number of different selections if the three letters include at least one M. [3]

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97. 9709_s19_qp_61 Q: 8

Freddie has 6 toy cars and 3 toy buses, all different. He chooses 4 toys to take on holiday with him.

(i) In how many different ways can Freddie choose 4 toys? [1]

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(ii) How many of these choices will include both his favourite car and his favourite bus? [2]

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Freddie arranges these 9 toys in a line.

(iii) Find the number of possible arrangements if the buses are all next to each other. [3]

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(iv) Find the number of possible arrangements if there is a car at each end of the line and no buses are next to each other. [3]

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98. 9709_s19_qp_62 Q: 7

(a) A group of 6 teenagers go boating. There are three boats available. One boat has room for 3 people, one has room for 2 people and one has room for 1 person. Find the number of different ways the group of 6 teenagers can be divided between the three boats. [3]

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(b) Find the number of different 7-digit numbers which can be formed from the seven digits 2, 2, 3, 7, 7, 7, 8 in each of the following cases.

  (i) The odd digits are together and the even digits are together. [3]

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(ii) The 2s are not together. [4]

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99. 9709_s19_qp_63 Q: 3

Mr and Mrs Keene and their 5 children all go to watch a football match, together with their friends Mr and Mrs Uzuma and their 2 children. Find the number of ways in which all 11 people can line up at the entrance in each of the following cases.

(i) Mr Keene stands at one end of the line and Mr Uzuma stands at the other end.   [2]

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(ii) The 5 Keene children all stand together and the Uzuma children both stand together.   [3]

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100. 9709_s19_qp_63 Q: 4

(i) Find the number of ways a committee of 6 people can be chosen from 8 men and 4 women if there must be at least twice as many men as there are women on the committee.   [3]

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(ii) Find the number of ways a committee of 6 people can be chosen from 8 men and 4 women if 2 particular men refuse to be on the committee together.   [3]

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101. 9709_w19_qp_61 Q: 6

(i) Find the number of different ways in which all 12 letters of the word STEEPLECHASE can be arranged so that all four Es are together.   [1]

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(ii) Find the number of different ways in which all 12 letters of the word STEEPLECHASE can be arranged so that the Ss are not next to each other.   [4]

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Four letters are selected from the 12 letters of the word STEEPLECHASE.

(iii) Find the number of different selections if the four letters include exactly one S. [4]

102. 9709_w19_qp_63 Q: 2

(i) How many different arrangements are there of the 9 letters in the word CORRIDORS?   [2]

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(ii) How many different arrangements are there of the 9 letters in the word CORRIDORS in which the first letter is D and the last letter is R or O?   [3]

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103. 9709_w19_qp_63 Q: 3

A sports team of 7 people is to be chosen from 6 attackers, 5 defenders and 4 midfielders. The team must include at least 3 attackers, at least 2 defenders and at least 1 midfielder.

(i) In how many different ways can the team of 7 people be chosen? [4]

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The team of 7 that is chosen travels to a match in two cars. A group of 4 travel in one car and a group of 3 travel in the other car.

(ii) In how many different ways can the team of 7 be divided into a group of 4 and a group of 3? [2]

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104. 9709_m18_qp_62 Q: 2

A selection of 3 letters from the 8 letters of the word COLLIDER is made.

(i) How many different selections of 3 letters can be made if there is exactly one L?   [1]

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(ii) How many different selections of 3 letters can be made if there are no restrictions?   [3]

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105. 9709_m18_qp_62 Q: 6

The digits 1, 3, 5, 6, 6, 6, 8 can be arranged to form many different 7-digit numbers.

(i) How many of the 7-digit numbers have all the even digits together and all the odd digits together?

[3]

(ii) How many of the 7-digit numbers are even?

[3]

106. 9709_s18_qp_61   Q: 7

Find the number of different ways in which all 9 letters of the word MINCEMEAT can be arranged in each of the following cases.

(i) There are no restrictions. [1]

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(ii) No vowel (A, E, I are vowels) is next to another vowel. [4]

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5 of the 9 letters of the word MINCEMEAT are selected.

