GCSE MATHEMATICS

HIGHER TIER

UNIT 5: PROBABILITY
PRACTICE BOOK

Modules 1-10 | 450 original questions | Formula guides, full methods and marking guidance

FREE WEBSITE EDITION

Student name: ____

Target grade: _______ Start date: _________ Completion date: _________

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MODULE 01 / P1-P9

Unit 5 Contents and Study Plan

MODULES 1-10 • FREE WEBSITE EDITION

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Begin with the short fluency check, then move through Standard Higher, Multi-step Higher and Grade 7-9 Challenge. Formula guides and all worked answers are collected at the end.

Module	Topic	Specification	Score
1	Probability Foundations, Relative Frequency and Expectation	P1-P5	____ / ____
2	Systematic Listing, Product Rule and Possibility Spaces	P6,P7	____ / ____
3	Venn Diagrams, Set Notation and Inclusion-Exclusion	P6,P9	____ / ____
4	Two-way Tables, Frequency Trees and Expected Frequencies	P1,P6,P9	____ / ____
5	Independent Events, Repeated Trials and Complements	P8	____ / ____
6	Dependent Events and Sampling Without Replacement	P8,P9	____ / ____
7	Conditional Probability and Reverse Conditionals	P9	____ / ____
8	Algebraic Probability and Model Constraints	P4,P8,P9	____ / ____
9	Repeated Independent Trials, Counting Orders and Simulation	P2,P3,P6-P8	____ / ____
10	Mixed Higher Probability Problem Solving	P1-P9 synthesis	____ / ____

Book structure

- 8 purposeful fluency questions per module
- 12 Standard Higher questions per module
- 15 multi-step Higher exam questions per module
- 10 Grade 7-9 challenge questions per module
- Formula and method bank for every module
- All answers, formulas and worked methods at the end

Unit 5 Specification Coverage Map

INDEPENDENTLY AUTHORED PRACTICE MAP

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

All questions are independently authored. The current AQA 8300 Probability specification and recurring Higher-paper structures informed representation choice, mark demand, conditional reasoning and multi-stage problem solving; no past-paper wording or numerical data are reproduced.

Module	Specification alignment	Design guidance
M2	P6,P7	Systematic Listing, Product Rule and Possibility Spaces
M3	P6,P9	Venn Diagrams, Set Notation and Inclusion-Exclusion
M4	P1,P6,P9	Two-way Tables, Frequency Trees and Expected Frequencies
M5	P8	Independent Events, Repeated Trials and Complements
M6	P8,P9	Dependent Events and Sampling Without Replacement
M7	P9	Conditional Probability and Reverse Conditionals
M8	P4,P8,P9	Algebraic Probability and Model Constraints
M9	P2,P3,P6-P8	Repeated Independent Trials, Counting Orders and Simulation
M10	P1-P9 synthesis	Mixed Higher Probability Problem Solving

Specification references above identify curriculum coverage only. All questions, diagrams, solutions and marking guidance in this resource are independently authored.

MODULE 01 / P1-P9

How to Use and Check Your Work

STUDENT ROUTINE AND QUALITY STANDARD

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

1 Attempt Work without notes first. Represent the information with a table, Venn diagram, possibility space or probability tree before calculating.

2 Mark Use the worked answer. Credit a method only when its mathematical setup is visible.

3 Repair Identify whether the error was modelling, units, algebra, arithmetic or interpretation; then redo from blank.

4 Retest Repeat a similar question after 2-7 days without support.

5 Present Give exact values where appropriate, sensible accuracy, units and a concluding statement.

Higher answer standard

- Define the variables and governing relationship
- State whether events are independent, dependent or mutually exclusive
- Check exhaustive branches sum to 1 and every probability lies between 0 and 1
- Distinguish average rates (chords) from instantaneous rates (tangents)
- Check whether a result is physically and mathematically reasonable

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

FLUENCY CHECK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

A short prerequisite check. Work accurately, then move promptly to Higher demand.

1. **A biased coin has P(heads)=1/5. Find P(tails) and the expected number of tails in 40 throws. [U5-M01-Q01]** [2 marks]

2. **An experiment gives 13 successes in 52 trials. Estimate the probability of success and predict successes in 310 further trials. [U5-M01-Q02]** [3 marks]

3. **A spinner has probabilities x, 2x, 3x and 1/5. Find x and identify the most likely outcome. [U5-M01-Q03]** [3 marks]

4. **Two samples estimate an event: 21/66 and 73/255. Decide which estimate is more reliable and explain. [U5-M01-Q04]** [3 marks]

5. **A game pays £4 for a win and costs £1 to play. P(win)=1/9. Find the expected net gain per play and judge fairness. [U5-M01-Q05]** [4 marks]

6. **An event of probability 1/4 is expected 20 times. Find the number of trials required. [U5-M01-Q06]** [4 marks]

7. **Explain why increasing the number of trials does not guarantee the experimental probability equals the theoretical probability exactly (case 7). [U5-M01-Q07]** [4 marks]

8. **A simulation uses random digits 0-9 to model an event of probability 2/10. Specify a valid coding and explain how to estimate the probability after N trials. [U5-M01-Q08]** **[4 marks]**

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

STANDARD HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Higher-tier application. Show the governing relationship and exact working.

1. **A biased coin has P(heads)=1/6. Find P(tails) and the expected number of tails in 80 throws. [U5-M01-Q09]** [3 marks]

2. **An experiment gives 21 successes in 68 trials. Estimate the probability of success and predict successes in 390 further trials. [U5-M01-Q10]** [3 marks]

3. **A spinner has probabilities x, 2x, 3x and 1/5. Find x and identify the most likely outcome. [U5-M01-Q11]** [3 marks]

4. **Two samples estimate an event: 29/82 and 81/295. Decide which estimate is more reliable and explain. [U5-M01-Q12]** [3 marks]

5. **A game pays £4 for a win and costs £1 to play. P(win)=1/7. Find the expected net gain per play and judge fairness. [U5-M01-Q13]** [4 marks]

6. **An event of probability 1/5 is expected 28 times. Find the number of trials required. [U5-M01-Q14]** [4 marks]

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

STANDARD HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the Higher set. Interpret each result in context.

7. **Explain why increasing the number of trials does not guarantee the experimental probability equals the theoretical probability exactly (case 15). [U5-M01-Q15]** [4 marks]

8. **A simulation uses random digits 0-9 to model an event of probability 3/10. Specify a valid coding and explain how to estimate the probability after N trials. [U5-M01-Q16]** [4 marks]

9. **A biased coin has P(heads)=4/17. Find P(tails) and the expected number of tails in 120 throws. [U5-M01-Q17]** [3 marks]

10. **An experiment gives 29 successes in 84 trials. Estimate the probability of success and predict successes in 470 further trials. [U5-M01-Q18]** [3 marks]

11. **A spinner has probabilities x, 2x, 3x and 1/5. Find x and identify the most likely outcome. [U5-M01-Q19]** [3 marks]

12. **Two samples estimate an event: 37/98 and 89/335. Decide which estimate is more reliable and explain. [U5-M01-Q20]** [3 marks]

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

MULTI-STEP HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Original multi-step exam-style questions. Show every connected stage.

1. **A game pays £4 for a win and costs £1 to play. P(win)=1/5. Find the expected net gain per play and judge fairness. [U5-M01-Q21]** [4 marks]

2. **An event of probability 3/20 is expected 15 times. Find the number of trials required. [U5-M01-Q22]** [4 marks]

3. **Explain why increasing the number of trials does not guarantee the experimental probability equals the theoretical probability exactly (case 23). [U5-M01-Q23]** [4 marks]

4. **A simulation uses random digits 0-9 to model an event of probability 4/10. Specify a valid coding and explain how to estimate the probability after N trials. [U5-M01-Q24]** [4 marks]

5. **A biased coin has P(heads)=5/16. Find P(tails) and the expected number of tails in 160 throws. [U5-M01-Q25]** [3 marks]

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

MULTI-STEP HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the multi-step set. Explain decisions where requested.

6. **An experiment gives 37 successes in 100 trials. Estimate the probability of success and predict successes in 550 further trials. [U5-M01-Q26]** [3 marks]

7. **A spinner has probabilities x, 2x, 3x and 1/5. Find x and identify the most likely outcome. [U5-M01-Q27]** [3 marks]

8. **Two samples estimate an event: 45/114 and 97/375. Decide which estimate is more reliable and explain. [U5-M01-Q28]** [3 marks]

9. **A game pays £4 for a win and costs £1 to play. P(win)=1/8. Find the expected net gain per play and judge fairness. [U5-M01-Q29]** [4 marks]

10. **An event of probability 1/4 is expected 40 times. Find the number of trials required. [U5-M01-Q30]** [4 marks]

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

MULTI-STEP HIGHER • PART C

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Complete the multi-step set. Check units, accuracy and reasonableness.

11. Explain why increasing the number of trials does not guarantee the experimental probability equals the theoretical probability exactly (case 31). [U5-M01-Q31] [4 marks]

12. A simulation uses random digits 0-9 to model an event of probability 5/10. Specify a valid coding and explain how to estimate the probability after N trials. [U5-M01-Q32] [4 marks]

13. A biased coin has P(heads)=2/5. Find P(tails) and the expected number of tails in 200 throws. [U5-M01-Q33] [3 marks]

14. An experiment gives 45 successes in 116 trials. Estimate the probability of success and predict successes in 630 further trials. [U5-M01-Q34] [3 marks]

15. A spinner has probabilities x, 2x, 3x and 1/5. Find x and identify the most likely outcome. [U5-M01-Q35] [3 marks]

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

GRADE 7-9 CHALLENGE • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Extended reasoning. Plan the model before calculating.

1. **Two samples estimate an event: 53/130 and 105/415. Decide which estimate is more reliable and explain. [U5-M01-Q36]** [3 marks]

2. **A game pays £4 for a win and costs £1 to play. P(win)=1/6. Find the expected net gain per play and judge fairness. [U5-M01-Q37]** [4 marks]

3. **An event of probability 1/5 is expected 24 times. Find the number of trials required. [U5-M01-Q38]** [4 marks]

4. **Explain why increasing the number of trials does not guarantee the experimental probability equals the theoretical probability exactly (case 39). [U5-M01-Q39]** [4 marks]

5. **A simulation uses random digits 0-9 to model an event of probability 6/10. Specify a valid coding and explain how to estimate the probability after N trials. [U5-M01-Q40]** [4 marks]

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

GRADE 7-9 CHALLENGE • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Complete the challenge set. Present a clear mathematical argument.

6. **A biased coin has P(heads)=1/2. Find P(tails) and the expected number of tails in 240 throws. [U5-M01-Q41]** [4 marks]

7. **An experiment gives 53 successes in 132 trials. Estimate the probability of success and predict successes in 710 further trials. [U5-M01-Q42]** [3 marks]

8. **A spinner has probabilities x, 2x, 3x and 1/5. Find x and identify the most likely outcome. [U5-M01-Q43]** [3 marks]

9. **Two samples estimate an event: 61/146 and 113/455. Decide which estimate is more reliable and explain. [U5-M01-Q44]** [3 marks]

10. **A game pays £4 for a win and costs £1 to play. P(win)=1/9. Find the expected net gain per play and judge fairness. [U5-M01-Q45]** [4 marks]

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

FLUENCY CHECK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

A short prerequisite check. Work accurately, then move promptly to Higher demand.

1. **Two fair spinners are numbered 1 to 3 and 1 to 4. Find the probability that the sum is 4. [U5-M02-Q01]** [2 marks]

2. **A three-character code uses one of 4 letters followed by two different digits from 0-9. How many codes are possible? [U5-M02-Q02]** [3 marks]

3. **Choose one item from 5 colours, one from 6 sizes and one of 4 finishes. Find the number of combinations and explain the product rule. [U5-M02-Q03]** [3 marks]

4. **Two different numbers are chosen from 1 to 9. List systematically the unordered pairs and find the probability their sum is even. [U5-M02-Q04]** [4 marks]

5. **A fair die is rolled twice. Find P(product is a multiple of 2) using a 6×6 grid. [U5-M02-Q05]** [4 marks]

6. **A menu has 3 starters, 9 mains and 4 desserts. A meal uses two different courses, not all three. How many possible meals? [U5-M02-Q06]** [4 marks]

7. **Explain why a list of outcomes may be a correct sample space but unsuitable for calculating probability if outcomes are not equally likely (case 7). [U5-M02-Q07]** [4 marks]

8. **A security code uses three different letters chosen from 10 available letters, followed by two different digits. How many codes are possible? [U5-M02-Q08]**
[4 marks]

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

STANDARD HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: ______________ Score: ______ / ______

Higher-tier application. Show the governing relationship and exact working.

1. **Two fair spinners are numbered 1 to 6 and 1 to 6. Find the probability that the sum is 7. [U5-M02-Q09]** [3 marks]

2. **A three-character code uses one of 7 letters followed by two different digits from 0-9. How many codes are possible? [U5-M02-Q10]** [3 marks]

3. **Choose one item from 3 colours, one from 8 sizes and one of 4 finishes. Find the number of combinations and explain the product rule. [U5-M02-Q11]** [3 marks]

4. **Two different numbers are chosen from 1 to 7. List systematically the unordered pairs and find the probability their sum is even. [U5-M02-Q12]** [4 marks]

5. **A fair die is rolled twice. Find P(product is a multiple of 2) using a 6×6 grid. [U5-M02-Q13]** [4 marks]

6. **A menu has 6 starters, 5 mains and 7 desserts. A meal uses two different courses, not all three. How many possible meals? [U5-M02-Q14]** [4 marks]

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

STANDARD HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the Higher set. Interpret each result in context.

