HIGHER

6.3 The Product Rule for Counting: 2-hour Pack

Total Marks

EDEXCEL 1MA1 · Calculator allowed · about 120 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A locker code has 2 letters chosen from A, B, C, D, E, F, G, H and I, followed by 2 digits from 0 to 9. Letters and digits can be repeated. How many different codes are there?

(Total for Question 1 is 3 marks)

2 A code has 3 digits chosen from the digits 1 to 6. No digit can be used more than once. How many different codes are possible?

(Total for Question 2 is 2 marks)

3 5 different books are put on a shelf. Two particular books must stay together, in either order. In how many different ways can the books be arranged?

(Total for Question 3 is 3 marks)

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4 Using each of the digits 0, 2, 3, 6, 7 and 8 at most once, how many different 3-digit numbers can be made that are even? A number cannot start with 0.

(Total for Question 4 is 4 marks)

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5 A locker code has 3 letters chosen from A, B, C, D, E, F and G, followed by 2 digits from 0 to 9. Letters and digits can be repeated. How many different codes are there?

(Total for Question 5 is 3 marks)

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6 6 different books are put on a shelf. Two particular books must stay together, in either order. In how many different ways can the books be arranged?

(Total for Question 6 is 3 marks)

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7 Using each of the digits 0, 1, 4 and 7 at most once, how many different 3-digit numbers can be made that are less than 500? A number cannot start with 0.

(Total for Question 7 is 4 marks)

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8 Using each of the digits 1, 2, 5, 7 and 9 at most once, how many different 3-digit numbers can be made? A number cannot start with 0.

(Total for Question 8 is 3 marks)

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9 Using each of the digits 0, 1, 2, 4, 5 and 7 at most once, how many different 3-digit numbers can be made that are odd? A number cannot start with 0.

(Total for Question 9 is 4 marks)

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10 A car number plate is made from 2 letters followed by 2 digits, for example AB12. There are 26 possible letters and 10 possible digits, and letters or digits may be repeated.
Work out the total number of different number plates possible.

(Total for Question 10 is 3 marks)

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11 Five different novels are placed in a row on a bookshelf.
Work out the number of different ways the five novels can be arranged.

(Total for Question 11 is 3 marks)

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12 A school locker uses a 5-character code. The first two characters are different letters, chosen from the 26 letters of the alphabet, and the last three characters are different digits, chosen from 0 to 9. No letter is repeated and no digit is repeated.

(a) Work out the number of ways to choose the two letters, in order. **(2)**

.....

(b) Work out the number of ways to choose the three digits, in order. **(2)**

.....

(c) Hence work out the total number of different locker codes possible. **(1)**

.....

(Total for Question 12 is 5 marks)

---

13 Priya has 3 different revision books. She places all 3 books in a row on a shelf.
Work out the number of different orders the books can be placed in.

(Total for Question 13 is 2 marks)

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14 A school timetable has 4 different subjects to place into 4 lesson slots on Monday, one subject per slot.
Work out the number of different ways the 4 subjects can be arranged across the 4 slots.

(Total for Question 14 is 3 marks)

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15 A combination lock has 3 dials. Each dial can be set to any digit from 0 to 9, and digits may repeat across dials.
Work out the number of different combinations possible.

(Total for Question 15 is 3 marks)

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16 A sports team of 7 players must choose one captain and one different player as vice-captain.
Work out the number of different ways the captain and vice-captain can be chosen.

(Total for Question 16 is 3 marks)

---

17 In a race there are 8 runners. A gold, a silver and a bronze medal are awarded to the first, second and third runners respectively. No runner can win more than one medal.
Work out the number of different ways the three medals can be awarded.

(Total for Question 17 is 4 marks)

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18 A restaurant offers a set menu with 4 starters and 5 main courses. Two of the starters are soups. There is 1 fish main course, and soup cannot be chosen together with the fish main course.

(a) Work out the number of starter-and-main combinations there would be with no restriction. **(1)**

.....

