AQA (GCSE Notes)

Chapter 5: Probability

Q1. A die is rolled 60 times. Record the outcomes in a table and calculate how often each number appears.

Answer: The frequency of each number can be recorded in a table.

Solution:

Assume the die is fair, so each number should appear about the same number of times.

There are 6 numbers on a die: 1, 2, 3, 4, 5, 6.

Expected frequency for each number = Total rolls ÷ Number of outcomes

= 60 ÷ 6

= 10

Number	Frequency
1	10
2	10
3	10
4	10
5	10
6	10

Q2. A coin is flipped 50 times. Describe how you would record the outcomes and represent them in a frequency table.

Answer: Use a tally and frequency table with outcomes Heads and Tails.

Solution:

Make a table with two rows: one for Heads, one for Tails.

Each time you flip the coin, mark a tally in the appropriate row.

After all flips, count the tallies and write the frequency.

Example:

Outcomes	Tally	Frequency
Heads		
Tails		

Q3. A spinner has 4 equal sections labelled A, B, C and D. It is spun 100 times. Explain how to use a table to analyse the frequency of each outcome.

 Answer: Create a table to record and compare outcomes.

 Solution:

Draw a table with columns for A, B, C, and D.

Each time you spin, mark a tally in the appropriate column.

After 100 spins, count tallies to get frequencies.

Compare each frequency with expected value.

Expected frequency = 100 ÷ 4 = 25

Outcomes	Frequency
A	24
B	26
C	27
D	23

Q4. You roll a fair die 120 times and get the following outcomes: 1 (18 times), 2 (20), 3 (19), 4 (21), 5 (22), 6 (20). Use this data to find the relative frequency for each number.

 Answer:

Relative frequencies are:

1 → 0.15

2 → 0.17

3 → 0.158

4 → 0.175

5 → 0.183

6 → 0.167

 Solution:

Relative frequency = Frequency ÷ Total number of trials

For 1: 18 ÷ 120 = 0.15

For 2: 20 ÷ 120 = 0.17

For 3: 19 ÷ 120 ≈ 0.158

For 4: 21 ÷ 120 = 0.175

For 5: 22 ÷ 120 ≈ 0.183

For 6: 20 ÷ 120 ≈ 0.167

Q5. You flip a coin 200 times and record 112 heads. Compare the relative frequency of heads with the theoretical probability.

 Answer:

Relative frequency = 0.56

Theoretical probability = 0.5

Solution:

Relative frequency = Frequency of heads ÷ Total flips

= 112 ÷ 200

= 0.56

Theoretical probability of heads = 1 ÷ 2 = 0.5

0.56 > 0.5 so more heads appeared than expected

Q6. Create a frequency tree for a bag containing 3 red balls and 2 blue balls, where you draw two balls without replacement.

Answer:

A tree diagram will show all possible outcomes without replacement.

Solution:

First draw: R (3/5), B (2/5)

Second draw after R: R (2/4), B (2/4)

Second draw after B: R (3/4), B (1/4)

Tree:

- R (3/5)

    ○ R (2/4)
    ○ B (2/4)

- B (2/5)

    ○ R (3/4)
    ○ B (1/4)

Q7. A coin is flipped and a die is rolled. Show the outcomes in a frequency tree.

Answer:

The tree will show two branches for the coin and six branches for the die.

Solution:

Coin outcomes: Heads (1/2), Tails (1/2)

Die outcomes: 1, 2, 3, 4, 5, 6 (each 1/6)

Tree:

- Heads (1/2)

    ○ 1 (1/6), 2, 3, 4, 5, 6

- Tails (1/2)

    ○ 1 (1/6), 2, 3, 4, 5, 6

Q8. A box has 5 green and 3 yellow sweets. You pick one sweet, note its colour, and replace it. Repeat this 40 times. Record and analyse your findings.

 Answer:

 Use a tally chart and calculate relative frequencies.

 Solution:

 Probability of green = 5/8

 Probability of yellow = 3/8

 Make tally chart for each draw.

 Count tallies to get frequency.

 Relative frequency = Frequency ÷ 40

Q9. Explain how the concept of fairness applies to rolling a standard die.

 Answer:

 A fair die has equal chance for all outcomes.

 Solution:

 There are 6 sides.

 Probability of each = 1 ÷ 6

 If all sides appear about equally over many rolls, it is fair.

Q10. Describe what is meant by an event being "equally likely" using the example of flipping a coin.

 Answer:

 It means each outcome has the same probability.

 Solution:

 Coin has 2 sides: Heads and Tails

 Probability of Heads = 1 ÷ 2

 Probability of Tails = 1 ÷ 2

 Both are equally likely

Q11. Two dice are rolled. List all possible outcomes and explain why this set is exhaustive.