7. **Explain why a list of outcomes may be a correct sample space but unsuitable for calculating probability if outcomes are not equally likely (case 15). [U5-M02-Q15]** **[4 marks]**

8. **A security code uses three different letters chosen from 10 available letters, followed by two different digits. How many codes are possible? [U5-M02-Q16]** **[4 marks]**

9. **Two fair spinners are numbered 1 to 4 and 1 to 8. Find the probability that the sum is 5. [U5-M02-Q17]** **[3 marks]**

10. **A three-character code uses one of 5 letters followed by two different digits from 0-9. How many codes are possible? [U5-M02-Q18]** **[3 marks]**

11. **Choose one item from 6 colours, one from 4 sizes and one of 4 finishes. Find the number of combinations and explain the product rule. [U5-M02-Q19]** **[3 marks]**

12. **Two different numbers are chosen from 1 to 10. List systematically the unordered pairs and find the probability their sum is even. [U5-M02-Q20]** **[4 marks]**

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

MULTI-STEP HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Original multi-step exam-style questions. Show every connected stage.

1. **A fair die is rolled twice. Find P(product is a multiple of 2) using a 6×6 grid. [U5-M02-Q21]** [4 marks]

2. **A menu has 4 starters, 7 mains and 5 desserts. A meal uses two different courses, not all three. How many possible meals? [U5-M02-Q22]** [4 marks]

3. **Explain why a list of outcomes may be a correct sample space but unsuitable for calculating probability if outcomes are not equally likely (case 23). [U5-M02-Q23]** [4 marks]

4. **A security code uses three different letters chosen from 10 available letters, followed by two different digits. How many codes are possible? [U5-M02-Q24]** [4 marks]

5. **Two fair spinners are numbered 1 to 7 and 1 to 4. Find the probability that the sum is 8. [U5-M02-Q25]** [3 marks]

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

MULTI-STEP HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the multi-step set. Explain decisions where requested.

6. **A three-character code uses one of 3 letters followed by two different digits from 0-9. How many codes are possible? [U5-M02-Q26]** [3 marks]

7. **Choose one item from 4 colours, one from 6 sizes and one of 4 finishes. Find the number of combinations and explain the product rule. [U5-M02-Q27]** [3 marks]

8. **Two different numbers are chosen from 1 to 8. List systematically the unordered pairs and find the probability their sum is even. [U5-M02-Q28]** [4 marks]

9. **A fair die is rolled twice. Find P(product is a multiple of 2) using a 6×6 grid. [U5-M02-Q29]** [4 marks]

10. **A menu has 7 starters, 9 mains and 8 desserts. A meal uses two different courses, not all three. How many possible meals? [U5-M02-Q30]** [4 marks]

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

MULTI-STEP HIGHER • PART C

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Complete the multi-step set. Check units, accuracy and reasonableness.

11. **Explain why a list of outcomes may be a correct sample space but unsuitable for calculating probability if outcomes are not equally likely (case 31). [U5-M02-Q31]** [4 marks]

12. **A security code uses three different letters chosen from 10 available letters, followed by two different digits. How many codes are possible? [U5-M02-Q32]** [4 marks]

13. **Two fair spinners are numbered 1 to 5 and 1 to 6. Find the probability that the sum is 6. [U5-M02-Q33]** [3 marks]

14. **A three-character code uses one of 6 letters followed by two different digits from 0-9. How many codes are possible? [U5-M02-Q34]** [3 marks]

15. **Choose one item from 7 colours, one from 8 sizes and one of 4 finishes. Find the number of combinations and explain the product rule. [U5-M02-Q35]** [3 marks]

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

GRADE 7-9 CHALLENGE • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Extended reasoning. Plan the model before calculating.

1. **Two different numbers are chosen from 1 to 6. List systematically the unordered pairs and find the probability their sum is even. [U5-M02-Q36]** [4 marks]

2. **A fair die is rolled twice. Find P(product is a multiple of 2) using a 6×6 grid. [U5-M02-Q37]** [4 marks]

3. **A menu has 5 starters, 5 mains and 6 desserts. A meal uses two different courses, not all three. How many possible meals? [U5-M02-Q38]** [4 marks]

4. **Explain why a list of outcomes may be a correct sample space but unsuitable for calculating probability if outcomes are not equally likely (case 39). [U5-M02-Q39]** [4 marks]

5. **A security code uses three different letters chosen from 10 available letters, followed by two different digits. How many codes are possible? [U5-M02-Q40]** [4 marks]

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

GRADE 7-9 CHALLENGE • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Complete the challenge set. Present a clear mathematical argument.

6. **Two fair spinners are numbered 1 to 3 and 1 to 8. Find the probability that the sum is 4. [U5-M02-Q41]** [4 marks]

7. **A three-character code uses one of 4 letters followed by two different digits from 0-9. How many codes are possible? [U5-M02-Q42]** [3 marks]

8. **Choose one item from 5 colours, one from 4 sizes and one of 4 finishes. Find the number of combinations and explain the product rule. [U5-M02-Q43]** [3 marks]

9. **Two different numbers are chosen from 1 to 9. List systematically the unordered pairs and find the probability their sum is even. [U5-M02-Q44]** [4 marks]

10. **A fair die is rolled twice. Find P(product is a multiple of 2) using a 6×6 grid. [U5-M02-Q45]** [4 marks]

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

FLUENCY CHECK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

A short prerequisite check. Work accurately, then move promptly to Higher demand.

1. **In a group of 80, 35 study art, 30 study music and 10 study both. Find the number studying neither. [U5-M03-Q01]** [3 marks]

2. **Given P(A)=3/8, P(B)=3/8 and P(A∩B)=1/8, find P(A∪B). [U5-M03-Q02]** [3 marks]

3. **In a Venn diagram, n(A only)=x+2, n(B only)=2x-2, n(A∩B)=10, neither=7, total=59. Find x. [U5-M03-Q03]** [4 marks]

4. **Events A and B have P(A)=0.7, P(B)=0.6 and P(A∪B)=0.6. Find P(A∩B) and decide whether the data are valid. [U5-M03-Q04]** [4 marks]

5. **Write in set notation: “in A or B but not both”, and describe the shaded Venn regions (variant 5). [U5-M03-Q05]** [3 marks]

6. **Three sets A,B,C have pairwise overlaps and a triple overlap. Explain an inclusion-exclusion method for n(A∪B∪C) (case 6). [U5-M03-Q06]** [5 marks]

7. **Prove P(A∪B)=P(A)+P(B) when A and B are mutually exclusive (case 7). [U5-M03-Q07]** [4 marks]

8. **Given P(A′∩B)=2/9, P(A∩B)=1/6 and P(B′)=5/12, complete the four-region Venn probabilities. [U5-M03-Q08]** **[4 marks]**

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

STANDARD HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Higher-tier application. Show the governing relationship and exact working.

1. **A survey chooses a person at random. Use a Venn diagram to express and calculate P(A′|B) from region frequencies (variant 9). [U5-M03-Q09]** [5 marks]

2. **In a group of 116, 44 study art, 39 study music and 11 study both. Find the number studying neither. [U5-M03-Q10]** [3 marks]

3. **Given $P(A)=4/7$, $P(B)=3/8$ and $P(A\cap B)=1/8$, find $P(A\cup B)$. [U5-M03-Q11]** [3 marks]

4. **In a Venn diagram, n(A only)=x+1, n(B only)=2x-3, n(A∩B)=13, neither=8, total=67. Find x. [U5-M03-Q12]** [4 marks]

5. **Events A and B have $P(A)=0.4$, $P(B)=0.5$ and $P(A\cup B)=0.6$. Find $P(A\cap B)$ and decide whether the data are valid. [U5-M03-Q13]** [4 marks]

6. **Write in set notation: “in A or B but not both”, and describe the shaded Venn regions (variant 14). [U5-M03-Q14]** [3 marks]

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

STANDARD HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Continue the Higher set. Interpret each result in context.

7. **Three sets A,B,C have pairwise overlaps and a triple overlap. Explain an inclusion-exclusion method for $n(A\cup B\cup C)$ (case 15). [U5-M03-Q15]** [5 marks]

8. **Prove $P(A\cup B)=P(A)+P(B)$ when A and B are mutually exclusive (case 16). [U5-M03-Q16]** [4 marks]

9. **Given $P(A'\cap B)=2/9$, $P(A\cap B)=1/6$ and $P(B')=5/12$, complete the four-region Venn probabilities. [U5-M03-Q17]** [4 marks]

10. **A survey chooses a person at random. Use a Venn diagram to express and calculate $P(A'|B)$ from region frequencies (variant 18). [U5-M03-Q18]** [5 marks]

11. **In a group of 152, 53 study art, 33 study music and 12 study both. Find the number studying neither. [U5-M03-Q19]** [3 marks]

12. **Given $P(A)=5/11$, $P(B)=3/8$ and $P(A\cap B)=1/8$, find $P(A\cup B)$. [U5-M03-Q20]** [3 marks]

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

MULTI-STEP HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Original multi-step exam-style questions. Show every connected stage.

1. **In a Venn diagram, n(A only)=x+0, n(B only)=2x-0, n(A∩B)=10, neither=5, total=69. Find x. [U5-M03-Q21]** [4 marks]

2. **Events A and B have P(A)=0.5, P(B)=0.4 and P(A∪B)=0.6. Find P(A∩B) and decide whether the data are valid. [U5-M03-Q22]** [4 marks]

3. **Write in set notation: “in A or B but not both”, and describe the shaded Venn regions (variant 23). [U5-M03-Q23]** [3 marks]

4. **Three sets A,B,C have pairwise overlaps and a triple overlap. Explain an inclusion-exclusion method for n(A∪B∪C) (case 24). [U5-M03-Q24]** [5 marks]

5. **Prove P(A∪B)=P(A)+P(B) when A and B are mutually exclusive (case 25). [U5-M03-Q25]** [4 marks]

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

MULTI-STEP HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the multi-step set. Explain decisions where requested.

6. **Given $P(A'\cap B)=2/9$, $P(A\cap B)=1/6$ and $P(B')=5/12$, complete the four-region Venn probabilities. [U5-M03-Q26]** [4 marks]

7. **A survey chooses a person at random. Use a Venn diagram to express and calculate $P(A'|B)$ from region frequencies (variant 27). [U5-M03-Q27]** [5 marks]

8. **In a group of 188, 62 study art, 42 study music and 13 study both. Find the number studying neither. [U5-M03-Q28]** [3 marks]

9. **Given $P(A)=1/5$, $P(B)=3/8$ and $P(A\cap B)=1/8$, find $P(A\cup B)$. [U5-M03-Q29]** [3 marks]

10. **In a Venn diagram, n(A only)=x+4, n(B only)=2x-1, $n(A\cap B)=13$, neither=6, total=61. Find x. [U5-M03-Q30]** [4 marks]

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

MULTI-STEP HIGHER • PART C

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Complete the multi-step set. Check units, accuracy and reasonableness.

11. **Events A and B have $P(A)=0.6$, $P(B)=0.3$ and $P(A\cup B)=0.6$. Find $P(A\cap B)$ and decide whether the data are valid. [U5-M03-Q31]** [4 marks]

12. **Write in set notation: “in A or B but not both”, and describe the shaded Venn regions (variant 32). [U5-M03-Q32]** [3 marks]

13. **Three sets A,B,C have pairwise overlaps and a triple overlap. Explain an inclusion-exclusion method for $n(A\cup B\cup C)$ (case 33). [U5-M03-Q33]** [5 marks]

14. **Prove $P(A\cup B)=P(A)+P(B)$ when A and B are mutually exclusive (case 34). [U5-M03-Q34]** [4 marks]

15. **Given $P(A'\cap B)=2/9$, $P(A\cap B)=1/6$ and $P(B')=5/12$, complete the four-region Venn probabilities. [U5-M03-Q35]** [4 marks]

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

GRADE 7-9 CHALLENGE • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Extended reasoning. Plan the model before calculating.

1. **A survey chooses a person at random. Use a Venn diagram to express and calculate P(A′|B) from region frequencies (variant 36). [U5-M03-Q36]** [5 marks]

2. **In a group of 224, 71 study art, 36 study music and 14 study both. Find the number studying neither. [U5-M03-Q37]** [3 marks]

3. **Given P(A)=1/3, P(B)=3/8 and P(A∩B)=1/8, find P(A∪B). [U5-M03-Q38]** [3 marks]

4. **In a Venn diagram, n(A only)=x+3, n(B only)=2x-2, n(A∩B)=10, neither=7, total=63. Find x. [U5-M03-Q39]** [4 marks]

5. **Events A and B have P(A)=0.7, P(B)=0.7 and P(A∪B)=0.6. Find P(A∩B) and decide whether the data are valid. [U5-M03-Q40]** [4 marks]

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

GRADE 7-9 CHALLENGE • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Complete the challenge set. Present a clear mathematical argument.

6. Write in set notation: "in A or B but not both", and describe the shaded Venn regions (variant 41). [U5-M03-Q41] [3 marks]

7. Three sets A,B,C have pairwise overlaps and a triple overlap. Explain an inclusion-exclusion method for $n(A \cup B \cup C)$ (case 42). [U5-M03-Q42] [5 marks]

8. Prove $P(A \cup B)=P(A)+P(B)$ when A and B are mutually exclusive (case 43). [U5-M03-Q43] [4 marks]

9. Given $P(A' \cap B)=2/9$, $P(A \cap B)=1/6$ and $P(B')=5/12$, complete the four-region Venn probabilities. [U5-M03-Q44] [4 marks]

10. A survey chooses a person at random. Use a Venn diagram to express and calculate $P(A'|B)$ from region frequencies (variant 45). [U5-M03-Q45] [5 marks]

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

FLUENCY CHECK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

A short prerequisite check. Work accurately, then move promptly to Higher demand.