(iii) Find the number of possible selections which contain exactly 1 M and exactly 1 E. [2]

(iv) Find the number of possible selections which contain at least 1 M and at least 1 E. [3]

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107. 9709_s18_qp_62 Q: 6

(a) Find the number of ways in which all 9 letters of the word AUSTRALIA can be arranged in each of the following cases.

(i) All the vowels (A, I, U are vowels) are together. [3]

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(ii) The letter T is in the central position and each end position is occupied by one of the other consonants (R, S, L). [3]

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(b) Donna has 2 necklaces, 8 rings and 4 bracelets, all different. She chooses 4 pieces of jewellery. How many possible selections can she make if she chooses at least 1 necklace and at least 1 bracelet?   [4]

108. 9709_s18_qp_63 Q: 7

Find the number of ways the 9 letters of the word SEVENTEEN can be arranged in each of the following cases.

(i) One of the letter Es is in the centre with 4 letters on either side. [2]

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(ii) No E is next to another E. [3]

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5 letters are chosen from the 9 letters of the word SEVENTEEN.

(iii) Find the number of possible selections which contain exactly 2 Es and exactly 2 Ns. [1]

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(iv) Find the number of possible selections which contain at least 2 Es. [4]

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109. 9709_w18_qp_61 Q: 1

9 people are to be divided into a group of 4, a group of 3 and a group of 2. In how many different ways can this be done? [3]

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110. 9709_w18_qp_61 Q: 3

In an orchestra, there are 11 violinists, 5 cellists and 4 double bass players. A small group of 6 musicians is to be selected from these 20.

(i) How many different selections of 6 musicians can be made if there must be at least 4 violinists, at least 1 cellist and no more than 1 double bass player? [4]

The small group that is selected contains 4 violinists, 1 cellist and 1 double bass player. They sit in a line to perform a concert.

(ii) How many different arrangements are there of these 6 musicians if the violinists must sit together?

[3]

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111. 9709_w18_qp_62 Q: 4

(i) Find the number of different ways that 5 boys and 6 girls can stand in a row if all the boys stand together and all the girls stand together. [3]

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(ii) Find the number of different ways that 5 boys and 6 girls can stand in a row if no boy stands next to another boy. [3]

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112. 9709_w18_qp_63 Q: 1

A group consists of 5 men and 2 women. Find the number of different ways that the group can stand in a line if the women are not next to each other. [3]

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113. 9709_m17_qp_62 Q: 5

(i) A plate of cakes holds 12 different cakes. Find the number of ways these cakes can be shared between Alex and James if each receives an odd number of cakes.   [3]

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(ii) Another plate holds 7 cup cakes, each with a different colour icing, and 4 brownies, each of a different size. Find the number of different ways these 11 cakes can be arranged in a row if no brownie is next to another brownie.   [3]

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(iii) A plate of biscuits holds 4 identical chocolate biscuits, 6 identical shortbread biscuits and 2 identical gingerbread biscuits. These biscuits are all placed in a row. Find how many different arrangements are possible if the chocolate biscuits are all kept together. [3]

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114. 9709_s17_qp_61 Q: 7

(a) Eight children of different ages stand in a random order in a line. Find the number of different ways this can be done if none of the three youngest children stand next to each other.   [3]

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(b) David chooses 5 chocolates from 6 different dark chocolates, 4 different white chocolates and 1 milk chocolate. He must choose at least one of each type. Find the number of different selections he can make.   [4]

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(c) A password for Chelsea's computer consists of 4 characters in a particular order. The characters are chosen from the following.

- The 26 capital letters A to Z
- The 9 digits 1 to 9
- The 5 symbols # ~ * ? !

The password must include at least one capital letter, at least one digit and at least one symbol. No character can be repeated. Find the number of different passwords that Chelsea can make.

[4]

115. 9709_s17_qp_62 Q: 6

A library contains 4 identical copies of book *A*, 2 identical copies of book *B* and 5 identical copies of book *C*. These 11 books are arranged on a shelf in the library.