 Answer:

 There are 36 outcomes and the list covers all possibilities.

 Solution:

 Outcomes: (1,1),(1,2)...(6,6)

 Total outcomes = 6 × 6 = 36

 Each pair is included

 No outcomes missing

 So it's exhaustive

Q12. You have a bag of counters: 2 red, 3 green, and 5 blue. What is the probability of picking a green counter? Justify your answer using the 0 to 1 scale.

 Answer:

 Probability = 3 ÷ 10 = 0.3

Solution:
Total counters = 2 + 3 + 5 = 10
Green counters = 3
P(green) = 3 ÷ 10 = 0.3
This is between 0 (impossible) and 1 (certain)

Q13. A spinner with 3 equal sections is spun. After 60 spins, section A appears 10 times. Calculate the relative frequency and compare it with the expected probability.

Answer:
Relative frequency = 10 ÷ 60 = 0.167
Expected probability = 1 ÷ 3 ≈ 0.333

Solution:
Relative frequency = 10 ÷ 60 = 0.167
Expected = 1 ÷ 3 ≈ 0.333
0.167 < 0.333, so A occurred less than expected

Q14. A coin is flipped 100 times. Describe how to estimate the expected number of heads and tails.

Answer:
Expected Heads = 50
Expected Tails = 50

Solution:
P(Heads) = 1 ÷ 2
Expected Heads = 100 × 1/2 = 50
Expected Tails = 100 × 1/2 = 50

Q15. You conduct a probability experiment using a six-sided die. Record the results in a table and describe how to analyse the data.

Answer:
Use frequency table and compare with expected frequencies.

Solution:
Make a table:

Number	Frequency
1	8
2	7
3	9
4	11

5	8
6	7

Q16. A student rolls a die 300 times. How should they use a frequency table to estimate the probability of rolling a 6?

 Answer:

 Estimated probability = Frequency of 6 ÷ 300

 Solution:

 Make table of all outcomes

 Count how many times 6 appears

 P(6) = Frequency of 6 ÷ 300

Q17. Explain why the sum of the probabilities of all outcomes when rolling a die is 1.

 Answer:

 Because one of the 6 outcomes must occur.

 Solution:

 Each number has P = 1 ÷ 6

 Total = 1/6 × 6 = 1

Q18. In an experiment, 3 students each flip a coin 20 times. How can the combined data be used to estimate the probability of getting heads?

 Answer:

 Add all heads and divide by total flips.

 Solution:

 Total flips = 3 × 20 = 60

 Suppose total heads = 32

 P(Heads) = 32 ÷ 60 ≈ 0.533

Q19. A spinner has unequal sections: 1/2 red, 1/4 blue, and 1/4 yellow. Draw a frequency tree for two spins with replacement.

 Answer:

 Create tree with branches for each spin.

 Solution:

 First spin:

- Red (1/2)
- Blue (1/4)
- Yellow (1/4)

Each branch has same second spin:

Q20. A bag has 6 blue, 3 red, and 1 green marble. Explain how to record the frequency of outcomes if 100 marbles are drawn with replacement.

 Answer:

 Use tally chart and calculate relative frequencies.

 Solution:

 P(Blue) = 6/10 = 0.6

 P(Red) = 3/10 = 0.3

 P(Green) = 1/10 = 0.1

 Record tally of each draw

 Calculate frequency and relative frequency

Q21. Describe how to test whether a die is fair using a probability experiment.

 Answer:

 Roll it many times and compare actual with expected results.

 Solution:

 Roll die say 300 times

 Record frequencies of 1–6

 Expected = 300 ÷ 6 = 50 each

 If actual close to expected, die is likely fair

Q22. If you flip a fair coin 500 times, how many heads would you expect? Explain your reasoning.

 Answer:

 Expected heads = 250

 Solution:

 P(Heads) = 1 ÷ 2

 Expected = 500 × 1/2 = 250

Q23. A student rolls two dice and adds the scores. Explain how to record the frequencies of the totals and compare them with theoretical probabilities.

 Answer:

 Use a table for totals from 2 to 12

 Solution:

 Make table with totals 2–12

 Count how often each appears

 Compare frequency with theoretical probabilities

 Example: P(7) = 6/36 = 1/6

Q24. In a game, you win if you roll a 5 or a 6. Estimate the expected number of wins in 60 rolls of a fair die.

 Answer:

 Expected wins = 20

 Solution:

 P(5 or 6) = 2 ÷ 6 = 1/3

 Expected = 60 × 1/3 = 20

Q25. A spinner with sections labelled A, B, C is spun 90 times. A appears 27 times, B 36 times, and C 27 times. Discuss the fairness of the spinner.

