GRADEUP

# 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:**

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

**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:**
$P(A \cap B) = 0$
$P(A \cup B) = P(A) + P(B)$

**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