(i) Calculate the number of different arrangements if the end books are either both book *A* or both book *B*. [4]

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(ii) Calculate the number of different arrangements if all the books *A* are next to each other and none of the books *B* are next to each other. [5]

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116. 9709_w17_qp_61 Q: 6

(a) A village hall has seats for 40 people, consisting of 8 rows with 5 seats in each row. Mary, Ahmad, Wayne, Elsie and John are the first to arrive in the village hall and no seats are taken before they arrive.

    (i) How many possible arrangements are there of seating Mary, Ahmad, Wayne, Elsie and John assuming there are no restrictions? [2]

    (ii) How many possible arrangements are there of seating Mary, Ahmad, Wayne, Elsie and John if Mary and Ahmad sit together in the front row and the other three sit together in one of the other rows? [4]

(b) In how many ways can a team of 4 people be chosen from 10 people if 2 of the people, Ross and Lionel, refuse to be in the team together? [4]

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117. 9709_w17_qp_62   Q: 6

(a) Find the number of different 3-digit numbers greater than 300 that can be made from the digits 1, 2, 3, 4, 6, 8 if

   (i) no digit can be repeated,   [3]

  (ii) a digit can be repeated and the number made is even.   [3]

(b) A team of 5 is chosen from 6 boys and 4 girls. Find the number of ways the team can be chosen if

   (i) there are no restrictions,   [1]

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   (ii) the team contains more boys than girls.   [3]

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118. 9709_m16_qp_62 Q: 6

Hannah chooses 5 singers from 15 applicants to appear in a concert. She lists the 5 singers in the order in which they will perform.

  (i) How many different lists can Hannah make?   [2]

Of the 15 applicants, 10 are female and 5 are male.

  (ii) Find the number of lists in which the first performer is male, the second is female, the third is male, the fourth is female and the fifth is male.   [2]

Hannah's friend Ami would like the group of 5 performers to include more males than females. The order in which they perform is no longer relevant.

(iii) Find the number of different selections of 5 performers with more males than females.   [3]

(iv) Two of the applicants are Mr and Mrs Blake. Find the number of different selections that include Mr and Mrs Blake and also fulfil Ami's requirement.   [3]

119. 9709_s16_qp_61 Q: 6

(a)   **(i)** Find how many numbers there are between 100 and 999 in which all three digits are different.
                                                                                   [3]

   (ii) Find how many of the numbers in part **(i)** are odd numbers greater than 700.   [4]

(b) A bunch of flowers consists of a mixture of roses, tulips and daffodils. Tom orders a bunch of 7 flowers from a shop to give to a friend. There must be at least 2 of each type of flower. The shop has 6 roses, 5 tulips and 4 daffodils, all different from each other. Find the number of different bunches of flowers that are possible.   [4]

120. 9709_s16_qp_62 Q: 7

(a) Find the number of different arrangements which can be made of all 10 letters of the word WALLFLOWER if

   (i) there are no restrictions,   [1]

   (ii) there are exactly six letters between the two Ws.   [4]

(b) A team of 6 people is to be chosen from 5 swimmers, 7 athletes and 4 cyclists. There must be at least 1 from each activity and there must be more athletes than cyclists. Find the number of different ways in which the team can be chosen.   [4]

121. 9709_s16_qp_63 Q: 6

Find the number of ways all 9 letters of the word EVERGREEN can be arranged if

  (i) there are no restrictions, [1]

  (ii) the first letter is R and the last letter is G, [2]

 (iii) the Es are all together. [2]

Three letters from the 9 letters of the word EVERGREEN are selected.

(iv) Find the number of selections which contain no Es and exactly 1 R. [1]

 (v) Find the number of selections which contain no Es. [3]

122. 9709_w16_qp_61 Q: 5

(a) Find the number of different ways of arranging all nine letters of the word PINEAPPLE if no vowel (A, E, I) is next to another vowel. [4]

(b) A certain country has a cricket squad of 16 people, consisting of 7 batsmen, 5 bowlers, 2 all-rounders and 2 wicket-keepers. The manager chooses a team of 11 players consisting of 5 batsmen, 4 bowlers, 1 all-rounder and 1 wicket-keeper.