1. **A two-way table classifies 120 people by membership and age. 45 are members, 60 are adults and 25 are adult members. Complete all four cells. [U5-M04-Q01]** [3 marks]

2. **From a completed two-way table, 31 of 81 females prefer option A and 21 of 71 males prefer A. Compare conditional probabilities. [U5-M04-Q02]** [3 marks]

3. **A frequency tree begins with 130 items. 37% pass inspection. Of those passing, 10% are premium. Find the expected premium passes. [U5-M04-Q03]** [4 marks]

4. **A frequency tree has total 238; branch A has x items and branch B has 2x+13 items. Find x, then split A in the ratio 3:2. [U5-M04-Q04]** [4 marks]

5. **Explain why a two-way table can calculate P(A|B) but does not by itself prove that A causes B (case 5). [U5-M04-Q05]** [4 marks]

6. **A sample contains 145 people. P(A)=4/5 and P(B|A)=1/2. Use expected frequencies to find n(A∩B). [U5-M04-Q06]** [4 marks]

7. **A partially completed table has row and column totals expressed in x. Describe a reliable algebraic completion method (variant 7). [U5-M04-Q07]** [4 marks]

8. **Two surveys report the same overall success rate but different subgroup rates. Explain how this can happen and how a two-way table exposes it (case 8). [U5-M04-Q08]** [5 marks]

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

STANDARD HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Higher-tier application. Show the governing relationship and exact working.

1. **A two-way table classifies 160 people by membership and age. 53 are members, 68 are adults and 33 are adult members. Complete all four cells. [U5-M04-Q09]** [3 marks]

2. **From a completed two-way table, 39 of 89 females prefer option A and 20 of 79 males prefer A. Compare conditional probabilities. [U5-M04-Q10]** [3 marks]

3. **A frequency tree begins with 170 items. 45% pass inspection. Of those passing, 8% are premium. Find the expected premium passes. [U5-M04-Q11]** [4 marks]

4. **A frequency tree has total 246; branch A has x items and branch B has 2x+21 items. Find x, then split A in the ratio 3:2. [U5-M04-Q12]** [4 marks]

5. **Explain why a two-way table can calculate P(A|B) but does not by itself prove that A causes B (case 13). [U5-M04-Q13]** [4 marks]

6. **A sample contains 185 people. P(A)=3/5 and P(B|A)=1/2. Use expected frequencies to find n(A∩B). [U5-M04-Q14]** [4 marks]

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

STANDARD HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the Higher set. Interpret each result in context.

7. **A partially completed table has row and column totals expressed in x. Describe a reliable algebraic completion method (variant 15). [U5-M04-Q15]** [4 marks]

8. **Two surveys report the same overall success rate but different subgroup rates. Explain how this can happen and how a two-way table exposes it (case 16). [U5-M04-Q16]** [5 marks]

9. **A two-way table classifies 200 people by membership and age. 61 are members, 76 are adults and 26 are adult members. Complete all four cells. [U5-M04-Q17]** [3 marks]

10. **From a completed two-way table, 47 of 97 females prefer option A and 28 of 87 males prefer A. Compare conditional probabilities. [U5-M04-Q18]** [3 marks]

11. **A frequency tree begins with 210 items. 53% pass inspection. Of those passing, 11% are premium. Find the expected premium passes. [U5-M04-Q19]** [4 marks]

12. **A frequency tree has total 254; branch A has x items and branch B has 2x+29 items. Find x, then split A in the ratio 3:2. [U5-M04-Q20]** [4 marks]

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

MULTI-STEP HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Original multi-step exam-style questions. Show every connected stage.

1. **Explain why a two-way table can calculate P(A|B) but does not by itself prove that A causes B (case 21). [U5-M04-Q21]** [4 marks]

2. **A sample contains 225 people. P(A)=2/5 and P(B|A)=1/2. Use expected frequencies to find n(A∩B). [U5-M04-Q22]** [4 marks]

3. **A partially completed table has row and column totals expressed in x. Describe a reliable algebraic completion method (variant 23). [U5-M04-Q23]** [4 marks]

4. **Two surveys report the same overall success rate but different subgroup rates. Explain how this can happen and how a two-way table exposes it (case 24). [U5-M04-Q24]** [5 marks]

5. **A two-way table classifies 240 people by membership and age. 69 are members, 84 are adults and 34 are adult members. Complete all four cells. [U5-M04-Q25]** [3 marks]

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

MULTI-STEP HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Continue the multi-step set. Explain decisions where requested.

6. **From a completed two-way table, 55 of 105 females prefer option A and 27 of 95 males prefer A. Compare conditional probabilities. [U5-M04-Q26]** **[3 marks]**

7. **A frequency tree begins with 250 items. 61% pass inspection. Of those passing, 9% are premium. Find the expected premium passes. [U5-M04-Q27]** **[4 marks]**

8. **A frequency tree has total 262; branch A has x items and branch B has 2x+37 items. Find x, then split A in the ratio 3:2. [U5-M04-Q28]** **[4 marks]**

9. **Explain why a two-way table can calculate P(A|B) but does not by itself prove that A causes B (case 29). [U5-M04-Q29]** **[4 marks]**

10. **A sample contains 265 people. P(A)=4/5 and P(B|A)=1/2. Use expected frequencies to find n(A∩B). [U5-M04-Q30]** **[4 marks]**

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

MULTI-STEP HIGHER • PART C

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: ______________ Score: ______ / ______

Complete the multi-step set. Check units, accuracy and reasonableness.

11. **A partially completed table has row and column totals expressed in x. Describe a reliable algebraic completion method (variant 31). [U5-M04-Q31]** [4 marks]

12. **Two surveys report the same overall success rate but different subgroup rates. Explain how this can happen and how a two-way table exposes it (case 32). [U5-M04-Q32]** [5 marks]

13. **A two-way table classifies 280 people by membership and age. 77 are members, 92 are adults and 27 are adult members. Complete all four cells. [U5-M04-Q33]** [3 marks]

14. **From a completed two-way table, 63 of 113 females prefer option A and 26 of 103 males prefer A. Compare conditional probabilities. [U5-M04-Q34]** [3 marks]

15. **A frequency tree begins with 290 items. 69% pass inspection. Of those passing, 12% are premium. Find the expected premium passes. [U5-M04-Q35]** [4 marks]

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

GRADE 7-9 CHALLENGE • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Extended reasoning. Plan the model before calculating.

1. **A frequency tree has total 270; branch A has x items and branch B has 2x+45 items. Find x, then split A in the ratio 3:2. [U5-M04-Q36]** [4 marks]

2. **Explain why a two-way table can calculate P(A|B) but does not by itself prove that A causes B (case 37). [U5-M04-Q37]** [4 marks]

3. **A sample contains 305 people. P(A)=3/5 and P(B|A)=1/2. Use expected frequencies to find n(A∩B). [U5-M04-Q38]** [4 marks]

4. **A partially completed table has row and column totals expressed in x. Describe a reliable algebraic completion method (variant 39). [U5-M04-Q39]** [4 marks]

5. **Two surveys report the same overall success rate but different subgroup rates. Explain how this can happen and how a two-way table exposes it (case 40). [U5-M04-Q40]** [5 marks]

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

GRADE 7-9 CHALLENGE • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Complete the challenge set. Present a clear mathematical argument.

6. **A two-way table classifies 320 people by membership and age. 85 are members, 100 are adults and 35 are adult members. Complete all four cells. [U5-M04-Q41]** [3 marks]

7. **From a completed two-way table, 71 of 121 females prefer option A and 25 of 111 males prefer A. Compare conditional probabilities. [U5-M04-Q42]** [3 marks]

8. **A frequency tree begins with 330 items. 77% pass inspection. Of those passing, 10% are premium. Find the expected premium passes. [U5-M04-Q43]** [4 marks]

9. **A frequency tree has total 278; branch A has x items and branch B has 2x+53 items. Find x, then split A in the ratio 3:2. [U5-M04-Q44]** [4 marks]

10. **Explain why a two-way table can calculate P(A|B) but does not by itself prove that A causes B (case 45). [U5-M04-Q45]** [4 marks]

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

FLUENCY CHECK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

A short prerequisite check. Work accurately, then move promptly to Higher demand.

1. **An event has probability 3/8 on each independent trial. Find P(success twice). [U5-M05-Q01]** [2 marks]

2. **P(A)=2/5 and P(B)=2/5; A and B are independent. Find P(A∩B) and P(A∪B). [U5-M05-Q02]** [4 marks]

3. **A biased coin has P(H)=5/12. It is tossed three times. Find P(exactly two heads). [U5-M05-Q03]** [4 marks]

4. **An event has probability 3/7. Find P(at least one success in 6 independent trials). [U5-M05-Q04]** [4 marks]

5. **A test has sensitivity 74% and false-positive rate 8%. For a person with disease probability 2%, draw a tree and find P(positive). [U5-M05-Q05]** [5 marks]

6. **Given independent events A and B with P(A∩B)=1/4 and P(A)=1/3, find P(B). [U5-M05-Q06]** [4 marks]

7. **Explain how to test independence using probabilities and why “mutually exclusive” usually means not independent (case 7). [U5-M05-Q07]** [5 marks]

8. **A player wins each round independently with probability 4/9. Find P(first win occurs on round 5). [U5-M05-Q08]** **[5 marks]**

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

STANDARD HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Higher-tier application. Show the governing relationship and exact working.

1. **An event has probability 5/11 on each independent trial. Find P(success twice). [U5-M05-Q09]** [2 marks]

2. **P(A)=6/13 and P(B)=2/5; A and B are independent. Find P(A∩B) and P(A∪B). [U5-M05-Q10]** [4 marks]

3. **A biased coin has P(H)=7/15. It is tossed three times. Find P(exactly two heads). [U5-M05-Q11]** [4 marks]

4. **An event has probability 8/17. Find P(at least one success in 6 independent trials). [U5-M05-Q12]** [4 marks]

5. **A test has sensitivity 82% and false-positive rate 4%. For a person with disease probability 2%, draw a tree and find P(positive). [U5-M05-Q13]** [5 marks]

6. **Given independent events A and B with P(A∩B)=1/6 and P(A)=1/3, find P(B). [U5-M05-Q14]** [4 marks]

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

STANDARD HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the Higher set. Interpret each result in context.

7. **Explain how to test independence using probabilities and why “mutually exclusive” usually means not independent (case 15). [U5-M05-Q15]** [5 marks]

8. **A player wins each round independently with probability 1/2. Find P(first win occurs on round 3). [U5-M05-Q16]** [5 marks]

9. **An event has probability 1/2 on each independent trial. Find P(success twice). [U5-M05-Q17]** [2 marks]

10. **P(A)=1/2 and P(B)=2/5; A and B are independent. Find P(A∩B) and P(A∪B). [U5-M05-Q18]** [4 marks]

11. **A biased coin has P(H)=1/4. It is tossed three times. Find P(exactly two heads). [U5-M05-Q19]** [4 marks]

12. **An event has probability 2/7. Find P(at least one success in 6 independent trials). [U5-M05-Q20]** [4 marks]

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

MULTI-STEP HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Original multi-step exam-style questions. Show every connected stage.

1. **A test has sensitivity 70% and false-positive rate 6%. For a person with disease probability 2%, draw a tree and find P(positive). [U5-M05-Q21]** [5 marks]

2. **Given independent events A and B with P(A∩B)=1/12 and P(A)=1/3, find P(B). [U5-M05-Q22]** [4 marks]

3. **Explain how to test independence using probabilities and why "mutually exclusive" usually means not independent (case 23). [U5-M05-Q23]** [5 marks]

4. **A player wins each round independently with probability 8/15. Find P(first win occurs on round 6). [U5-M05-Q24]** [5 marks]

5. **An event has probability 3/11 on each independent trial. Find P(success twice). [U5-M05-Q25]** [2 marks]

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

MULTI-STEP HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________ Date: __________ Score: _____ / _____

Continue the multi-step set. Explain decisions where requested.

6. **P(A)=4/13 and P(B)=2/5; A and B are independent. Find P(A∩B) and P(A∪B). [U5-M05-Q26]** [4 marks]

7. **A biased coin has P(H)=1/3. It is tossed three times. Find P(exactly two heads). [U5-M05-Q27]** [4 marks]

8. **An event has probability 6/17. Find P(at least one success in 6 independent trials). [U5-M05-Q28]** [4 marks]

9. **A test has sensitivity 78% and false-positive rate 8%. For a person with disease probability 2%, draw a tree and find P(positive). [U5-M05-Q29]** [5 marks]

10. **Given independent events A and B with P(A∩B)=1/4 and P(A)=1/3, find P(B). [U5-M05-Q30]** [4 marks]

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

MULTI-STEP HIGHER • PART C

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Complete the multi-step set. Check units, accuracy and reasonableness.

11. **Explain how to test independence using probabilities and why "mutually exclusive" usually means not independent (case 31). [U5-M05-Q31]** [5 marks]

12. **A player wins each round independently with probability 1/3. Find P(first win occurs on round 4). [U5-M05-Q32]** [5 marks]

13. **An event has probability 5/14 on each independent trial. Find P(success twice). [U5-M05-Q33]** [2 marks]

14. **P(A)=3/8 and P(B)=2/5; A and B are independent. Find P(A∩B) and P(A∪B). [U5-M05-Q34]** [4 marks]

15. **A biased coin has P(H)=7/18. It is tossed three times. Find P(exactly two heads). [U5-M05-Q35]** [4 marks]

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

GRADE 7-9 CHALLENGE • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Extended reasoning. Plan the model before calculating.