(b) Work out the number of starter-and-main combinations that are not allowed, because of the soup-and-fish restriction. **(1)**

.....

(c) Hence work out the number of valid starter-and-main combinations. **(2)**

.....

(Total for Question 18 is 4 marks)

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19 The digits 1, 2, 3, 4, 5, 6 and 7 are each used at most once to form a four-digit number, so no digit is repeated.

Work out how many of these four-digit numbers are even.

(Total for Question 19 is 3 marks)

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20 A charity club has 8 members. Three different roles, chair, vice-chair and treasurer, are each given to a different member.

(a) Work out the number of different ways the three roles can be given out. **(2)**

.....

(b) The treasurer role must go to either Kwame or Sophie. Work out the number of different ways the three roles can now be given out. **(3)**

.....

(Total for Question 20 is 5 marks)

---

21 A code is formed by choosing 2 different symbols, in order, from a set of n available symbols, where $n \geq 2$. No symbol is repeated. The number of possible 2-symbol codes is 132.
Work out the value of n.

(Total for Question 21 is 5 marks)

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22 Four different keys are laid out in a row on a table: a house key, a car key, a shed key and a bike key.

(a) Work out the total number of different ways the four keys can be arranged in a row. **(2)**

.....

(b) Work out the number of these arrangements in which the house key and the car key are next to each other. **(2)**

.....

(c) Hence find the probability that, if the four keys are arranged in a random order, the house key and the car key are next to each other. Give your answer as a fraction in its simplest form. **(2)**

.....

(Total for Question 22 is 6 marks)

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23 The digits 2, 3, 5, 7 and 8 are each used at most once to form a 3-digit number, so no digit is repeated.

(a) Work out how many different 3-digit numbers can be formed. **(2)**

.....

(b) Work out how many of these 3-digit numbers are even. **(3)**

.....

(Total for Question 23 is 5 marks)

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24 A student ID is made from 2 letters, each chosen from the 26 letters of the alphabet. Letters may be repeated.

(a) Work out the number of different student IDs possible. **(2)**

.....

(b) Work out the number of these student IDs that contain at least one letter Z. **(3)**

.....

(Total for Question 24 is 5 marks)

---

25 A padlock code has 3 digits. Each digit can be any number from 0 to 9 and digits may repeat, but the first digit cannot be 0 and the last digit cannot be 0.
Work out the number of different codes possible.

(Total for Question 25 is 3 marks)

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Mark scheme · 6.3 The Product Rule for Counting: 2-hour Pack

A correct answer earns full marks unless the question asks for working, a method, proof or explanation.

Question 1

number of letter combinations 81 found	**M1**
100 digit combinations	**M1**
8100 cao	**A1**

Answer: 8100

Question 2

6 x 5 x 4	**M1**
120 cao	**A1**

Answer: 120

Question 3

treats the pair as one object	**M1**
2 x 4!	**M1**
48 cao	**A1**

Answer: 48

Question 4

considers the restricted digit first (or equivalent systematic method)	**M1**
product of the choices for each place	**M1**
correct treatment of the restriction	**M1**
68 cao	**A1**

Answer: 68

Question 5

number of letter combinations 343 found	**M1**
100 digit combinations	**M1**
34300 cao	**A1**

Answer: 34300

Question 6

treats the pair as one object	**M1**
2 x 5!	**M1**
240 cao	**A1**

Answer: 240

Question 7

considers the restricted digit first (or equivalent systematic method)	**M1**
product of the choices for each place	**M1**
correct treatment of the restriction	**M1**
12 cao	**A1**

Answer: 12

Question 8

considers the restricted digit first (or equivalent systematic method)	**M1**
product of the choices for each place	**M1**
60 cao	**A1**

Answer: 60

Question 9

considers the restricted digit first (or equivalent systematic method)	**M1**
product of the choices for each place	**M1**
correct treatment of the restriction	**M1**
48 cao	**A1**

Answer: 48

Question 10

26 x 26 (= 676) oe	**M1**
676 x 10 x 10 oe (dependent on first M1)	**M1**
67600 cao	**A1**