  (i) Find the number of different teams the manager can choose. [2]

 (ii) Find the number of different teams the manager can choose if one particular batsman refuses to be in the team when one particular bowler is in the team. [3]

123. 9709_w16_qp_62 Q: 6

Find the number of ways all 10 letters of the word COPENHAGEN can be arranged so that

  (i) the vowels (A, E, O) are together and the consonants (C, G, H, N, P) are together, [3]

 (ii) the Es are not next to each other. [4]

Four letters are selected from the 10 letters of the word COPENHAGEN.

(iii) Find the number of different selections if the four letters must contain the same number of Es and Ns with at least one of each. [5]

124. 9709_w16_qp_63 Q: 1

A committee of 5 people is to be chosen from 4 men and 6 women. William is one of the 4 men and Mary is one of the 6 women. Find the number of different committees that can be chosen if William and Mary refuse to be on the committee together. [3]

125. 9709_w16_qp_63 Q: 3

Numbers are formed using some or all of the digits 4, 5, 6, 7 with no digit being used more than once.

  (i) Show that, using exactly 3 of the digits, there are 12 different odd numbers that can be formed. [3]

 (ii) Find how many odd numbers altogether can be formed. [3]

126. 9709_s15_qp_61 Q: 7

(a) Find how many different numbers can be made by arranging all nine digits of the number 223 677 888 if

    (i) there are no restrictions,   [2]

    (ii) the number made is an even number.   [4]

(b) Sandra wishes to buy some applications (apps) for her smartphone but she only has enough money for 5 apps in total. There are 3 train apps, 6 social network apps and 14 games apps available. Sandra wants to have at least 1 of each type of app. Find the number of different possible selections of 5 apps that Sandra can choose.   [5]

127. 9709_s15_qp_62 Q: 6

(a) Find the number of different ways the 7 letters of the word BANANAS can be arranged

    (i) if the first letter is N and the last letter is B,   [3]

    (ii) if all the letters A are next to each other.   [3]

(b) Find the number of ways of selecting a group of 9 people from 14 if two particular people cannot both be in the group together.   [3]

128. 9709_s15_qp_63 Q: 7

Rachel has 3 types of ornament. She has 6 different wooden animals, 4 different sea-shells and 3 different pottery ducks.

  (i) She lets her daughter Cherry choose 5 ornaments to play with. Cherry chooses at least 1 of each type of ornament. How many different selections can Cherry make?   [5]

Rachel displays 10 of the 13 ornaments in a row on her window-sill. Find the number of different arrangements that are possible if

  (ii) she has a duck at each end of the row and no ducks anywhere else,   [3]

  (iii) she has a duck at each end of the row and wooden animals and sea-shells are placed alternately in the positions in between.   [3]

129. 9709_w15_qp_61 Q: 5

(a) Find the number of ways in which all nine letters of the word TENNESSEE can be arranged

    (i) if all the letters E are together,   [3]

    (ii) if the T is at one end and there is an S at the other end.   [3]

(b) Four letters are selected from the nine letters of the word VENEZUELA. Find the number of possible selections which contain exactly one E.   [3]

130. 9709_w15_qp_62 Q: 4

A group of 8 friends travels to the airport in two taxis, *P* and *Q*. Each taxi can take 4 passengers.

  (i) The 8 friends divide themselves into two groups of 4, one group for taxi *P* and one group for taxi *Q*, with Jon and Sarah travelling in the same taxi. Find the number of different ways in which this can be done. [3]

Taxi *P*

Back | | Front

Taxi *Q*

Back | | Front

Each taxi can take 1 passenger in the front and 3 passengers in the back (see diagram). Mark sits in the front of taxi *P* and Jon and Sarah sit in the back of taxi *P* next to each other.

  (ii) Find the number of different seating arrangements that are now possible for the 8 friends. [4]

131. 9709_w15_qp_63 Q: 5

(a) Find the number of different ways that the 13 letters of the word ACCOMMODATION can be arranged in a line if all the vowels (A, I, O) are next to each other. [3]

(b) There are 7 Chinese, 6 European and 4 American students at an international conference. Four of the students are to be chosen to take part in a television broadcast. Find the number of different ways the students can be chosen if at least one Chinese and at least one European student are included. [5]