1. An event has probability 8/13. Find P(at least one success in 6 independent trials). [U5-M05-Q36] [4 marks]

2. A test has sensitivity 86% and false-positive rate 4%. For a person with disease probability 2%, draw a tree and find P(positive). [U5-M05-Q37] [5 marks]

3. Given independent events A and B with P(A∩B)=1/6 and P(A)=1/3, find P(B). [U5-M05-Q38] [4 marks]

4. Explain how to test independence using probabilities and why "mutually exclusive" usually means not independent (case 39). [U5-M05-Q39] [5 marks]

5. A player wins each round independently with probability 2/5. Find P(first win occurs on round 7). [U5-M05-Q40] [5 marks]

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

GRADE 7-9 CHALLENGE • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Complete the challenge set. Present a clear mathematical argument.

6. **An event has probability 7/17 on each independent trial. Find P(success twice). [U5-M05-Q41]** [2 marks]

7. **P(A)=8/19 and P(B)=2/5; A and B are independent. Find P(A∩B) and P(A∪B). [U5-M05-Q42]** [4 marks]

8. **A biased coin has P(H)=3/8. It is tossed three times. Find P(exactly two heads). [U5-M05-Q43]** [4 marks]

9. **An event has probability 2/5. Find P(at least one success in 6 independent trials). [U5-M05-Q44]** [4 marks]

10. **A test has sensitivity 74% and false-positive rate 6%. For a person with disease probability 2%, draw a tree and find P(positive). [U5-M05-Q45]** [5 marks]

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

FLUENCY CHECK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

A short prerequisite check. Work accurately, then move promptly to Higher demand.

1. **A bag contains 3 red and 5 blue counters. Two are drawn without replacement. Find P(both red). [U5-M06-Q01]** [3 marks]

2. **A bag contains 4 red and 6 blue counters. Two are drawn without replacement. Find P(one of each colour). [U5-M06-Q02]** [4 marks]

3. **Three counters are drawn without replacement from 5 red and 7 blue. Find P(all the same colour). [U5-M06-Q03]** [5 marks]

4. **A bag has x red and 8 blue counters. Two are drawn without replacement. P(both red)=1/6. Form an equation for x. [U5-M06-Q04]** [5 marks]

5. **Two items are selected from 16. Exactly 7 are defective. Find P(at least one defective). [U5-M06-Q05]** [4 marks]

6. **A counter is drawn from 8 red and 10 blue, its colour recorded, then it is replaced with two counters of the opposite colour. Explain the second-stage probabilities. [U5-M06-Q06]** [5 marks]

7. **Compare sampling with and without replacement from a bag of 3 red and 11 blue counters (case 7). [U5-M06-Q07]** [4 marks]

8. **An urn contains 4 A and 5 B objects. Objects are drawn without replacement until the first A. Find P(first A is on draw 3). [U5-M06-Q08]** **[5 marks]**

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

STANDARD HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Higher-tier application. Show the governing relationship and exact working.

1. **A bag contains 5 red and 6 blue counters. Two are drawn without replacement. Find P(both red). [U5-M06-Q09]** [3 marks]

2. **A bag contains 6 red and 7 blue counters. Two are drawn without replacement. Find P(one of each colour). [U5-M06-Q10]** [4 marks]

3. **Three counters are drawn without replacement from 7 red and 8 blue. Find P(all the same colour). [U5-M06-Q11]** [5 marks]

4. **A bag has x red and 9 blue counters. Two are drawn without replacement. P(both red)=1/6. Form an equation for x. [U5-M06-Q12]** [5 marks]

5. **Two items are selected from 13. Exactly 3 are defective. Find P(at least one defective). [U5-M06-Q13]** [4 marks]

6. **A counter is drawn from 4 red and 11 blue, its colour recorded, then it is replaced with two counters of the opposite colour. Explain the second-stage probabilities. [U5-M06-Q14]** [5 marks]

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

STANDARD HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the Higher set. Interpret each result in context.

7. **Compare sampling with and without replacement from a bag of 5 red and 5 blue counters (case 15). [U5-M06-Q15]** [4 marks]

8. **An urn contains 6 A and 6 B objects. Objects are drawn without replacement until the first A. Find P(first A is on draw 3). [U5-M06-Q16]** [5 marks]

9. **A bag contains 7 red and 7 blue counters. Two are drawn without replacement. Find P(both red). [U5-M06-Q17]** [3 marks]

10. **A bag contains 8 red and 8 blue counters. Two are drawn without replacement. Find P(one of each colour). [U5-M06-Q18]** [4 marks]

11. **Three counters are drawn without replacement from 3 red and 9 blue. Find P(all the same colour). [U5-M06-Q19]** [5 marks]

12. **A bag has x red and 10 blue counters. Two are drawn without replacement. P(both red)=1/6. Form an equation for x. [U5-M06-Q20]** [5 marks]

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

MULTI-STEP HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Original multi-step exam-style questions. Show every connected stage.

1. **Two items are selected from 16. Exactly 5 are defective. Find P(at least one defective). [U5-M06-Q21]** [4 marks]

2. **A counter is drawn from 6 red and 5 blue, its colour recorded, then it is replaced with two counters of the opposite colour. Explain the second-stage probabilities. [U5-M06-Q22]** [5 marks]

3. **Compare sampling with and without replacement from a bag of 7 red and 6 blue counters (case 23). [U5-M06-Q23]** [4 marks]

4. **An urn contains 8 A and 7 B objects. Objects are drawn without replacement until the first A. Find P(first A is on draw 3). [U5-M06-Q24]** [5 marks]

5. **A bag contains 3 red and 8 blue counters. Two are drawn without replacement. Find P(both red). [U5-M06-Q25]** [3 marks]

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

MULTI-STEP HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the multi-step set. Explain decisions where requested.

6. **A bag contains 4 red and 9 blue counters. Two are drawn without replacement. Find P(one of each colour). [U5-M06-Q26]** [4 marks]

7. **Three counters are drawn without replacement from 5 red and 10 blue. Find P(all the same colour). [U5-M06-Q27]** [5 marks]

8. **A bag has x red and 11 blue counters. Two are drawn without replacement. P(both red)=1/6. Form an equation for x. [U5-M06-Q28]** [5 marks]

9. **Two items are selected from 12. Exactly 7 are defective. Find P(at least one defective). [U5-M06-Q29]** [4 marks]

10. **A counter is drawn from 8 red and 6 blue, its colour recorded, then it is replaced with two counters of the opposite colour. Explain the second-stage probabilities. [U5-M06-Q30]** [5 marks]

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

MULTI-STEP HIGHER • PART C

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Complete the multi-step set. Check units, accuracy and reasonableness.

11. **Compare sampling with and without replacement from a bag of 3 red and 7 blue counters (case 31). [U5-M06-Q31]** [4 marks]

12. **An urn contains 4 A and 8 B objects. Objects are drawn without replacement until the first A. Find P(first A is on draw 3). [U5-M06-Q32]** [5 marks]

13. **A bag contains 5 red and 9 blue counters. Two are drawn without replacement. Find P(both red). [U5-M06-Q33]** [3 marks]

14. **A bag contains 6 red and 10 blue counters. Two are drawn without replacement. Find P(one of each colour). [U5-M06-Q34]** [4 marks]

15. **Three counters are drawn without replacement from 7 red and 11 blue. Find P(all the same colour). [U5-M06-Q35]** [5 marks]

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

GRADE 7-9 CHALLENGE • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Extended reasoning. Plan the model before calculating.

1. **A bag has x red and 5 blue counters. Two are drawn without replacement. P(both red)=1/6. Form an equation for x. [U5-M06-Q36]** [5 marks]

2. **Two items are selected from 9. Exactly 3 are defective. Find P(at least one defective). [U5-M06-Q37]** [4 marks]

3. **A counter is drawn from 4 red and 7 blue, its colour recorded, then it is replaced with two counters of the opposite colour. Explain the second-stage probabilities. [U5-M06-Q38]** [5 marks]

4. **Compare sampling with and without replacement from a bag of 5 red and 8 blue counters (case 39). [U5-M06-Q39]** [4 marks]

5. **An urn contains 6 A and 9 B objects. Objects are drawn without replacement until the first A. Find P(first A is on draw 3). [U5-M06-Q40]** [5 marks]

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

GRADE 7-9 CHALLENGE • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Complete the challenge set. Present a clear mathematical argument.

6. **A bag contains 7 red and 10 blue counters. Two are drawn without replacement. Find P(both red). [U5-M06-Q41]** [3 marks]

7. **A bag contains 8 red and 11 blue counters. Two are drawn without replacement. Find P(one of each colour). [U5-M06-Q42]** [4 marks]

8. **Three counters are drawn without replacement from 3 red and 5 blue. Find P(all the same colour). [U5-M06-Q43]** [5 marks]

9. **A bag has x red and 6 blue counters. Two are drawn without replacement. P(both red)=1/6. Form an equation for x. [U5-M06-Q44]** [5 marks]

10. **Two items are selected from 12. Exactly 5 are defective. Find P(at least one defective). [U5-M06-Q45]** [4 marks]

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

FLUENCY CHECK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

A short prerequisite check. Work accurately, then move promptly to Higher demand.

1. **In a group of 100, 35 take A, 45 take B and 15 take both. Find P(A|B). [U5-M07-Q01]** [3 marks]

2. **P(A)=2/5, P(B|A)=3/7 and P(B|A′)=1/4. Find P(A|B). [U5-M07-Q02]** [5 marks]

3. **A two-way table shows 32 successes among 62 trained people and 22 successes among 72 untrained people. Find P(trained|success). [U5-M07-Q03]** [4 marks]

4. **Given P(A∩B)=1/6 and P(B)=5/12, find P(A|B). Decide whether A and B could be independent if P(A)=2/5. [U5-M07-Q04]** [4 marks]

5. **A diagnostic test problem gives base rate 6%, sensitivity 84% and specificity 92%. Explain why P(disease|positive) is not the sensitivity. [U5-M07-Q05]** [5 marks]

6. **Events A and B satisfy P(A|B)=1/3, P(B)=3/5, P(A|B′)=1/8. Find P(A). [U5-M07-Q06]** [5 marks]

7. **Explain how an expected-frequency tree can calculate a conditional probability more transparently than decimals (case 7). [U5-M07-Q07]** [4 marks]

8. **Prove $P(A|B)P(B)=P(B|A)P(A)$ whenever the conditionals are defined (case 8). [U5-M07-Q08]** **[5 marks]**

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

STANDARD HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Higher-tier application. Show the governing relationship and exact working.

1. **In a group of 140, 43 take A, 53 take B and 23 take both. Find P(A|B). [U5-M07-Q09]** [3 marks]

2. **P(A)=2/5, P(B|A)=3/7 and P(B|A′)=1/4. Find P(A|B). [U5-M07-Q10]** [5 marks]

3. **A two-way table shows 40 successes among 70 trained people and 30 successes among 80 untrained people. Find P(trained|success). [U5-M07-Q11]** [4 marks]

4. **Given P(A∩B)=1/6 and P(B)=5/12, find P(A|B). Decide whether A and B could be independent if P(A)=2/5. [U5-M07-Q12]** [4 marks]

5. **A diagnostic test problem gives base rate 4%, sensitivity 92% and specificity 90%. Explain why P(disease|positive) is not the sensitivity. [U5-M07-Q13]** [5 marks]

6. **Events A and B satisfy P(A|B)=1/3, P(B)=3/5, P(A|B′)=1/8. Find P(A). [U5-M07-Q14]** [5 marks]

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

STANDARD HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the Higher set. Interpret each result in context.

7. **Explain how an expected-frequency tree can calculate a conditional probability more transparently than decimals (case 15). [U5-M07-Q15]** [4 marks]

8. **Prove $P(A|B)P(B)=P(B|A)P(A)$ whenever the conditionals are defined (case 16). [U5-M07-Q16]** [5 marks]

9. **In a group of 180, 51 take A, 61 take B and 21 take both. Find $P(A|B)$. [U5-M07-Q17]** [3 marks]

10. **$P(A)=2/5$, $P(B|A)=3/7$ and $P(B|A')=1/4$. Find $P(A|B)$. [U5-M07-Q18]** [5 marks]

11. **A two-way table shows 48 successes among 78 trained people and 26 successes among 88 untrained people. Find P(trained|success). [U5-M07-Q19]** [4 marks]

12. **Given $P(A\cap B)=1/6$ and $P(B)=5/12$, find $P(A|B)$. Decide whether A and B could be independent if $P(A)=2/5$. [U5-M07-Q20]** [4 marks]

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

MULTI-STEP HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Original multi-step exam-style questions. Show every connected stage.

1. **A diagnostic test problem gives base rate 2%, sensitivity 85% and specificity 88%. Explain why P(disease|positive) is not the sensitivity. [U5-M07-Q21]** [5 marks]

2. **Events A and B satisfy $P(A|B)=1/3$, $P(B)=3/5$, $P(A|B')=1/8$. Find P(A). [U5-M07-Q22]** [5 marks]

3. **Explain how an expected-frequency tree can calculate a conditional probability more transparently than decimals (case 23). [U5-M07-Q23]** [4 marks]

4. **Prove $P(A|B)P(B)=P(B|A)P(A)$ whenever the conditionals are defined (case 24). [U5-M07-Q24]** [5 marks]

5. **In a group of 220, 59 take A, 49 take B and 19 take both. Find P(A|B). [U5-M07-Q25]** [3 marks]

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

MULTI-STEP HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the multi-step set. Explain decisions where requested.

