11 Permutations and combinations

Syllabus content	Suggested teaching activities
Whole unit	This is a 'standalone' topic. It does not rely on any other of the topics and therefore can be taught at any time during the course. However, learners should preferably cover this topic before **12 Series**, as some reference to combinations will be needed in that unit together with use of appropriate notation when considering binomial expansions. This topic is likely to be completely new for learners. They should be able to think in a logical fashion in order to solve the problems posed. Learners will need to become familiar with, and be able to use, factorial notation. Learners will also need to be able to distinguish between the words 'arrangements', 'permutations' and 'combinations'.
• recognise and distinguish between a permutation case and a combination case	One of the most important aspects of this unit is the ability to distinguish between permutations and combinations. Useful sources of explanation can be found in the resource 'Easy permutations and combinations' at: http://betterexplained.com/articles/easy-permutations-and-combinations/ and 'Counting principle and factorial' at www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations. A simple introduction to this would be to ask three learners to stand in a line (one combination) and then ask them to see in how many different ways they are able to arrange themselves(six permutations). Extend this to four learners in a line; the rest of the class can help in trying to see a quick and logical way of obtaining all the permutations. Ask the class how many combinations there will be if five learners stood in a line. Keep re-iterating the difference between a permutation and a combination. Use this to introduce the factorial notation and how learners can use their calculators to determine factorials. Repeat the above exercise with a group of four learners and ask the class to see how many ways groups of one, two, three and four can be chosen from the four learners. Keep reinforcing the difference between permutations and combinations. Start to repeat the exercise with a group of five learners and ask the class to see if they can deduce how many ways groups of one, two, three, four and five can be chosen.

Syllabus content	Suggested teaching activities
• know and use the notation $n!$ (with $0! = 1$), and the expressions for permutations and combinations of n items taken r at a time	Continue with the activity above and ask learners to see if they can deduce a formula to represent this using factorial notation. Extend this to six and seven objects and then to choosing r objects from n objects. See if learners can deduce the difference to the formulae obtained if order suddenly becomes important. Make use of online resources/presentations that can be shown to the class, for example 'Easy permutations and combinations' at: http://betterexplained.com/articles/easy-permutations-and-combinations/ and 'Counting principle and factorial' at www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations.
• answer simple problems on arrangement and selection (cases with repetition of objects, or with objects arranged in a circle, or involving both permutations and combinations, are excluded)	For more complex, challenging problems adopt a practical approach. For example, How many teams of two people can be chosen from five people if two of the five people have to stay together? (combinations). How many ways are there of arranging a certain number of books on a shelf if two books have to be kept together? (permutations) Set worksheets/exercises with lots of straightforward basic examples involving arrangements, permutations and combinations to reinforce the differences. For example, the 'Simple permutations and combinations worksheet' at http://mrnewbatt.wikispaces.com/file/view/MDM4U+U1L4+worksheet.pdf **(I)**
Past and specimen papers	
Past/specimen papers and mark schemes are available to download at www.cambridgeinternational.org/support **(I)(F)** 2020 Specimen Paper 2 Q5 Nov 2017 Paper 11 Q8; Nov 2017 Paper 13 Q9; Nov 2017 Paper 22 Q5 Jun 2017 Paper 12 Q8; Jun 2017 Paper 21 Q8; Jun 2017 Paper 23 Q5 Mar 2017 Paper 12 Q6 Nov 2016 Paper 13 Q9; Nov 2016 Paper 21 Q11 Jun 2016 Paper 21 Q10; Jun 2016 Paper 22 Q3 Mar 2016 Paper 12 Q5; Mar 2015 Paper 22 Q2	