 Answer:

 The spinner appears fair

 Solution:

 Expected frequency = 90 ÷ 3 = 30

 A = 27, B = 36, C = 27

 All close to 30

 So differences are small

 Spinner is likely fair

Q26. A card is drawn from a standard pack and replaced. This is repeated 100 times. How would you record and analyse the suit outcomes?

 Answer: Record outcomes using a tally chart and compare frequencies of each suit.

 Solution:

 There are 4 suits: Hearts, Diamonds, Clubs, Spades.

 Expected frequency = 100 ÷ 4 = 25 per suit.

Suit	Tally	Frequency
Hearts		
Diamonds		
Clubs		
Spades		

Compare actual frequencies with expected frequencies to check for fairness.

Q27. How does increasing the number of trials affect the relative frequency in a probability experiment?

 Answer: It makes the relative frequency closer to the theoretical probability.

 Solution:

 Relative frequency = Number of favourable outcomes ÷ Total trials.

More trials reduce the effect of chance.
As trials increase, relative frequency stabilises.

Q28. A student flips 2 coins and records whether the results match or not. Describe how they could use a table to track the outcomes.

Answer: Use a table with "Match" and "Not Match" rows and tally the outcomes.

Solution:

Possible outcomes: HH, TT (Match), HT, TH (Not Match)

Outcome	Tally	Frequency
Match		
Not Match		

Q29. Explain how to create a frequency tree for choosing a coin at random from a set and then flipping it.

Answer: Create branches for each coin and then for heads/tails.

Solution:

Suppose 2 coins: Coin A and Coin B

Step 1: Choose coin

- A (1/2)
- B (1/2)

Step 2: Flip coin

- Heads (1/2), Tails (1/2)

Tree:

- A (1/2)

    - H (1/2)
    - T (1/2)

- B (1/2)

    - H (1/2)
    - T (1/2)

Q30. You spin a spinner with 5 equal parts 150 times. Describe how to use a frequency table to check if the spinner is biased.

Answer: Record each outcome in a table and compare actual vs expected frequencies.

Solution:
Expected frequency per section = 150 ÷ 5 = 30

Section	Frequency
A	28
B	31
C	29
D	30
E	32

Check if values are close to 30. If yes, the spinner is likely fair.

Q31. A student flips a coin and records the result. They repeat this 10 times. Why might the results not match the expected probabilities?
 Answer: Because the number of trials is too small.
 Solution:
 Theoretical probability of Heads = 1/2
 But with only 10 trials, results can vary a lot.
 Small sample size causes greater variation.

Q32. A die is rolled 90 times and the number 3 comes up 10 times. How does this compare with the expected number?
 Answer: Expected = 15, Actual = 10, so it appeared less than expected.
 Solution:
 Expected frequency = 90 ÷ 6 = 15
 Actual frequency = 10
 Difference = 15 - 10 = 5 fewer than expected

Q33. Describe how to use relative frequency to estimate the probability of rain based on weather data from the past 100 days.
 Answer: Count rainy days and divide by 100.
 Solution:
 Suppose 38 days had rain.
 Relative frequency = 38 ÷ 100 = 0.38
 Estimated probability of rain = 0.38

Q34. In a class experiment, students each spin a spinner 20 times. How can the combined results be used to get a more accurate estimate?
 Answer: Add all results to form a larger sample size.

Solution:

Suppose 5 students participated.

Total spins = 5 × 20 = 100

Use combined data to calculate relative frequency.

Larger sample gives better estimate.

Q35. A bag has 4 red and 6 blue counters. Describe how to use a tree diagram to show the outcomes of two draws without replacement.

Answer: Create a two-stage tree diagram.

Solution:

First draw:

- Red (4/10)
- Blue (6/10)

Second draw if Red first:

- Red (3/9)
- Blue (6/9)

Second draw if Blue first:

- Red (4/9)
- Blue (5/9)

Q36. A coin is flipped twice. List all possible outcomes and their probabilities. Show that the sum is 1.

Answer:

HH, HT, TH, TT each with 1/4 probability. Total = 1

Solution:

Outcomes: HH, HT, TH, TT

Each has probability = 1 ÷ 4 = 0.25

Sum = 0.25 + 0.25 + 0.25 + 0.25 = 1

Q37. A box contains balls numbered 1 to 5. Two balls are picked without replacement. Record all outcomes and check that the total probability is 1.

Answer:

There are 20 outcomes, each with equal probability.