6. **P(A)=2/5, P(B|A)=3/7 and P(B|A′)=1/4. Find P(A|B). [U5-M07-Q26]** **[5 marks]**

7. **A two-way table shows 56 successes among 86 trained people and 22 successes among 96 untrained people. Find P(trained|success). [U5-M07-Q27]** **[4 marks]**

8. **Given P(A∩B)=1/6 and P(B)=5/12, find P(A|B). Decide whether A and B could be independent if P(A)=2/5. [U5-M07-Q28]** **[4 marks]**

9. **A diagnostic test problem gives base rate 5%, sensitivity 93% and specificity 96%. Explain why P(disease|positive) is not the sensitivity. [U5-M07-Q29]** **[5 marks]**

10. **Events A and B satisfy P(A|B)=1/3, P(B)=3/5, P(A|B′)=1/8. Find P(A). [U5-M07-Q30]** **[5 marks]**

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

MULTI-STEP HIGHER • PART C

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Complete the multi-step set. Check units, accuracy and reasonableness.

11. **Explain how an expected-frequency tree can calculate a conditional probability more transparently than decimals (case 31). [U5-M07-Q31]** [4 marks]

12. **Prove P(A|B)P(B)=P(B|A)P(A) whenever the conditionals are defined (case 32). [U5-M07-Q32]** [5 marks]

13. **In a group of 260, 67 take A, 57 take B and 17 take both. Find P(A|B). [U5-M07-Q33]** [3 marks]

14. **P(A)=2/5, P(B|A)=3/7 and P(B|A′)=1/4. Find P(A|B). [U5-M07-Q34]** [5 marks]

15. **A two-way table shows 64 successes among 94 trained people and 30 successes among 104 untrained people. Find P(trained|success). [U5-M07-Q35]** [4 marks]

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

GRADE 7-9 CHALLENGE • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Extended reasoning. Plan the model before calculating.

1. **Given $P(A \cap B)=1/6$ and $P(B)=5/12$, find $P(A|B)$. Decide whether A and B could be independent if $P(A)=2/5$. [U5-M07-Q36]** [4 marks]

2. **A diagnostic test problem gives base rate 3%, sensitivity 86% and specificity 94%. Explain why P(disease|positive) is not the sensitivity. [U5-M07-Q37]** [5 marks]

3. **Events A and B satisfy $P(A|B)=1/3$, $P(B)=3/5$, $P(A|B')=1/8$. Find $P(A)$. [U5-M07-Q38]** [5 marks]

4. **Explain how an expected-frequency tree can calculate a conditional probability more transparently than decimals (case 39). [U5-M07-Q39]** [4 marks]

5. **Prove $P(A|B)P(B)=P(B|A)P(A)$ whenever the conditionals are defined (case 40). [U5-M07-Q40]** [5 marks]

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

GRADE 7-9 CHALLENGE • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Complete the challenge set. Present a clear mathematical argument.

6. In a group of 300, 75 take A, 45 take B and 15 take both. Find P(A|B). [U5-M07-Q41] [3 marks]

7. P(A)=2/5, P(B|A)=3/7 and P(B|A′)=1/4. Find P(A|B). [U5-M07-Q42] [5 marks]

8. A two-way table shows 72 successes among 102 trained people and 26 successes among 112 untrained people. Find P(trained|success). [U5-M07-Q43] [4 marks]

9. Given P(A∩B)=1/6 and P(B)=5/12, find P(A|B). Decide whether A and B could be independent if P(A)=2/5. [U5-M07-Q44] [4 marks]

10. A diagnostic test problem gives base rate 6%, sensitivity 94% and specificity 92%. Explain why P(disease|positive) is not the sensitivity. [U5-M07-Q45] [5 marks]

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

FLUENCY CHECK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

A short prerequisite check. Work accurately, then move promptly to Higher demand.

1. **A biased coin has P(H)=x. It is tossed twice. P(two heads)=1/9. Find x. [U5-M08-Q01]** [3 marks]

2. **A bag contains x red and 9 blue counters. One is chosen. P(red)=2/5. Find x. [U5-M08-Q02]** [4 marks]

3. **Two independent events each have probability x. P(at least one occurs)=1/2. Form and solve an equation for x. [U5-M08-Q03]** [5 marks]

4. **A spinner has probabilities x, x+0.1, 2x and 0.2. Find x and check validity. [U5-M08-Q04]** [3 marks]

5. **A bag contains x red and 7 blue. Two are drawn without replacement. P(both blue)=7/16. Form an equation for x. [U5-M08-Q05]** [5 marks]

6. **For independent A and B, P(A)=x, P(B)=x+1/5 and P(A∪B)=3/5. Form an equation and state how valid roots are selected. [U5-M08-Q06]** [5 marks]

7. **Explain why algebraic probability solutions must be checked against 0≤p≤1 and physical integer constraints (case 7). [U5-M08-Q07]** [4 marks]

8. **A game has win probability x and pays £5 on a win but loses £2 otherwise. Find x for a fair game. [U5-M08-Q08]** **[4 marks]**

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

STANDARD HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Higher-tier application. Show the governing relationship and exact working.

1. **A biased coin has P(H)=x. It is tossed twice. P(two heads)=1/16. Find x. [U5-M08-Q09]** [3 marks]

2. **A bag contains x red and 9 blue counters. One is chosen. P(red)=2/5. Find x. [U5-M08-Q10]** [4 marks]

3. **Two independent events each have probability x. P(at least one occurs)=3/5. Form and solve an equation for x. [U5-M08-Q11]** [5 marks]

4. **A spinner has probabilities x, x+0.1, 2x and 0.2. Find x and check validity. [U5-M08-Q12]** [3 marks]

5. **A bag contains x red and 8 blue. Two are drawn without replacement. P(both blue)=4/9. Form an equation for x. [U5-M08-Q13]** [5 marks]

6. **For independent A and B, P(A)=x, P(B)=x+1/5 and P(A∪B)=3/5. Form an equation and state how valid roots are selected. [U5-M08-Q14]** [5 marks]

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

STANDARD HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________ Date: __________ Score: ____ / ____

Continue the Higher set. Interpret each result in context.

7. **Explain why algebraic probability solutions must be checked against 0≤p≤1 and physical integer constraints (case 15). [U5-M08-Q15]** [4 marks]

8. **A game has win probability x and pays £6 on a win but loses £2 otherwise. Find x for a fair game. [U5-M08-Q16]** [4 marks]

9. **A biased coin has P(H)=x. It is tossed twice. P(two heads)=1/25. Find x. [U5-M08-Q17]** [3 marks]

10. **A bag contains x red and 9 blue counters. One is chosen. P(red)=2/5. Find x. [U5-M08-Q18]** [4 marks]

11. **Two independent events each have probability x. P(at least one occurs)=7/10. Form and solve an equation for x. [U5-M08-Q19]** [5 marks]

12. **A spinner has probabilities x, x+0.1, 2x and 0.2. Find x and check validity. [U5-M08-Q20]** [3 marks]

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

MULTI-STEP HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Original multi-step exam-style questions. Show every connected stage.

1. **A bag contains x red and 9 blue. Two are drawn without replacement. P(both blue)=9/20. Form an equation for x. [U5-M08-Q21]** [5 marks]

2. **For independent A and B, P(A)=x, P(B)=x+1/5 and P(A∪B)=3/5. Form an equation and state how valid roots are selected. [U5-M08-Q22]** [5 marks]

3. **Explain why algebraic probability solutions must be checked against 0≤p≤1 and physical integer constraints (case 23). [U5-M08-Q23]** [4 marks]

4. **A game has win probability x and pays £7 on a win but loses £2 otherwise. Find x for a fair game. [U5-M08-Q24]** [4 marks]

5. **A biased coin has P(H)=x. It is tossed twice. P(two heads)=1/36. Find x. [U5-M08-Q25]** [3 marks]

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

MULTI-STEP HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the multi-step set. Explain decisions where requested.

6. **A bag contains x red and 9 blue counters. One is chosen. P(red)=2/5. Find x. [U5-M08-Q26]** [4 marks]

7. **Two independent events each have probability x. P(at least one occurs)=4/5. Form and solve an equation for x. [U5-M08-Q27]** [5 marks]

8. **A spinner has probabilities x, x+0.1, 2x and 0.2. Find x and check validity. [U5-M08-Q28]** [3 marks]

9. **A bag contains x red and 3 blue. Two are drawn without replacement. P(both blue)=3/8. Form an equation for x. [U5-M08-Q29]** [5 marks]

10. **For independent A and B, P(A)=x, P(B)=x+1/5 and P(A∪B)=3/5. Form an equation and state how valid roots are selected. [U5-M08-Q30]** [5 marks]

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

MULTI-STEP HIGHER • PART C

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Complete the multi-step set. Check units, accuracy and reasonableness.

11. **Explain why algebraic probability solutions must be checked against $0 \le p \le 1$ and physical integer constraints (case 31). [U5-M08-Q31]** [4 marks]

12. **A game has win probability x and pays £8 on a win but loses £2 otherwise. Find x for a fair game. [U5-M08-Q32]** [4 marks]

13. **A biased coin has P(H)=x. It is tossed twice. P(two heads)=1/49. Find x. [U5-M08-Q33]** [3 marks]

14. **A bag contains x red and 9 blue counters. One is chosen. P(red)=2/5. Find x. [U5-M08-Q34]** [4 marks]

15. **Two independent events each have probability x. P(at least one occurs)=9/10. Form and solve an equation for x. [U5-M08-Q35]** [5 marks]

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

GRADE 7-9 CHALLENGE • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Extended reasoning. Plan the model before calculating.

1. **A spinner has probabilities x, x+0.1, 2x and 0.2. Find x and check validity. [U5-M08-Q36]** **[3 marks]**

2. **A bag contains x red and 4 blue. Two are drawn without replacement. P(both blue)=2/5. Form an equation for x. [U5-M08-Q37]** **[5 marks]**

3. **For independent A and B, P(A)=x, P(B)=x+1/5 and P(A∪B)=3/5. Form an equation and state how valid roots are selected. [U5-M08-Q38]** **[5 marks]**

4. **Explain why algebraic probability solutions must be checked against 0≤p≤1 and physical integer constraints (case 39). [U5-M08-Q39]** **[4 marks]**

5. **A game has win probability x and pays £9 on a win but loses £2 otherwise. Find x for a fair game. [U5-M08-Q40]** **[4 marks]**

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

GRADE 7-9 CHALLENGE • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Complete the challenge set. Present a clear mathematical argument.

6. A biased coin has P(H)=x. It is tossed twice. P(two heads)=1/64. Find x. [U5-M08-Q41] [3 marks]

7. A bag contains x red and 9 blue counters. One is chosen. P(red)=2/5. Find x. [U5-M08-Q42] [4 marks]

8. Two independent events each have probability x. P(at least one occurs)=3/10. Form and solve an equation for x. [U5-M08-Q43] [5 marks]

9. A spinner has probabilities x, x+0.1, 2x and 0.2. Find x and check validity. [U5-M08-Q44] [3 marks]

10. A bag contains x red and 5 blue. Two are drawn without replacement. P(both blue)=5/12. Form an equation for x. [U5-M08-Q45] [5 marks]

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

FLUENCY CHECK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

A short prerequisite check. Work accurately, then move promptly to Higher demand.

1. **A success probability is 1/5. In 4 independent trials, find P(exactly two successes). [U5-M09-Q01]** [4 marks]

2. **Find P(at most one success in 5 independent trials when p=2/5). [U5-M09-Q02]** [4 marks]

3. **A fair coin is tossed 8 times. Find P(more heads than tails). [U5-M09-Q03]** [5 marks]

4. **A player has probability 1/5 of scoring each attempt independently. Find the probability the third score occurs on attempt 9. [U5-M09-Q04]** [5 marks]

5. **Compare exact probability and a simulation estimate for a rare event over 1200 trials. State a suitable measure of discrepancy. [U5-M09-Q05]** [4 marks]

6. **Explain why the coefficient C(n,r) appears in a repeated independent-trials probability (case 6). [U5-M09-Q06]** [4 marks]

7. **A multiple-choice test has 7 questions with four options each. A student guesses. Find P(at least one correct). [U5-M09-Q07]** [3 marks]

8. Design a simulation for the number of successes in 7 trials with probability 2/5, including coding and repetition (variant 8). [U5-M09-Q08] **[4 marks]**

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

STANDARD HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Higher-tier application. Show the governing relationship and exact working.

1. **A success probability is 3/5. In 4 independent trials, find P(exactly two successes). [U5-M09-Q09]** [4 marks]

2. **Find P(at most one success in 5 independent trials when p=1/5). [U5-M09-Q10]** [4 marks]

3. **A fair coin is tossed 8 times. Find P(more heads than tails). [U5-M09-Q11]** [5 marks]

4. **A player has probability 3/5 of scoring each attempt independently. Find the probability the third score occurs on attempt 9. [U5-M09-Q12]** [5 marks]

5. **Compare exact probability and a simulation estimate for a rare event over 1600 trials. State a suitable measure of discrepancy. [U5-M09-Q13]** [4 marks]

6. **Explain why the coefficient C(n,r) appears in a repeated independent-trials probability (case 14). [U5-M09-Q14]** [4 marks]

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

STANDARD HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: ______________ Score: ______ / ______

Continue the Higher set. Interpret each result in context.