Answer: 67600

Question 11

5 x 4 oe (choices for the first two positions)	**M1**
(dep) x 3 x 2 x 1 oe (remaining positions)	**M1**
120 cao	**A1**

Answer: 120

Question 12

(a) 26 x 25 oe seen	**M1**
(a) 650 cao	**A1**

(a) Answer: 650

(b) 10 x 9 x 8 oe seen	**M1**
(b) 720 cao	**A1**

(b) Answer: 720

(c) 468000 cao, ft from 650 x their (b)	**B1**

(c) Answer: 468000

Question 13

3 * 2 * 1 oe seen	**M1**
6 cao	**A1**

Answer: 6

Question 14

4 choices identified for the first slot	**B1**
(dep) 4 * 3 * 2 * 1 oe for all four slots	**M1**
24 cao	**A1**

Answer: 24

Question 15

10 choices identified for each dial	**B1**
(dep) 10 * 10 * 10 oe	**M1**
1000 cao	**A1**

Answer: 1000

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Question 16

7 choices identified for captain	**B1**
(dep) 7 * 6 oe for vice-captain	**M1**
42 cao	**A1**

Answer: 42

Question 17

8 choices for gold	**M1**
(dep) x 7 for silver	**M1**
(dep) x 6 for bronze	**M1**
336 cao	**A1**

Answer: 336

Question 18

(a) 20 cao	**B1**

(a) Answer: 20

(b) 2 cao	**B1**

(b) Answer: 2

(c) their (a) - their (b), ft	**M1**
(c) 18 cao	**A1**

(c) Answer: 18

Question 19

identifies 3 choices for the units digit (2, 4 or 6)	**M1**
(dep) 6 x 5 x 4 for the remaining three digits, in some order	**M1**
360 cao	**A1**

Answer: 360

Question 20

(a) 8 * 7 * 6 oe seen	**M1**
(a) 336 cao	**A1**

(a) Answer: 336

(b) identifies 2 choices for treasurer (Kwame or Sophie)	**M1**
(b) (dep) 2 * 7 * 6 oe for the remaining two roles	**M1**
(b) 84 cao	**A1**

(b) Answer: 84

Question 21

sets up $n(n - 1) = 132$ oe	**M1**
forms $n^2 - n - 132 = 0$ oe	**M1**
(dep) factorises to $(n - 12)(n + 11) = 0$, or uses the quadratic formula correctly	**M1**
$n = 12$	**A1**
cso: rejects $n = -11$ since n must satisfy $n \geq 2$, so $n = 12$	**A1**

Answer: n = 12

Question 22

(a) 4 x 3 x 2 x 1 oe seen	**M1**
(a) 24 cao	**A1**

(a) Answer: 24

(b) treats house key and car key as a single block, giving 3 items to arrange (3! = 6), then multiplies by 2 for the two internal orders of the block	**M1**
(b) 12 cao	**A1**

(b) Answer: 12

(c) their (b) / their (a), ft	**M1**
(c) 1/2 cao	**A1**

(c) Answer: 1/2

Question 23

(a) 5 * 4 * 3 oe seen	**M1**
(a) 60 cao	**A1**

(a) Answer: 60

(b) identifies that the last digit must be 2 or 8 (2 choices)	**M1**
(b) (dep) 2 * 4 * 3 oe for the remaining two digits	**M1**
(b) 24 cao	**A1**

(b) Answer: 24

Question 24

(a) 26 * 26 oe seen	**M1**
(a) 676 cao	**A1**

(a) Answer: 676

(b) 25 * 25 (= 625) identified as the number of IDs with no letter Z	**M1**
(b) (dep) 676 - 625 oe (total minus none)	**M1**
(b) 51 cao	**A1**

(b) Answer: 51

Question 25

identifies 9 choices for the first digit and 9 choices for the last digit (excluding 0 in each case)	**M1**
(dep) 9 * 10 * 9 oe	**M1**
810 cao	**A1**

Answer: 810

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