OCR Level 3 FSMQ: Additional Mathematics (6993)
Enumeration (EN1-EN6) - Past Paper Questions Grouped by Topic

Covers June 2015-2019, 2022, 2023, 2024, and the 2020 Specimen paper. Sourced from official OCR question papers and mark schemes (ocr.org.uk).

Questions

EN1 - Binomial expansion

1. Find the coefficient of x^3 in the expansion of $(2 + 3x)^5$, giving your answer as simply as possible. [4]
Source: 2020 Specimen, Q2

2. Find the term independent of x in the expansion of $\left(x + \frac{2}{x}\right)^6$. [3]
Source: June 2023, Q1

3. (i) Write down the binomial expansion of $(1 + \delta)^3$. [2]
(ii) Hence explain why, if δ is small, $(1 + \delta)^3 \approx 1 + 3\delta$. [1]
[≈ means "is approximately equal to"]
Source: June 2016, Q8(i)-(ii)

EN2 - Representation (tree diagrams, two-way tables, Venn diagrams, binomial distribution)

4. A group of 68 students was asked about their preference for pop music or classical music.
10 said they did not like either pop music or classical music.
20 said they liked classical music.
50 said they liked pop music.
(a) Draw a Venn diagram to illustrate this information. [2]
(b) Determine the number of students who said they liked both pop music and classical music. [2]
Source: June 2024, Q4

5. Amir asked 80 people about their preferences for the drinks tea, coffee or hot chocolate. The results of his investigation were as follows.
25 liked all three drinks. 3 liked tea and coffee but not hot chocolate. 4 liked hot chocolate and coffee but not tea. 5 liked tea but neither of the other two drinks. 35 liked tea and hot chocolate. 48 liked hot chocolate. 47 liked coffee.
(a) Draw a Venn diagram to represent these data. [3]
(b) Hence determine how many people said that they did not like any of the drinks. [2]
Source: June 2023, Q11

6. A local council investigated the pattern of travel to a nearby town in one month. Residents were asked whether they drove, cycled or walked into the town, with the opportunity to state if they used more than one mode of transport during the month.
Some of the results are summarised in the table below.
Mode of travel: Frequency - Only walked: 15, Only cycled: 9, Only drove: 12, Used all three modes: 4,

Walked and cycled but did not drive: 6.
The total number of residents surveyed was 60.
(a) Draw a Venn diagram to illustrate this incomplete set of data. [3]
The number that said they drove and walked but did not cycle was the same as the number that said they drove and cycled but did not walk. All those surveyed had travelled to the nearby town by one of these three modes at least once.
(b) Determine how many of these residents drove and walked but did not cycle. [3]
Source: June 2022, Q7

7. Layla drives to work along a road which has three sets of traffic lights. The lights work independently of each other. Experience indicates that the probability that Layla has to stop at each set of lights is 0.5, 0.6 and 0.7 respectively.
(a) Draw a tree diagram to illustrate the probabilities of Layla having to stop at each set of lights on a particular journey to work. [3]
(b) Calculate the probability that Layla has to stop exactly once on a particular journey to work. [3]
Source: June 2022, Q6

8. Two fair six-sided dice are rolled. If they both display the same number, then that number is recorded in the table below. When they display different numbers, the higher of the two numbers is recorded in the table below.
(a) Complete the two-way table showing the number that would be recorded. [2]
(b) Write down the probability that:
(i) a 1 is recorded [1]
(ii) a 6 is recorded. [1]
Source: June 2024, Q9

EN3 - The product rule for counting

9. A security keypad uses three letters A, B and C and four digits 1-4. A passcode is created using four inputs.
If there are no restrictions, how many different passcodes are possible? [1]
Source: 2020 Specimen, Q10(a)

10. A photograph is to be taken of 9 students who have represented their college in sailing this year. The students are to be arranged in a line. The captain is to stand in the middle with the vice-captain standing beside the captain.
How many ways are there of arranging the students? [3]
Source: June 2022, Q3

EN4 - Permutations

11. A committee consists of five people. The roles of Chairman, Secretary and Treasurer are to be allocated at random from the committee with no one person taking more than one role.
In how many ways can this allocation of roles be made? [2]
Source: June 2019, Q1

12. (Continuing the security keypad from Q9 above.) If the passcode must have exactly two letters and two digits, with no repeats, how many different passcodes are possible? [3]
Source: 2020 Specimen, Q10(b) - this part also draws on EN5 (combinations) in choosing which letters/digits are used before arranging them

EN6 - Applications: probability, including use of the binomial distribution

13. China cups are packed in boxes of 10. It is known that 1 in 8 are cracked. Find the probability that in a box of 10, chosen at random,
(a) exactly 1 cup is cracked, [3]
(b) at least 2 cups are cracked. [4]
Source: 2020 Specimen, Q12

14. The proportion of people who are left-handed is 20%.
(a) For a group of 10 students chosen at random, use the binomial distribution to find the probability that
(i) no student is left-handed, [2]
(ii) exactly 4 students are left-handed. [3]
(b) State the conditions necessary for the binomial distribution to be valid. [2]
Source: June 2018, Q9

15. A distributor of flower bulbs has a large number of tulip bulbs and daffodil bulbs, mixed in the ratio 1:3 respectively. He packs the bulbs in boxes. He puts 10 bulbs, chosen at random, into each box.
(a) Find the probability that a box, chosen at random, contains
(i) exactly 4 daffodil bulbs, [4]
(ii) at least 1 tulip bulb. [3]
(b) Two boxes of bulbs are chosen at random. Find the probability that there is a total of 3 tulip bulbs in the two boxes. [5]
Source: June 2015, Q12