7. **A multiple-choice test has 7 questions with four options each. A student guesses. Find P(at least one correct). [U5-M09-Q15]** [3 marks]

8. **Design a simulation for the number of successes in 7 trials with probability 1/5, including coding and repetition (variant 16). [U5-M09-Q16]** [4 marks]

9. **A success probability is 2/5. In 4 independent trials, find P(exactly two successes). [U5-M09-Q17]** [4 marks]

10. **Find P(at most one success in 5 independent trials when p=3/5). [U5-M09-Q18]** [4 marks]

11. **A fair coin is tossed 8 times. Find P(more heads than tails). [U5-M09-Q19]** [5 marks]

12. **A player has probability 2/5 of scoring each attempt independently. Find the probability the third score occurs on attempt 9. [U5-M09-Q20]** [5 marks]

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

MULTI-STEP HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________ Date: __________ Score: _____ / _____

Original multi-step exam-style questions. Show every connected stage.

1. **Compare exact probability and a simulation estimate for a rare event over 2000 trials. State a suitable measure of discrepancy. [U5-M09-Q21]** [4 marks]

2. **Explain why the coefficient C(n,r) appears in a repeated independent-trials probability (case 22). [U5-M09-Q22]** [4 marks]

3. **A multiple-choice test has 7 questions with four options each. A student guesses. Find P(at least one correct). [U5-M09-Q23]** [3 marks]

4. **Design a simulation for the number of successes in 7 trials with probability 3/5, including coding and repetition (variant 24). [U5-M09-Q24]** [4 marks]

5. **A success probability is 1/5. In 4 independent trials, find P(exactly two successes). [U5-M09-Q25]** [4 marks]

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

MULTI-STEP HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the multi-step set. Explain decisions where requested.

6. **Find P(at most one success in 5 independent trials when p=2/5). [U5-M09-Q26]** [4 marks]

7. **A fair coin is tossed 8 times. Find P(more heads than tails). [U5-M09-Q27]** [5 marks]

8. **A player has probability 1/5 of scoring each attempt independently. Find the probability the third score occurs on attempt 9. [U5-M09-Q28]** [5 marks]

9. **Compare exact probability and a simulation estimate for a rare event over 2400 trials. State a suitable measure of discrepancy. [U5-M09-Q29]** [4 marks]

10. **Explain why the coefficient C(n,r) appears in a repeated independent-trials probability (case 30). [U5-M09-Q30]** [4 marks]

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

MULTI-STEP HIGHER • PART C

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Complete the multi-step set. Check units, accuracy and reasonableness.

11. A multiple-choice test has 7 questions with four options each. A student guesses. Find P(at least one correct). [U5-M09-Q31] [3 marks]

12. Design a simulation for the number of successes in 7 trials with probability 2/5, including coding and repetition (variant 32). [U5-M09-Q32] [4 marks]

13. A success probability is 3/5. In 4 independent trials, find P(exactly two successes). [U5-M09-Q33] [4 marks]

14. Find P(at most one success in 5 independent trials when p=1/5). [U5-M09-Q34] [4 marks]

15. A fair coin is tossed 8 times. Find P(more heads than tails). [U5-M09-Q35] [5 marks]

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

GRADE 7-9 CHALLENGE • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Extended reasoning. Plan the model before calculating.

1. **A player has probability 3/5 of scoring each attempt independently. Find the probability the third score occurs on attempt 9. [U5-M09-Q36]** [5 marks]

2. **Compare exact probability and a simulation estimate for a rare event over 2800 trials. State a suitable measure of discrepancy. [U5-M09-Q37]** [4 marks]

3. **Explain why the coefficient C(n,r) appears in a repeated independent-trials probability (case 38). [U5-M09-Q38]** [4 marks]

4. **A multiple-choice test has 7 questions with four options each. A student guesses. Find P(at least one correct). [U5-M09-Q39]** [3 marks]

5. **Design a simulation for the number of successes in 7 trials with probability 1/5, including coding and repetition (variant 40). [U5-M09-Q40]** [4 marks]

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

GRADE 7-9 CHALLENGE • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Complete the challenge set. Present a clear mathematical argument.

6. **A success probability is 2/5. In 4 independent trials, find P(exactly two successes). [U5-M09-Q41]** [4 marks]

7. **Find P(at most one success in 5 independent trials when p=3/5). [U5-M09-Q42]** [4 marks]

8. **A fair coin is tossed 8 times. Find P(more heads than tails). [U5-M09-Q43]** [5 marks]

9. **A player has probability 2/5 of scoring each attempt independently. Find the probability the third score occurs on attempt 9. [U5-M09-Q44]** [5 marks]

10. **Compare exact probability and a simulation estimate for a rare event over 3200 trials. State a suitable measure of discrepancy. [U5-M09-Q45]** [4 marks]

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

FLUENCY CHECK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

A short prerequisite check. Work accurately, then move promptly to Higher demand.

1. **A bag contains 4 red and 6 blue counters. Two are drawn without replacement. Given that the colours are different, find the probability that the first counter was red. [U5-M10-Q01]** [5 marks]

2. **A biased coin has P(heads)=1/5 and is tossed 5 times. Find the probability of at least two heads. [U5-M10-Q02]** [5 marks]

3. **In a group of 200, 80 study French, 90 study Spanish and 30 study both. One student is chosen from those who study at least one language. Find P(French | at least one language). [U5-M10-Q03]** [4 marks]

4. **In a population, 2% have a condition. A test has sensitivity 80% and false-positive rate 10%. Find the probability that a person has the condition, given a positive test. [U5-M10-Q04]** [5 marks]

5. **A game costs £2. A win pays £6 in total and a loss pays nothing. Find the win probability that makes the game fair, then find the expected profit from 120 plays if the actual win probability is 1/4. [U5-M10-Q05]** [5 marks]

6. **A bag contains x red and 2x blue counters. A red counter is drawn, not replaced, and then a blue counter is drawn. The probability of this route is 1/4 when x is a positive integer. Find x. [U5-M10-Q06]** [5 marks]

7. **Two fair dice are rolled. Given that the first die is greater than the second, find the probability that their sum is at least 9. [U5-M10-Q07]** **[5 marks]**

8. **Events A and B satisfy P(A)=1/5, P(B)=3/10 and P(A∩B)=3/50. Decide whether they are independent, then find P(exactly one of A and B). [U5-M10-Q08]** **[5 marks]**

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

STANDARD HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: ______________ Score: ______ / ______

Higher-tier application. Show the governing relationship and exact working.

1. **A code consists of two different letters chosen from 5 available letters, followed by one non-zero digit. Codes are generated uniformly. Find the probability that a code begins with a specified letter or ends in an even digit. [U5-M10-Q09]** [5 marks]

2. **A bag contains 5 red and 7 blue counters. Two are drawn without replacement. Given that the colours are different, find the probability that the first counter was red. [U5-M10-Q10]** [5 marks]

3. **A biased coin has P(heads)=3/10 and is tossed 6 times. Find the probability of at least two heads. [U5-M10-Q11]** [5 marks]

4. **In a group of 250, 90 study French, 100 study Spanish and 35 study both. One student is chosen from those who study at least one language. Find P(French | at least one language). [U5-M10-Q12]** [4 marks]

5. **In a population, 3% have a condition. A test has sensitivity 82% and false-positive rate 9%. Find the probability that a person has the condition, given a positive test. [U5-M10-Q13]** [5 marks]

6. **A game costs £2. A win pays £7 in total and a loss pays nothing. Find the win probability that makes the game fair, then find the expected profit from 120 plays if the actual win probability is 2/9. [U5-M10-Q14]** **[5 marks]**

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

STANDARD HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the Higher set. Interpret each result in context.

7. **A bag contains x red and 2x blue counters. A red counter is drawn, not replaced, and then a blue counter is drawn. The probability of this route is 8/33 when x is a positive integer. Find x. [U5-M10-Q15]** [5 marks]

8. **Two fair dice are rolled. Given that the first die is greater than the second, find the probability that their sum is at least 10. [U5-M10-Q16]** [5 marks]

9. **Events A and B satisfy P(A)=3/10, P(B)=2/5 and P(A∩B)=3/25. Decide whether they are independent, then find P(exactly one of A and B). [U5-M10-Q17]** [5 marks]

10. **A code consists of two different letters chosen from 6 available letters, followed by one non-zero digit. Codes are generated uniformly. Find the probability that a code begins with a specified letter or ends in an even digit. [U5-M10-Q18]** [5 marks]

11. **A bag contains 6 red and 8 blue counters. Two are drawn without replacement. Given that the colours are different, find the probability that the first counter was red. [U5-M10-Q19]** [5 marks]

12. **A biased coin has P(heads)=2/5 and is tossed 7 times. Find the probability of at least two heads. [U5-M10-Q20]** [5 marks]

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

MULTI-STEP HIGHER • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Original multi-step exam-style questions. Show every connected stage.

1. **In a group of 300, 100 study French, 110 study Spanish and 40 study both. One student is chosen from those who study at least one language. Find P(French | at least one language). [U5-M10-Q21]** [4 marks]

2. **In a population, 4% have a condition. A test has sensitivity 84% and false-positive rate 8%. Find the probability that a person has the condition, given a positive test. [U5-M10-Q22]** [5 marks]

3. **A game costs £2. A win pays £8 in total and a loss pays nothing. Find the win probability that makes the game fair, then find the expected profit from 120 plays if the actual win probability is 1/5. [U5-M10-Q23]** [5 marks]

4. **A bag contains x red and 2x blue counters. A red counter is drawn, not replaced, and then a blue counter is drawn. The probability of this route is 5/21 when x is a positive integer. Find x. [U5-M10-Q24]** [5 marks]

5. **Two fair dice are rolled. Given that the first die is greater than the second, find the probability that their sum is at least 11. [U5-M10-Q25]** [5 marks]

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

MULTI-STEP HIGHER • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Continue the multi-step set. Explain decisions where requested.

6. **Events A and B satisfy P(A)=2/5, P(B)=1/2 and P(A∩B)=1/5. Decide whether they are independent, then find P(exactly one of A and B). [U5-M10-Q26]** [5 marks]

7. **A code consists of two different letters chosen from 7 available letters, followed by one non-zero digit. Codes are generated uniformly. Find the probability that a code begins with a specified letter or ends in an even digit. [U5-M10-Q27]** [5 marks]

8. **A bag contains 7 red and 9 blue counters. Two are drawn without replacement. Given that the colours are different, find the probability that the first counter was red. [U5-M10-Q28]** [5 marks]

9. **A biased coin has P(heads)=1/2 and is tossed 8 times. Find the probability of at least two heads. [U5-M10-Q29]** [5 marks]

10. **In a group of 350, 110 study French, 120 study Spanish and 45 study both. One student is chosen from those who study at least one language. Find P(French | at least one language). [U5-M10-Q30]** [4 marks]

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

MULTI-STEP HIGHER • PART C

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Complete the multi-step set. Check units, accuracy and reasonableness.

11. In a population, 5% have a condition. A test has sensitivity 86% and false-positive rate 7%. Find the probability that a person has the condition, given a positive test. [U5-M10-Q31] [5 marks]

12. A game costs £2. A win pays £9 in total and a loss pays nothing. Find the win probability that makes the game fair, then find the expected profit from 120 plays if the actual win probability is 2/11. [U5-M10-Q32] [5 marks]

13. A bag contains x red and 2x blue counters. A red counter is drawn, not replaced, and then a blue counter is drawn. The probability of this route is 4/17 when x is a positive integer. Find x. [U5-M10-Q33] [5 marks]

14. Two fair dice are rolled. Given that the first die is greater than the second, find the probability that their sum is at least 12. [U5-M10-Q34] [5 marks]

15. Events A and B satisfy P(A)=1/2, P(B)=3/5 and P(A∩B)=3/10. Decide whether they are independent, then find P(exactly one of A and B). [U5-M10-Q35] [5 marks]

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

GRADE 7-9 CHALLENGE • PART A

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________ Date: __________ Score: _____ / _____

Extended reasoning. Plan the model before calculating.

1. A code consists of two different letters chosen from 8 available letters, followed by one non-zero digit. Codes are generated uniformly. Find the probability that a code begins with a specified letter or ends in an even digit. [U5-M10-Q36] [5 marks]

2. A bag contains 8 red and 10 blue counters. Two are drawn without replacement. Given that the colours are different, find the probability that the first counter was red. [U5-M10-Q37] [5 marks]

3. A biased coin has P(heads)=3/5 and is tossed 9 times. Find the probability of at least two heads. [U5-M10-Q38] [5 marks]

4. In a group of 400, 120 study French, 130 study Spanish and 50 study both. One student is chosen from those who study at least one language. Find P(French | at least one language). [U5-M10-Q39] [4 marks]

5. In a population, 6% have a condition. A test has sensitivity 88% and false-positive rate 6%. Find the probability that a person has the condition, given a positive test. [U5-M10-Q40] [5 marks]

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

GRADE 7-9 CHALLENGE • PART B

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Complete the challenge set. Present a clear mathematical argument.

