

# 1.7 Permutations & Combinations

## Question Paper

Course	DPIB Maths
Section	1. Number & Algebra
Topic	1.7 Permutations & Combinations
Difficulty	Medium

**Time allowed:** 100  
**Score:** /80  
**Percentage:** /100

**Question 1**

Consider the letters of the word SUNDAY. Find the number of permutations of four letters that can be chosen if

- (i) no restrictions apply
- (ii) there must be at least one vowel (A or U)
- (iii) both vowels must be chosen and they must be kept together in any permutation.

[6 marks]

### Question 2a

Three letters are chosen at random from the letters in the word AIRFIELD.

(a) Find the number of ways that the selection may contain

- (i) no Is
- (ii) exactly one I
- (iii) two Is.

[4 marks]

### Question 2b

(b) Write down the number of arrangements of three letters chosen at random from the word AIRFIELD that have exactly one letter I.

[2 marks]

**Question 3a**

In a maths test students are required to answer four out of seven questions.

- (a) Find the number of ways in which the questions can be chosen if there are no restrictions.

[2 marks]

**Question 3b**

- (b) Find the number of ways in which the questions can be chosen if the last question is compulsory.

[3 marks]

**Question 3c**

- (c) Find the number of ways in which the questions can be chosen if the students must do at least 1 of the last two questions.

[3 marks]

**Question 4a**

A farm has a new litter of kittens. Two of the kittens are classed as mostly white, four are mostly black, and five are classed as black and white mixed.

Five of the kittens are selected at random.

(a) Find the number of ways in which the selection might contain:

- (i) both of the mostly white kittens
- (ii) none of the kittens that are classed as black and white mixed.

[4 marks]

**Question 4b**

(b) Find the number of ways in which the selection might contain at least two kittens that are classed as mostly black.

[4 marks]

**Question 5a**

A pool table has fifteen different balls including the black ball.

- (a) Given that the black ball is the last to be potted and the rest of the balls are potted one at a time in a random order, in how many ways can the fifteen balls be potted?

[2 marks]

**Question 5b**

The other fourteen balls consist of seven pairs of different coloured balls. One of each pair has a stripe across it and the other has a spot on it.

- (b) Given that the black ball is still the last to be potted, in how many ways can the fifteen balls be potted one at a time if
- (i) all the balls of one type (striped or spotted) must be potted before any balls of the other type?
  - (ii) both balls from a coloured pair must be potted (one after the other, in any order) before any balls of another colour are potted?

[5 marks]

**Question 6**

Ms Aiba has twelve different maths textbooks on her classroom bookshelf. Five of them are Statistics textbooks and the other seven are Pure Mathematics textbooks. Determine the number of different ways that the books can be arranged on the shelf if

- (i) there are no restrictions
- (ii) the Statistics textbooks are all first and then the Pure textbooks are all last
- (iii) the Statistics textbooks are all together and the Pure textbooks are all together
- (iv) only the Statistics textbooks are all together.

[7 marks]

**Question 7**

Nine shirts for a baseball team are numbered from 1 to 9. Five players are allowed to take one shirt each.

Find the number of ways this can be done if

- (i) there are no restrictions
- (ii) the first three players all decide to choose an even numbered shirt.

[5 marks]



**Question 8a**

Riley is going on holiday and is allowed to bring along four of his toys. At home he has nine different plastic dinosaurs, six different toy cars, and five different wooden reptiles.

- (a) How many different selections of his toys can he make if he chooses at least one of each type of toy?

[4 marks]

**Question 8b**

Riley can't decide so he persuades his parents to allow him to bring along five toys instead.

- (b) Given that he brings more plastic dinosaurs than any other type of toy, how many different selections can he make now?

[4 marks]

**Question 9**

Two parents, Julie and Malcolm, have 15 household chores to be given to their five children, Bidy, Gus, Mandy, Charlie and Claire.

Find the number of ways in which the 15 household chores can be distributed if Bidy is to do 5 of them, Gus is to do 4 of them, Mandy is to do 3 of them, Charlie is to do 2 of them and Claire is to do 1 of them.

[5 marks]

**Question 10a**

A team of 16 is to be split up in order to complete a number of tasks.

(a) Find the number of ways the team can be divided into

- (i) two equal groups
- (ii) four equal groups.

[4 marks]

**Question 10b**

A quarter of the team are unable to help with the tasks due to COVID-19 infections.

(b) Find the number of ways that the remaining team members can be divided into

- (i) two equal groups
- (ii) three equal groups.

[4 marks]

**Question 11a**

You have a set of four different coloured flashlights that you use to send messages to your friend who lives across from you on the same street.

(For purposes of this question, a 'message' is considered to be a single sequence of one or more coloured lights, displayed one after the other.)

- (a) Find the number of different messages you can send using two different coloured flashlights displayed one after the other.

[2 marks]

**Question 11b**

- (b) Find the number of different messages you can send using three different coloured flashlights displayed one after the other.

[2 marks]

**Question 11c**

- (c) Find the total number of different messages you could send using your four flashlights, under the condition that all the colours in a given message must be different from each other.

[1 mark]

**Question 12a**

**In this question give your answers in the form  $a \times 10^k$ , where  $1 \leq a < 10$  and  $k \in \mathbb{Z}$ .**

John is a builder who has divided his day's work into 15 separate tasks. Two of these tasks John considers 'physically demanding' because one includes moving bricks and the other includes concrete mixing.

- (a) Find the number of ways John can complete the tasks given that one 'physically demanding' task is done at the start of the day and the other 'physically demanding' task is done at the end of the day.

[3 marks]

**Question 12b**

- (b) Find the number of ways John can complete the tasks given that the two physically demanding tasks are not done consecutively.

[4 marks]