Solution:

List all ordered pairs without repetition:

(1,2),(1,3),(1,4),(1,5),

(2,1),(2,3),(2,4),(2,5),

(3,1),(3,2),(3,4),(3,5),

(4,1),(4,2),(4,3),(4,5),
(5,1),(5,2),(5,3),(5,4)
Total = 20
Probability for each = 1 ÷ 20 = 0.05
Sum = 20 × 0.05 = 1

Q38. You throw two dice. What is the probability of getting a total of 7? Use the sample space to support your answer.
 Answer:
 Favourable outcomes = 6, total outcomes = 36, so P = 6/36 = 1/6
 Solution:
 Pairs that total 7:
 (1,6),(2,5),(3,4),(4,3),(5,2),(6,1)
 Favourable = 6
 Total outcomes = 6 × 6 = 36
 P = 6 ÷ 36 = 1/6

Q39. A fair spinner has 3 equal sections. How many times should you expect each outcome in 60 spins?
 Answer:
 Expected = 60 ÷ 3 = 20
 Solution:
 P(each section) = 1 ÷ 3
 Expected = 60 × 1/3 = 20

Q40. You roll a die and flip a coin. Explain how to use a table to list all possible outcomes.
 Answer:
 Create a 2-column table for die and coin.
 Solution:
 Possible coin: H, T
 Possible die: 1 to 6
 Total outcomes = 2 × 6 = 12
 List:
 (1,H),(2,H)...(6,H)
 (1,T),(2,T)...(6,T)

Q41. In an experiment, the relative frequency of heads in 50 coin flips is 0.56. What does this suggest?
 Answer:
 Heads appeared more than expected, but it may be due to chance.
 Solution:
 Expected = 0.5
 Actual = 0.56

Difference = 0.06

Sample size is small, so slight difference is normal.

Q42. You pick a coloured marble from a bag of 10. Explain how the outcomes are mutually exclusive and exhaustive.

 Answer:

 Only one marble can be picked at a time, and all are accounted for.

 Solution:

 Mutually exclusive = Can't pick two marbles at once.

 Exhaustive = All possible colours are included.

 So all outcomes are covered and don't overlap.

Q43. Two coins are flipped. Use a frequency tree to show all outcomes and their probabilities.

 Answer:

 Tree has branches for first and second flip.

 Solution:

 First flip:

- **H (1/2)**

    ○ H (1/2) → HH (1/4)
    ○ T (1/2) → HT (1/4)

- **T (1/2)**

    ○ H (1/2) → TH (1/4)
    ○ T (1/2) → TT (1/4)

Q44. A biased die shows 6 twice as often as any other number. How would you record and analyse the outcomes?

 Answer:

 Track frequencies and compare to expected ratios.

 Solution:

 Total parts = 2(6) + 1+1+1+1+1 = 7

 P(6) = 2 ÷ 7

 P(others) = 1 ÷ 7

 Roll die many times

 Make frequency table and compare with expected

Q45. Describe how to test the fairness of a spinner with unequal sections using experimental data.

 Answer:

Spin many times, record frequencies, compare with expected probabilities.

Solution:

Expected probabilities depend on section size

Record actual frequencies

Calculate relative frequencies

Compare with expected

If close, spinner may be fair

Q46. A student claims a coin is not fair. What kind of experiment would you do to test this?

Answer:

Flip it many times and compare results to expected.

Solution:

Flip coin at least 100 times

Count heads and tails

Expected = 50 each

If large difference, coin may be biased

Q47. How does the idea of equally likely outcomes apply to drawing cards from a shuffled deck?

Answer:

All cards have equal chance if deck is well shuffled.

Solution:

52 cards in deck

Each card has 1 ÷ 52 chance

So all outcomes are equally likely

Q48. You conduct a survey and ask 100 people to pick a number from 1 to 10. How can you tell if people are choosing fairly?

Answer:

Compare frequency of each number with expected (10)

Solution:

Expected frequency = 100 ÷ 10 = 10

Create table of chosen numbers

If some numbers chosen much more, not fair

Q49. A student rolls a die 180 times and records the frequency of each result. How do they use this to estimate probability?

Answer:

Divide each frequency by 180 to get relative frequency

Solution:

P(number) = Frequency ÷ 180

Repeat for all numbers

Compare with 1 ÷ 6 = 0.167

Q50. A class plays a game where they roll a die and win if they roll a 6. How would they use a table to record and analyse their results?

Answer:

Record wins and losses in a table

Solution:

Outcome	Tally	Frequency
Win (6)		
Lose		

Total Rolls = 60
P(Win) = 10 ÷ 60 = 0.167
Compare with expected = 1 ÷ 6 = 0.167

Q51. A bag contains 4 red balls and 6 blue balls. One ball is taken out at random. List all possible outcomes and show that their probabilities add up to 1.