6. **A game costs £2. A win pays £10 in total and a loss pays nothing. Find the win probability that makes the game fair, then find the expected profit from 120 plays if the actual win probability is 1/6. [U5-M10-Q41]** [5 marks]

7. **A bag contains x red and 2x blue counters. A red counter is drawn, not replaced, and then a blue counter is drawn. The probability of this route is 7/30 when x is a positive integer. Find x. [U5-M10-Q42]** [5 marks]

8. **Two fair dice are rolled. Given that the first die is greater than the second, find the probability that their sum is at least 13. [U5-M10-Q43]** [5 marks]

9. **Events A and B satisfy P(A)=3/5, P(B)=7/10 and P(A∩B)=21/50. Decide whether they are independent, then find P(exactly one of A and B). [U5-M10-Q44]** [5 marks]

10. **A code consists of two different letters chosen from 9 available letters, followed by one non-zero digit. Codes are generated uniformly. Find the probability that a code begins with a specified letter or ends in an even digit. [U5-M10-Q45]** [5 marks]

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

FORMULAS AND METHOD BANK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use these methods before checking the answer tables. Write the setup first, substitute values, calculate, then give a final answer with units.

When to use it	Formula / method
Complement	P(not A)=1-P(A).
Exhaustive outcomes	Probabilities sum to 1.
Expected frequency	number of trials × probability.
Relative frequency	event frequency/number of trials.
Reliability	Larger unbiased samples tend to be more stable.
Fair game	Expected net gain is 0.

Marking reminder: a correct setup can earn method marks even when a later arithmetic error occurs.

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

FORMULAS AND METHOD BANK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use these methods before checking the answer tables. Write the setup first, substitute values, calculate, then give a final answer with units.

When to use it	Formula / method
Product rule	Multiply choices at successive stages.
Ordered outcomes	(A,B) differs from (B,A) when order matters.
Unordered pairs	Use systematic lists or combinations.
Possibility space	Use equally likely cells before favourable/total.
Restrictions	Adjust the number of available choices at each stage.
Repeated objects	Divide or count by cases to avoid overcounting identical arrangements.

Marking reminder: a correct setup can earn method marks even when a later arithmetic error occurs.

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

FORMULAS AND METHOD BANK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ________________________________ Date: ______________ Score: ______ / ______

Use these methods before checking the answer tables. Write the setup first, substitute values, calculate, then give a final answer with units.

When to use it	Formula / method
Union	$P(A \cup B)=P(A)+P(B)-P(A \cap B)$.
Complement	A' means not A.
Mutually exclusive	$A \cap B=\varnothing$.
Neither	Complement of the union.
Conditional from Venn	Restrict denominator to the conditioning set.
Three sets	Add singles, subtract pairs, add triple intersection.

Marking reminder: a correct setup can earn method marks even when a later arithmetic error occurs.

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

FORMULAS AND METHOD BANK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use these methods before checking the answer tables. Write the setup first, substitute values, calculate, then give a final answer with units.

When to use it	Formula / method
Two-way table	Interior cells sum to row/column totals.
Conditional table probability	Desired cell/conditioning row or column total.
Frequency tree	Use counts; child branches sum to parent.
Expected frequency	Multiply down successive proportions.
Comparison	Use conditional percentages with correct denominators.
Interpretation	Association does not prove causation.

Marking reminder: a correct setup can earn method marks even when a later arithmetic error occurs.

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

FORMULAS AND METHOD BANK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use these methods before checking the answer tables. Write the setup first, substitute values, calculate, then give a final answer with units.

When to use it	Formula / method
Tree diagrams	Multiply along branches; add mutually exclusive routes.
Complement	At least one =1-none.
Independent	Later probabilities stay unchanged.
Without replacement	Update numerator and denominator after each draw.
Exactly r successes	Count orders, then multiply one route probability.
Check	Probabilities from each node sum to 1.

Marking reminder: a correct setup can earn method marks even when a later arithmetic error occurs.

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

FORMULAS AND METHOD BANK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use these methods before checking the answer tables. Write the setup first, substitute values, calculate, then give a final answer with units.

When to use it	Formula / method
Tree diagrams	Multiply along branches; add mutually exclusive routes.
Complement	At least one =1-none.
Independent	Later probabilities stay unchanged.
Without replacement	Update numerator and denominator after each draw.
Exactly r successes	Count orders, then multiply one route probability.
Check	Probabilities from each node sum to 1.

Marking reminder: a correct setup can earn method marks even when a later arithmetic error occurs.

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

FORMULAS AND METHOD BANK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use these methods before checking the answer tables. Write the setup first, substitute values, calculate, then give a final answer with units.

When to use it	Formula / method
Definition	$P(A\|B)=P(A\cap B)/P(B)$.
Multiplication rule	$P(A\cap B)=P(A\|B)P(B)$.
Total probability	Split through B and B′.
Reverse conditional	Do not confuse $P(A\|B)$ with $P(B\|A)$.
Expected frequencies	Choose a convenient population and work with counts.
Independence	$P(A\|B)=P(A)$, when $P(B)>0$.

Marking reminder: a correct setup can earn method marks even when a later arithmetic error occurs.

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

FORMULAS AND METHOD BANK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use these methods before checking the answer tables. Write the setup first, substitute values, calculate, then give a final answer with units.

When to use it	Formula / method
Unknown probability	Use exhaustive sum or a tree to form an equation.
Independent repetition	Multiply identical branch probabilities.
Without replacement	Use changing denominators.
Fair game	Set expected net gain to zero.
Quadratics	Solve, then check roots in the original model.
Validity	Probabilities in [0,1]; counts are non-negative integers.

Marking reminder: a correct setup can earn method marks even when a later arithmetic error occurs.

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

FORMULAS AND METHOD BANK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use these methods before checking the answer tables. Write the setup first, substitute values, calculate, then give a final answer with units.

When to use it	Formula / method
Exactly r successes	C(n,r)p^r(1-p)^(n-r).
At least one	1-(1-p)^n.
At most one	P(0)+P(1).
First/target success	Count required earlier successes, then multiply final success.
Simulation	Use valid equal-likelihood coding and many repetitions.
Interpret	Simulation varies; exact model does not.

Marking reminder: a correct setup can earn method marks even when a later arithmetic error occurs.

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

FORMULAS AND METHOD BANK

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use these methods before checking the answer tables. Write the setup first, substitute values, calculate, then give a final answer with units.

When to use it	Formula / method
Represent	Choose table, Venn diagram, possibility space or tree.
Branches	Multiply along; add separate routes.
Conditional	Change the denominator to the known group.
Complement	Often simplifies “at least one” or “not all”.
Algebra	Form the model, solve and check validity.
Audit	All probabilities must be in [0,1] and exhaustive branches sum to 1.

Marking reminder: a correct setup can earn method marks even when a later arithmetic error occurs.

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

FLUENCY CHECK - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	P(tails)=1-1/5=4/5. Expected tails=40×4/5=32.	**2**	M1 method; A1 answer.
2	Estimated probability=(13)/(52)=1/4. Prediction=(310)×that=77.5.	**3**	M1 setup; M1 process; A1 conclusion.
3	6x+1/5=1, so 6x=4/5 and x=2/15. The 3x outcome has probability 2/5 and is most likely.	**3**	M1 setup; M1 process; A1 conclusion.
4	Compare relative frequencies, but the estimate from 255 trials is generally more reliable because the larger unbiased sample is less affected by random variation.	**3**	M1 setup; M1 process; A1 conclusion.
5	Expected winnings=£4/(9)=£0.444. Expected net=£-0.556. A fair monetary game has expected net 0; this one is unfavourable to the player.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	Expected frequency=np, so n=20/1/4=80 trials.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
7	Larger samples usually reduce random fluctuation, so relative frequency tends towards theoretical probability, but chance variation remains and exact equality is not guaranteed.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	Assign any 2 distinct digits to success and the remaining digits to failure. Generate N independent digits; estimated probability=number of coded successes/N. The coding works because the ten digits are equally likely.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

STANDARD HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: ______________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	P(tails)=1-1/6=5/6. Expected tails=80×5/6=200/3.	**3**	M1 setup; M1 process; A1 conclusion.
2	Estimated probability=(21)/(68)=21/68. Prediction=(390)×that=120.	**3**	M1 setup; M1 process; A1 conclusion.
3	6x+1/5=1, so 6x=4/5 and x=2/15. The 3x outcome has probability 2/5 and is most likely.	**3**	M1 setup; M1 process; A1 conclusion.
4	Compare relative frequencies, but the estimate from 295 trials is generally more reliable because the larger unbiased sample is less affected by random variation.	**3**	M1 setup; M1 process; A1 conclusion.
5	Expected winnings=£4/(7)=£0.571. Expected net=£-0.429. A fair monetary game has expected net 0; this one is unfavourable to the player.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	Expected frequency=np, so n=28/1/5=140 trials.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

STANDARD HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
7	Larger samples usually reduce random fluctuation, so relative frequency tends towards theoretical probability, but chance variation remains and exact equality is not guaranteed.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	Assign any 3 distinct digits to success and the remaining digits to failure. Generate N independent digits; estimated probability=number of coded successes/N. The coding works because the ten digits are equally likely.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
9	P(tails)=1-4/17=13/17. Expected tails=120×13/17=1560/17.	**3**	M1 setup; M1 process; A1 conclusion.
10	Estimated probability=(29)/(84)=29/84. Prediction=(470)×that=162.	**3**	M1 setup; M1 process; A1 conclusion.
11	6x+1/5=1, so 6x=4/5 and x=2/15. The 3x outcome has probability 2/5 and is most likely.	**3**	M1 setup; M1 process; A1 conclusion.
12	Compare relative frequencies, but the estimate from 335 trials is generally more reliable because the larger unbiased sample is less affected by random variation.	**3**	M1 setup; M1 process; A1 conclusion.

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

MULTI-STEP HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Expected winnings=£4/(5)=£0.8. Expected net=£-0.2. A fair monetary game has expected net 0; this one is unfavourable to the player.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
2	Expected frequency=np, so n=15/3/20=100 trials.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	Larger samples usually reduce random fluctuation, so relative frequency tends towards theoretical probability, but chance variation remains and exact equality is not guaranteed.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	Assign any 4 distinct digits to success and the remaining digits to failure. Generate N independent digits; estimated probability=number of coded successes/N. The coding works because the ten digits are equally likely.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	P(tails)=1-5/16=11/16. Expected tails=160×11/16=110.	**3**	M1 setup; M1 process; A1 conclusion.
6	Estimated probability=(37)/(100)=37/100. Prediction=(550)×that=204.	**3**	M1 setup; M1 process; A1 conclusion.
7	6x+1/5=1, so 6x=4/5 and x=2/15. The 3x outcome has probability 2/5 and is most likely.	**3**	M1 setup; M1 process; A1 conclusion.
8	Compare relative frequencies, but the estimate from 375 trials is generally more reliable because the larger unbiased sample is less affected by random variation.	**3**	M1 setup; M1 process; A1 conclusion.

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

MULTI-STEP HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
9	Expected winnings=£4/(8)=£0.5. Expected net=£-0.5. A fair monetary game has expected net 0; this one is unfavourable to the player.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
10	Expected frequency=np, so n=40/1/4=160 trials.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
11	Larger samples usually reduce random fluctuation, so relative frequency tends towards theoretical probability, but chance variation remains and exact equality is not guaranteed.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
12	Assign any 5 distinct digits to success and the remaining digits to failure. Generate N independent digits; estimated probability=number of coded successes/N. The coding works because the ten digits are equally likely.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
13	P(tails)=1-2/5=3/5. Expected tails=200×3/5=120.	**3**	M1 setup; M1 process; A1 conclusion.
14	Estimated probability=(45)/(116)=45/116. Prediction=(630)×that=244.	**3**	M1 setup; M1 process; A1 conclusion.
15	6x+1/5=1, so 6x=4/5 and x=2/15. The 3x outcome has probability 2/5 and is most likely.	**3**	M1 setup; M1 process; A1 conclusion.

MODULE 01 / P1-P5

Probability Foundations, Relative Frequency and Expectation

GRADE 7-9 CHALLENGE - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Compare relative frequencies, but the estimate from 415 trials is generally more reliable because the larger unbiased sample is less affected by random variation.	**3**	M1 setup; M1 process; A1 conclusion.
2	Expected winnings=£4/(6)=£0.667. Expected net=£-0.333. A fair monetary game has expected net 0; this one is unfavourable to the player.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	Expected frequency=np, so n=24/1/5=120 trials.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	Larger samples usually reduce random fluctuation, so relative frequency tends towards theoretical probability, but chance variation remains and exact equality is not guaranteed.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	Assign any 6 distinct digits to success and the remaining digits to failure. Generate N independent digits; estimated probability=number of coded successes/N. The coding works because the ten digits are equally likely.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	P(tails)=1-1/2=1/2. Expected tails=240×1/2=120.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
7	Estimated probability=(53)/(132)=53/132. Prediction=(710)×that=285.	**3**	M1 setup; M1 process; A1 conclusion.
8	6x+1/5=1, so 6x=4/5 and x=2/15. The 3x outcome has probability 2/5 and is most likely.	**3**	M1 setup; M1 process; A1 conclusion.
9	Compare relative frequencies, but the estimate from 455 trials is generally more reliable because the larger unbiased sample is less affected by random variation.	**3**	M1 setup; M1 process; A1 conclusion.
10	Expected winnings=£4/(9)=£0.444. Expected net=£-0.556. A fair monetary game has expected net 0; this one is unfavourable to the player.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