16. Four ordinary six-sided dice are rolled. Find the probability that at least 2 sixes are obtained. [6]
Source: June 2017, Q8

17. Jack throws 4 ordinary six-sided dice numbered 1 to 6. Find the probability that he throws at least one 3. [3]
Source: June 2023, Q2

18. Each of five students has a fair coin. They play a game in which each student tosses their coin and when the result of their toss is a head then that student is eliminated from the game. The game continues with the remaining students tossing their coin again. As before, any student who tosses a head is eliminated. The game continues until all the students have been eliminated or there is a single winner. Calculate the probability that
(a) all students are eliminated after their first toss of the coin, [2]
(b) exactly two students are eliminated after their first toss and exactly two after their second toss, leaving one winner. [4]
Source: June 2019, Q8

Answers

EN1

1. Coefficient of x^3 = C(5,3) × 2^2 × 3^3 = 10 × 4 × 27 = 1080 -- *official specimen mark scheme*
2. Independent term occurs at $r = 3$: C(6,3) × 2^3 = 20 × 8 = 160 -- *mark scheme (June 2023)*
3. (i) $(1+\delta)^3 = 1 + 3\delta + 3\delta^2 + \delta^3$. (ii) If δ is small, the terms $3\delta^2$ and δ^3 are very small and can be neglected, leaving $(1+\delta)^3 \approx 1 + 3\delta$ -- *mark scheme (June 2016)*

EN2

4. (a) Two overlapping circles inside a rectangle, with 10 outside both circles, and the total in the two circles (plus overlap) making up the remaining 58. (b) 12 (found by 20 + 50 - x = 58, where x is the overlap) -- *mark scheme (June 2024)*
5. (a) Three overlapping circles labelled tea/coffee/hot chocolate, with 25 in the centre and the other given values placed in the correct regions. (b) 80 - 71 = 9 people liked none of the drinks -- *mark scheme (June 2023)*
6. (a) Three overlapping circles (walked/cycled/drove) with the given frequencies placed in the correct regions, and two unknown but equal regions ("drove+walked only" and "drove+cycled only"). (b) 7 residents drove and walked but did not cycle (found by summing the 5 known regions = 46, then (60-46)/2 = 7) -- *mark scheme (June 2022)*
7. (a) A tree diagram with three sets of branches (stop/not stop), probabilities 0.5/0.5, 0.6/0.4, 0.7/0.3 respectively. (b) P(stop exactly once) = (0.5×0.6×0.3) + (0.5×0.4×0.7) + (0.5×0.4×0.3) = 0.09+0.14+0.06 = 0.29 -- *mark scheme (June 2022)*
8. (a) A 6×6 table where the diagonal shows the doubled value and each off-diagonal cell shows the larger of the row/column value. (b)(i) P(1 recorded) = 1/36 (ii) P(6 recorded) = 11/36 -- *mark scheme (June 2024)*

EN3

9. 7 possible characters (3 letters + 4 digits) for each of 4 positions, no restriction: 7^4 = 2401 -- *official specimen mark scheme*
10. With the captain fixed in the middle and the vice-captain in one of the 2 positions beside them, the remaining 7 students can be arranged in the other 7 positions in 7! ways: 7! × 2 = 10080 -- *mark scheme (June 2022)*

EN4

11. $^5P_3$ = 5!/2! = 5×4×3 = 60 -- *mark scheme (June 2019)*
12. Choose 2 letters from 3: C(3,2) = 3 ways. Choose 2 digits from 4: C(4,2) = 6 ways. That gives 3×6 = 18 selections of characters, each of which can be arranged in 4! = 24 ways: 18×24 = 432 -- *official specimen mark scheme*

EN6

13. (a) P(exactly 1 cracked) = C(10,1)$(1/8)^1(7/8)^9$ ≈ 0.376. (b) P(0 cracked) ≈ 0.263, P(1 cracked) ≈ 0.376, so P(at least 2) = 1 − (0.263+0.376) ≈ 0.361 -- *official specimen mark scheme*
14. (a)(i) P(none) = 0.8^{10} ≈ 0.107. (ii) P(exactly 4) = C(10,4)$(0.2)^4(0.8)^6$ ≈ 0.0881. (b) Fixed number of trials; each trial has exactly two outcomes; fixed probability of success on each trial; trials are independent -- *mark scheme (June 2018)*
15. (a)(i) With p(daffodil)=0.75, P(exactly 4 daffodil in 10) = C(10,4)$(0.75)^4(0.25)^6$ ≈ 0.0162. (ii)

P(at least 1 tulip) = 1 − $(0.75)^{10}$ ≈ 0.944. (b) P(total of 3 tulips across two boxes) ≈ 0.134 *-- mark scheme (June 2015)*

16. P(0 sixes) = $(5/6)^4$ = 625/1296 ≈ 0.4823, P(1 six) = 4(1/6)$(5/6)^3$ = 500/1296 ≈ 0.3858. P(at least 2) = 1 − (0.4823+0.3858) ≈ 0.132 *-- mark scheme (June 2017)*

17. P(at least one 3) = 1 - $(5/6)^4$ = 1 − 625/1296 = 671/1296 ≈ 0.518 *-- mark scheme (June 2023)*

18. (a) P(all eliminated first toss) = $(1/2)^5$ = 1/32 = 0.03125. (b) P(exactly 2 eliminated on toss 1 AND exactly 2 of the remaining 3 eliminated on toss 2) = [C(5,2)$(1/2)^2(1/2)^3$] × [C(3,2)$(1/2)^2(1/2)^1$] = 0.3125 × 0.375 ≈ 0.117 *-- mark scheme (June 2019)*