Answer: Possible outcomes are red and blue. Their probabilities add up to 1.

Solution:

Total balls = 4 + 6 = 10
P(Red) = 4 ÷ 10 = 0.4
P(Blue) = 6 ÷ 10 = 0.6
Sum = 0.4 + 0.6 = 1

Q52. Two dice are rolled. List all possible outcomes and verify that the sum of their probabilities is 1.

Answer: There are 36 outcomes. Each has probability 1/36.

Solution:

Each die has 6 faces.
Total outcomes = 6 × 6 = 36
Each outcome has probability = 1 ÷ 36
Sum of probabilities = 36 × (1 ÷ 36) = 1

Q53. A coin is flipped and a die is rolled. Write all possible combined outcomes and check that their total probability is 1.

Answer: There are 12 possible outcomes. Total probability is 1.

Solution:

Coin outcomes: H, T
Die outcomes: 1 to 6
Total outcomes = 2 × 6 = 12
Each outcome has probability = 1 ÷ 12
Sum = 12 × (1 ÷ 12) = 1

Q54. Explain how the outcomes from rolling a fair die once form an exhaustive and mutually exclusive set.

 Answer: The outcomes are 1, 2, 3, 4, 5, 6. They do not overlap and cover all possibilities.

 Solution:

 Each outcome is separate: mutually exclusive

 All six outcomes cover every possible result: exhaustive

 P(1 to 6) = 6 × (1 ÷ 6) = 1

Q55. A card is picked from a standard deck. List all suits and calculate their probabilities. Prove that they form an exhaustive set.

 Answer: Suits: Hearts, Diamonds, Clubs, Spades. Each has 1/4 probability.

 Solution:

 Total cards = 52

 Cards per suit = 13

 P(Each suit) = 13 ÷ 52 = 1 ÷ 4

 Sum = 1 ÷ 4 + 1 ÷ 4 + 1 ÷ 4 + 1 ÷ 4 = 1

Q56. A bag contains 3 green and 2 yellow counters. A counter is picked and then replaced. Describe all possible outcomes and show their total probability is 1.

 Answer: Outcomes: Green and Yellow. Total probability = 1.

 Solution:

 Total counters = 3 + 2 = 5

 P(Green) = 3 ÷ 5

 P(Yellow) = 2 ÷ 5

 Sum = 3 ÷ 5 + 2 ÷ 5 = 5 ÷ 5 = 1

Q57. A student flips a fair coin 100 times. What should happen to the relative frequency of heads as the number of flips increases?

 Answer: The relative frequency of heads should get closer to 0.5.

 Solution:

 Theoretical probability of heads = 1 ÷ 2 = 0.5

 As trials increase, relative frequency approaches 0.5 due to the law of large numbers

Q58. Explain why results from a small number of trials may differ from theoretical probabilities and how more trials help accuracy.

 Answer: Small samples have more variation. Large samples reduce this.

 Solution:

 Small sample → random variation has more effect

 Large sample → randomness averages out

 More trials → relative frequency closer to theoretical probability

Q59. A class rolls a die 20 times each. How can their combined results give a better estimate of probability than one student's results?

Answer: Combined results increase sample size, improving accuracy.
Solution:
Suppose 10 students roll 20 times each → 200 total rolls
Larger sample → more reliable results
Relative frequencies from combined data are closer to theoretical values

Q60. Describe how a two-way table can be used to compare observed and expected frequencies for flipping a coin 200 times.
Answer: List heads and tails in rows with observed and expected columns.
Solution:

Outcome	Observed	Expected
Heads	110	100
Tails	90	100

Compare results: the difference shows how close the experiment is to the theory

Q61. A bag has 2 red, 3 blue and 5 green counters. Describe a method to estimate the probability of drawing a red counter using experiment.
Answer: Draw a counter many times, record the results, calculate relative frequency.
Solution:
Step 1: Draw and replace counter 100 times
Step 2: Count number of times red is drawn
Step 3: P(Red) ≈ Number of reds ÷ 100

Q62. Draw a Venn diagram to represent the outcomes of drawing a red or even-numbered card from a standard pack.
Answer: One circle for red cards, one for even cards. Overlap shows red even cards.
Solution:
Red cards = 26
Even cards = cards numbered 2, 4, 6, 8, 10 from all suits = 20
Red even cards = 5
Venn diagram shows total, individual, and overlap regions

Q63. Two events A and B are mutually exclusive. Explain what this means and how to calculate the probability of A or B.
Answer: A and B cannot happen at the same time. P(A or B) = P(A) + P(B)
Solution:
P(A ∩ B) = 0
P(A ∪ B) = P(A) + P(B)

Q64. A group of students were asked whether they like maths or science. Use a Venn diagram to represent the data and find the number who like only one subject.

 Answer: Fill Venn diagram using values for maths, science, and both.

 Solution:

 Let total for maths = 25

 Total for science = 20

 Like both = 10

 Only maths = 25 - 10 = 15

 Only science = 20 - 10 = 10

 Only one subject = 15 + 10 = 25

Q65. Use a table to list the outcomes when a die is rolled and a coin is flipped. How many outcomes are there?

 Answer: There are 12 outcomes.

 Solution:

 Die: 1 to 6

 Coin: H, T

Die Roll	Coin Flip	Outcome
1	H	(1, H)
1	T	(1, T)
2	H	(2, H)
2	T	(2, T)
3	H	(3, H)
3	T	(3, T)
4	H	(4, H)
4	T	(4, T)
5	H	(5, H)
5	T	(5, T)
6	H	(6, H)
6	T	(6, T)

Q66. Draw a possibility space for two spins of a spinner with outcomes A, B, and C.
Answer: 9 outcomes in a 3×3 grid
Solution:
Outcomes: A, B, C

	A	B	C
A	AA	AB	AC
B	BA	BB	BC
C	CA	CB	CC

Total: 9

Q67. A spinner with four equal sections is spun twice. Construct the theoretical possibility space and calculate the probability of getting the same result both times.
Answer: 4 outcomes match: AA, BB, CC, DD out of 16 total
Solution:
Total outcomes = 4 × 4 = 16
Matching outcomes = 4
P(Same) = 4 ÷ 16 = 1 ÷ 4

Q68. Construct a tree diagram for picking a red or blue ball from a bag and then flipping a coin.
Answer: Tree with first stage red/blue, second stage heads/tails
Solution:
Stage 1:

- Red
  - Heads
  - Tails
- Blue
  - Heads
  - Tails

Total = 4 outcomes: RH, RT, BH, BT

Q69. Explain how to use a tree diagram to find the probability of getting two heads when flipping a coin twice.
Answer: Multiply probabilities along the path: H → H

Solution:
First flip: H (1/2), T (1/2)
Second flip: H (1/2), T (1/2)
P(H and H) = 1 ÷ 2 × 1 ÷ 2 = 1 ÷ 4

Q70. A student picks a card, replaces it, and picks again. Draw a tree diagram and use it to find the probability of getting two aces.
 Answer: Tree with ace and not ace branches for both draws
 Solution:
 Deck has 4 aces, 52 cards
 P(Ace) = 4 ÷ 52 = 1 ÷ 13
 P(Ace then Ace) = 1 ÷ 13 × 1 ÷ 13 = 1 ÷ 169

Q71. Explain how tree diagrams show the difference between independent and dependent events using the example of picking two counters without replacement.
 Answer: Tree diagrams show dependent events by adjusting probabilities in the second stage based on the first event.
 Solution:
 Tree diagrams show all possible outcomes in stages.
 When events are dependent (like picking without replacement), the total changes after the first event.
 Example: Bag has 3 red and 2 blue counters.
 First pick:

- Red = 3/5
- Blue = 2/5

 If red is picked first:

- Second red = 2/4
- Second blue = 2/4

If blue is picked first:

- Second red = 3/4
- Second blue = 1/4

This shows how second probabilities depend on the first.

Q72. In a bag of 10 balls (4 red, 6 blue), two are drawn without replacement. Use a tree diagram to find the probability of getting one red and one blue.
 Answer: 0.48
 Solution:
 First pick:

- Red = 4/10
- Blue = 6/10

If red is first:

- Blue = 6/9

Probability(Red then Blue) = (4/10) × (6/9) = 24/90

If blue is first:

- Red = 4/9

Probability(Blue then Red) = (6/10) × (4/9) = 24/90
Total probability = 24/90 + 24/90 = 48/90 = 0.48

Q73. Describe how the structure of a tree diagram changes when replacement is allowed versus when it is not.
Answer: With replacement, probabilities stay the same; without replacement, they change after the first event.
Solution:
With replacement: total number of items stays the same, so all branches in each stage have same probabilities.
Without replacement: total number reduces after each pick, so probabilities in the second stage change.
Example:
With replacement: First red = 3/5, Second red = 3/5
Without replacement: First red = 3/5, Second red = 2/4

Q74. A fair coin is flipped and then a biased die is rolled (where 6 is twice as likely). Construct a tree diagram and label probabilities.
Answer: Tree has 2 branches for coin, each followed by 6 die outcomes with adjusted probabilities.
Solution:
Coin:

- Heads = 1/2
- Tails = 1/2

Die: total parts = 1+1+1+1+1+2 = 7

- 1 to 5 = 1/7 each
- 6 = 2/7

Each branch after coin flip has die outcomes:

- 1 = 1/7
- 2 = 1/7
- 3 = 1/7
- 4 = 1/7
- 5 = 1/7
- 6 = 2/7

Q75. Explain how to use a possibility grid to show the outcomes of two dice and calculate the probability of getting a total greater than 9.
 Answer: Create 6×6 grid and count outcomes with sum >9; divide by 36.
 Solution:
Total outcomes = 6 × 6 = 36
Sums >9 are:

- (4,6), (5,5), (5,6), (6,4), (6,5), (6,6)
   Outcomes = 6
   Probability = 6/36 = 1/6 ≈ 0.1667

Q76. You draw a card and roll a die. Construct the full set of outcomes and determine how many are possible.
 Answer: 52 × 6 = 312 outcomes
 Solution:
 Deck has 52 cards
 Die has 6 faces
Total outcomes = 52 × 6 = 312

Q77. A jar has 3 red, 2 green, and 5 yellow sweets. One sweet is chosen, eaten, and then another is chosen. Find the probability of picking two different colours.
 Answer: 66/90 = 0.733
 Solution:
 Total = 10
 Total ways to choose 2 = 10×9 = 90
 Same colour:

- Red→Red = (3/10)×(2/9) = 6/90
- Green→Green = (2/10)×(1/9) = 2/90
- Yellow→Yellow = (5/10)×(4/9) = 20/90
   Same colour total = 6+2+20 = 28/90
   Different colour = 1 − 28/90 = 62/90 ≈ 0.6889
   Correction: Check combinations:
   Red→Green = (3/10)×(2/9) = 6/90

Red→Yellow = (3/10)×(5/9) = 15/90
Green→Red = (2/10)×(3/9) = 6/90
Green→Yellow = (2/10)×(5/9) = 10/90
Yellow→Red = (5/10)×(3/9) = 15/90
Yellow→Green = (5/10)×(2/9) = 10/90
Total different = 6+15+6+10+15+10 = 62/90 = 0.689

Q78. Two students flip a coin 50 times each. Explain how combining their results helps improve the estimate of the probability of heads.
Answer: Larger sample size gives better estimate of theoretical probability.
Solution:
Each student flips 50 times, total 100 flips
More trials reduce effect of chance
So relative frequency of heads over 100 flips gives more accurate estimate

Q79. A survey shows that 70 students like sports, 50 like music, and 30 like both. Represent this using a Venn diagram and find how many like only one activity.
Answer: 60 students like only one activity
Solution:
Only sports = 70 − 30 = 40
Only music = 50 − 30 = 20
Total liking only one = 40 + 20 = 60

Q80. A class of 40 students has 22 boys and 18 girls. 14 boys and 12 girls like maths. Use a two-way table to show this data.
Answer: Table created with totals and maths preferences

	Like Maths	Don't Like Maths	Total
Boys	14	8	22
Girls	12	6	18
Total	26	14	40

Solution:
Boys like maths = 14
Boys don't like maths = 22 - 14 = 18
Girls like maths = 12
Girls don't like maths = 18 −12 = 6
Total like maths = 14 + 12 = 26
Total don't like maths = 8 + 6 = 14
Total students = 40

Q81. Given that a student has passed a test, what is the probability they revised, using a table showing 100 students and their revision/pass status?
 Answer: 45/65 = 0.692
 Solution:
 From table:
 Students who revised and passed = 45
 Students who passed without revising = 20
 Total passed = 45 + 20 = 65
 P(Revised | Passed) = 45/65 = 0.692

Q82. In a game, a player wins if they draw a red card and then roll an even number. Draw a tree diagram and find the probability of winning.
 Answer: 1/4
 Solution:
 Probability of red card = 26/52 = 1/2
 Even numbers on die = 2,4,6 → 3 outcomes
 P(Even) = 3/6 = 1/2
 P(Win) = (1/2) × (1/2) = 1/4

Q83. A bag contains 5 red and 5 blue counters. One is drawn, not replaced, and another is drawn. Use a tree diagram to find the probability both are blue.
 Answer: 2/9
 Solution:
 First blue = 5/10 = 1/2
 Second blue (after 1st blue removed) = 4/9
 P(Both blue) = (1/2) × (4/9) = 4/18 = 2/9

Q84. A box has 3 pens: black, blue, and red. One pen is picked and used to tick an answer. How many outcomes are possible?
 Answer: 3
 Solution:
 Possible outcomes = black, blue, red
 Total = 3 outcomes

Q85. List all the outcomes of rolling two different dice and calculate the probability that the two numbers are equal.
 Answer: 1/6
 Solution:
 Total outcomes = 6 × 6 = 36
 Equal outcomes: (1,1), (2,2), (3,3), (4,4), (5,5), (6,6) = 6
 P(Equal numbers) = 6/36 = 1/6

Q86. A test has two questions. Each has a correct answer with probability 0.6. What is the probability of getting both right using a tree diagram?

Answer: 0.36

Solution:

P(Correct 1st) = 0.6

P(Correct 2nd) = 0.6

P(Both correct) = 0.6 × 0.6 = 0.36

Q87. Explain how Venn diagrams can be used to find the number of students who belong to neither of two clubs.

Answer: Subtract those in A, B or both from total.

Solution:

Venn diagram shows sets A and B and their overlap

Total in A or B = A + B − Both

Neither = Total − (A + B − Both)

Q88. A student draws two balls from a bag with 4 green and 6 red balls without replacement. What is the probability both are green?

Answer: 2/15

Solution:

First green = 4/10

Second green = 3/9

P(Both green) = (4/10) × (3/9) = 12/90 = 2/15

Q89. A spinner with three colours is spun twice. Describe how to list all possible outcomes and count how many are the same colour.

Answer: 3 outcomes same colour

Solution:

Colours: R, G, B

Possible outcomes: RR, RG, RB, GR, GG, GB, BR, BG, BB = 9

Same colour: RR, GG, BB = 3

Q90. You toss three coins. How many different outcomes are there? Use a tree diagram to find the probability of getting exactly two heads.

Answer: 3/8

Solution:

Total outcomes = 2^3 = 8

Outcomes with exactly 2 heads: HHT, HTH, THH = 3

P(Exactly 2 heads) = 3/8

Q91. A shop records how many customers buy snacks and drinks. Use a two-way table to analyse the data and find how many bought both.

Answer: Use the intersection value
Solution:

	Snacks Yes	Snacks No	Total
Drinks Yes	30	10	40
Drinks No	20	10	30
Total	50	20	70

Both = Snacks Yes and Drinks Yes = 30

Q92. A survey shows 40 people own dogs, 30 own cats, and 10 own both. How many own only cats? Use a Venn diagram.
Answer: 20
Solution:
Only cats = 30 − 10 = 20

Q93. A card is drawn from a deck. Find the probability of drawing a heart given that the card is red.
Answer: 1/2
Solution:
Red cards = 26
Hearts = 13 (all red)
P(Heart | Red) = 13/26 = 1/2

Q94. A test has a 70% pass rate. Given that a student passed, find the probability they studied, using a tree diagram and expected frequencies.
Answer: 0.875
Solution:
Assume 100 students
Studied = 80, Didn't = 20
P(Pass | Studied) = 0.75 → 80×0.75 = 60
P(Pass | Didn't) = 0.5 → 20×0.5 = 10
Total passed = 60 + 10 = 70
P(Studied | Passed) = 60/70 = 0.857

Q95. Describe how to calculate the conditional probability of passing a test given that a student studied, using a two-way table.
Answer: Divide number who studied and passed by total who studied
Solution:
P(Pass | Studied) = Passed and Studied / Total Studied

Q96. Use a tree diagram to calculate the probability of getting at least one head in two coin tosses.

Answer: 3/4

Solution:

Outcomes: HH, HT, TH, TT

At least one head = HH, HT, TH = 3

P = 3/4

Q97. A class rolls a die and records the number. How can they use relative frequencies to estimate the probability of each face?

Answer: Use number of times face appears ÷ total rolls

Solution:

P(Face) = frequency of face / total rolls

Q98. A box has 2 black, 3 white, and 5 red balls. Draw a ball, replace it, and draw again. What is the probability of getting the same colour twice?

Answer: 38/100 = 0.38

Solution:

P(Black twice) = (2/10)×(2/10) = 4/100

P(White twice) = (3/10)×(3/10) = 9/100

P(Red twice) = (5/10)×(5/10) = 25/100

Total = 4+9+25 = 38/100 = 0.38

Q99. Two events are A (even number on a die) and B (number less than 4). Show how to use a Venn diagram to find P(A ∩ B).

Answer: 1/6

Solution:

A = {2,4,6}

B = {1,2,3}

A ∩ B = {2}

P = 1/6

Q100. A test question is answered correctly with probability 0.75. What is the probability of getting exactly one correct answer in two attempts? Use a tree diagram

Answer: 0.375

Solution:

P(Correct) = 0.75

P(Wrong) = 0.25

Exactly one correct = CW or WC

P = (0.75×0.25) + (0.25×0.75) = 0.1875 + 0.1875 = 0.375