FLUENCY CHECK - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	There are 12 equally likely ordered pairs. The pairs with sum 4 number 3, so the probability is 1/4.	**2**	M1 method; A1 answer.
2	4 choices for the letter, then 10 choices and 9 choices without repetition: 4×10×9=360.	**3**	M1 setup; M1 process; A1 conclusion.
3	Independent stages give 5×6×4=120 combinations. Multiply because each earlier choice can be paired with every later choice.	**3**	M1 setup; M1 process; A1 conclusion.
4	Unordered pairs: [(1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (1, 7), (1, 8), (1, 9), (2, 3), (2, 4), (2, 5), (2, 6), (2, 7), (2, 8), (2, 9), (3, 4), (3, 5), (3, 6), (3, 7), (3, 8), (3, 9), (4, 5), (4, 6), (4, 7), (4, 8), (4, 9), (5, 6), (5, 7), (5, 8), (5, 9), (6, 7), (6, 8), (6, 9), (7, 8), (7, 9), (8, 9)]. Even-sum pairs: [(1, 3), (1, 5), (1, 7), (1, 9), (2, 4), (2, 6), (2, 8), (3, 5), (3, 7), (3, 9), (4, 6), (4, 8), (5, 7), (5, 9), (6, 8), (7, 9)]. Therefore P(even sum)=16/36=4/9.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	The 27 favourable ordered pairs are [(1, 2), (1, 4), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)]. Therefore P=27/36=3/4.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	Starter-main=27, starter-dessert=12, main-dessert=36. Total=75.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
7	Probability equals favourable/total only when listed elementary outcomes are equally likely. If not, attach the correct probability to each outcome or refine the space into equally likely cases.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	Letter choices are 10×9×8; digit choices are 10×9. Total=64800 codes.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

STANDARD HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	There are 36 equally likely ordered pairs. The pairs with sum 7 number 6, so the probability is 1/6.	**3**	M1 setup; M1 process; A1 conclusion.
2	7 choices for the letter, then 10 choices and 9 choices without repetition: 7×10×9=630.	**3**	M1 setup; M1 process; A1 conclusion.
3	Independent stages give 3×8×4=96 combinations. Multiply because each earlier choice can be paired with every later choice.	**3**	M1 setup; M1 process; A1 conclusion.
4	Unordered pairs: [(1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (1, 7), (2, 3), (2, 4), (2, 5), (2, 6), (2, 7), (3, 4), (3, 5), (3, 6), (3, 7), (4, 5), (4, 6), (4, 7), (5, 6), (5, 7), (6, 7)]. Even-sum pairs: [(1, 3), (1, 5), (1, 7), (2, 4), (2, 6), (3, 5), (3, 7), (4, 6), (5, 7)]. Therefore P(even sum)=9/21=3/7.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	The 27 favourable ordered pairs are [(1, 2), (1, 4), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)]. Therefore P=27/36=3/4.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	Starter-main=30, starter-dessert=42, main-dessert=35. Total=107.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

STANDARD HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
7	Probability equals favourable/total only when listed elementary outcomes are equally likely. If not, attach the correct probability to each outcome or refine the space into equally likely cases.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	Letter choices are 10×9×8; digit choices are 10×9. Total=64800 codes.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
9	There are 32 equally likely ordered pairs. The pairs with sum 5 number 4, so the probability is 1/8.	**3**	M1 setup; M1 process; A1 conclusion.
10	5 choices for the letter, then 10 choices and 9 choices without repetition: 5×10×9=450.	**3**	M1 setup; M1 process; A1 conclusion.
11	Independent stages give 6×4×4=96 combinations. Multiply because each earlier choice can be paired with every later choice.	**3**	M1 setup; M1 process; A1 conclusion.
12	Unordered pairs: [(1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (1, 7), (1, 8), (1, 9), (1, 10), (2, 3), (2, 4), (2, 5), (2, 6), (2, 7), (2, 8), (2, 9), (2, 10), (3, 4), (3, 5), (3, 6), (3, 7), (3, 8), (3, 9), (3, 10), (4, 5), (4, 6), (4, 7), (4, 8), (4, 9), (4, 10), (5, 6), (5, 7), (5, 8), (5, 9), (5, 10), (6, 7), (6, 8), (6, 9), (6, 10), (7, 8), (7, 9), (7, 10), (8, 9), (8, 10), (9, 10)]. Even-sum pairs: [(1, 3), (1, 5), (1, 7), (1, 9), (2, 4), (2, 6), (2, 8), (2, 10), (3, 5), (3, 7), (3, 9), (4, 6), (4, 8), (4, 10), (5, 7), (5, 9), (6, 8), (6, 10), (7, 9), (8, 10)]. Therefore P(even sum)=20/45=4/9.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

MULTI-STEP HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	The 27 favourable ordered pairs are [(1, 2), (1, 4), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)]. Therefore P=27/36=3/4.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
2	Starter-main=28, starter-dessert=20, main-dessert=35. Total=83.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	Probability equals favourable/total only when listed elementary outcomes are equally likely. If not, attach the correct probability to each outcome or refine the space into equally likely cases.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	Letter choices are 10×9×8; digit choices are 10×9. Total=64800 codes.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	There are 28 equally likely ordered pairs. The pairs with sum 8 number 4, so the probability is 1/7.	**3**	M1 setup; M1 process; A1 conclusion.
6	3 choices for the letter, then 10 choices and 9 choices without repetition: 3×10×9=270.	**3**	M1 setup; M1 process; A1 conclusion.
7	Independent stages give 4×6×4=96 combinations. Multiply because each earlier choice can be paired with every later choice.	**3**	M1 setup; M1 process; A1 conclusion.
8	Unordered pairs: [(1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (1, 7), (1, 8), (2, 3), (2, 4), (2, 5), (2, 6), (2, 7), (2, 8), (3, 4), (3, 5), (3, 6), (3, 7), (3, 8), (4, 5), (4, 6), (4, 7), (4, 8), (5, 6), (5, 7), (5, 8), (6, 7), (6, 8), (7, 8)]. Even-sum pairs: [(1, 3), (1, 5), (1, 7), (2, 4), (2, 6), (2, 8), (3, 5), (3, 7), (4, 6), (4, 8), (5, 7), (6, 8)]. Therefore P(even sum)=12/28=3/7.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

MULTI-STEP HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
9	The 27 favourable ordered pairs are [(1, 2), (1, 4), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)]. Therefore P=27/36=3/4.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
10	Starter-main=63, starter-dessert=56, main-dessert=72. Total=191.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
11	Probability equals favourable/total only when listed elementary outcomes are equally likely. If not, attach the correct probability to each outcome or refine the space into equally likely cases.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
12	Letter choices are 10×9×8; digit choices are 10×9. Total=64800 codes.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
13	There are 30 equally likely ordered pairs. The pairs with sum 6 number 5, so the probability is 1/6.	**3**	M1 setup; M1 process; A1 conclusion.
14	6 choices for the letter, then 10 choices and 9 choices without repetition: 6×10×9=540.	**3**	M1 setup; M1 process; A1 conclusion.
15	Independent stages give 7×8×4=224 combinations. Multiply because each earlier choice can be paired with every later choice.	**3**	M1 setup; M1 process; A1 conclusion.

MODULE 02 / P6,P7

Systematic Listing, Product Rule and Possibility Spaces

GRADE 7-9 CHALLENGE - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Unordered pairs: [(1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (2, 3), (2, 4), (2, 5), (2, 6), (3, 4), (3, 5), (3, 6), (4, 5), (4, 6), (5, 6)]. Even-sum pairs: [(1, 3), (1, 5), (2, 4), (2, 6), (3, 5), (4, 6)]. Therefore P(even sum)=6/15=2/5.	4	M1 setup; M1 development; A1 accuracy; A1 conclusion.
2	The 27 favourable ordered pairs are [(1, 2), (1, 4), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)]. Therefore P=27/36=3/4.	4	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	Starter-main=25, starter-dessert=30, main-dessert=30. Total=85.	4	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	Probability equals favourable/total only when listed elementary outcomes are equally likely. If not, attach the correct probability to each outcome or refine the space into equally likely cases.	4	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	Letter choices are 10×9×8; digit choices are 10×9. Total=64800 codes.	4	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	There are 24 equally likely ordered pairs. The pairs with sum 4 number 3, so the probability is 1/8.	4	M1 setup; M1 development; A1 accuracy; A1 conclusion.
7	4 choices for the letter, then 10 choices and 9 choices without repetition: 4×10×9=360.	3	M1 setup; M1 process; A1 conclusion.
8	Independent stages give 5×4×4=80 combinations. Multiply because each earlier choice can be paired with every later choice.	3	M1 setup; M1 process; A1 conclusion.
9	Unordered pairs: [(1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (1, 7), (1, 8), (1, 9), (2, 3), (2, 4), (2, 5), (2, 6), (2, 7), (2, 8), (2, 9), (3, 4), (3, 5), (3, 6), (3, 7), (3, 8), (3, 9), (4, 5), (4, 6), (4, 7), (4, 8), (4, 9), (5, 6), (5, 7), (5, 8), (5, 9), (6, 7), (6, 8), (6, 9), (7, 8), (7, 9), (8, 9)]. Even-sum pairs: [(1, 3), (1, 5), (1, 7), (1, 9), (2, 4), (2, 6), (2, 8), (3, 5), (3, 7), (3, 9), (4, 6), (4, 8), (5, 7), (5, 9), (6, 8), (7, 9)]. Therefore P(even sum)=16/36=4/9.	4	M1 setup; M1 development; A1 accuracy; A1 conclusion.

10	The 27 favourable ordered pairs are [(1, 2), (1, 4), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)]. Therefore P=27/36=3/4.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

FLUENCY CHECK - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	n(A∪B)=35+30-10=55. Neither=80-55=25.	**3**	M1 setup; M1 process; A1 conclusion.
2	P(A∪B)=P(A)+P(B)-P(A∩B)=5/8.	**3**	M1 setup; M1 process; A1 conclusion.
3	(x+2)+(2x-2)+10+7=59. Hence 3x=42, so x=14. The four region frequencies are 16, 26, 10 and 7; all are non-negative integers and sum to 59.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	P(A∩B)=P(A)+P(B)-P(A∪B)=0.7+0.6-0.6=0.7. The intersection must lie between max(0,P(A)+P(B)-1)=0.3 and min(P(A),P(B))=0.6; therefore the data are inconsistent.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	(A∩B′)∪(A′∩B), the symmetric difference. Shade the two non-overlap lenses and leave A∩B unshaded.	**3**	M1 setup; M1 process; A1 conclusion.
6	Add n(A)+n(B)+n(C), subtract each pairwise intersection, then add back n(A∩B∩C), because the triple region was added three times and subtracted three times.	**5**	M1 setup; M2–M4 development; A1 conclusion.
7	Mutually exclusive means A∩B=∅, so P(A∩B)=0. Substitute into P(A∪B)=P(A)+P(B)-P(A∩B).	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	B total=2/9+1/6=7/18. Thus B′=11/18, but stated P(B′)=5/12 is inconsistent. The data cannot form a valid exhaustive probability model; identify the contradiction before completing it.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

STANDARD HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Restrict the denominator to set B. $P(A'\|B)=n(A'\cap B)/n(B)$. The sample space changes because B is known to have occurred.	**5**	M1 setup; M2–M4 development; A1 conclusion.
2	$n(A\cup B)=44+39-11=72$. Neither$=116-72=44$.	**3**	M1 setup; M1 process; A1 conclusion.
3	$P(A\cup B)=P(A)+P(B)-P(A\cap B)=23/28$.	**3**	M1 setup; M1 process; A1 conclusion.
4	$(x+1)+(2x-3)+13+8=67$. Hence $3x=48$, so $x=16$. The four region frequencies are 17, 29, 13 and 8; all are non-negative integers and sum to 67.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	$P(A\cap B)=P(A)+P(B)-P(A\cup B)=0.4+0.5-0.6=0.3$. The intersection must lie between $\max(0,P(A)+P(B)-1)=0.0$ and $\min(P(A),P(B))=0.4$; therefore the data are valid.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	$(A\cap B')\cup(A'\cap B)$, the symmetric difference. Shade the two non-overlap lenses and leave $A\cap B$ unshaded.	**3**	M1 setup; M1 process; A1 conclusion.

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

STANDARD HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: ______________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
7	Add n(A)+n(B)+n(C), subtract each pairwise intersection, then add back n(A∩B∩C), because the triple region was added three times and subtracted three times.	**5**	M1 setup; M2–M4 development; A1 conclusion.
8	Mutually exclusive means A∩B=∅, so P(A∩B)=0. Substitute into P(A∪B)=P(A)+P(B)-P(A∩B).	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
9	B total=2/9+1/6=7/18. Thus B′=11/18, but stated P(B′)=5/12 is inconsistent. The data cannot form a valid exhaustive probability model; identify the contradiction before completing it.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
10	Restrict the denominator to set B. P(A′|B)=n(A′∩B)/n(B). The sample space changes because B is known to have occurred.	**5**	M1 setup; M2–M4 development; A1 conclusion.
11	n(A∪B)=53+33-12=74. Neither=152-74=78.	**3**	M1 setup; M1 process; A1 conclusion.
12	P(A∪B)=P(A)+P(B)-P(A∩B)=31/44.	**3**	M1 setup; M1 process; A1 conclusion.

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

MULTI-STEP HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	(x+0)+(2x-0)+10+5=69. Hence 3x=54, so x=18. The four region frequencies are 18, 36, 10 and 5; all are non-negative integers and sum to 69.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
2	P(A∩B)=P(A)+P(B)-P(A∪B)=0.5+0.4-0.6=0.3. The intersection must lie between max(0,P(A)+P(B)-1)=0.0 and min(P(A),P(B))=0.4; therefore the data are valid.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	(A∩B′)∪(A′∩B), the symmetric difference. Shade the two non-overlap lenses and leave A∩B unshaded.	**3**	M1 setup; M1 process; A1 conclusion.
4	Add n(A)+n(B)+n(C), subtract each pairwise intersection, then add back n(A∩B∩C), because the triple region was added three times and subtracted three times.	**5**	M1 setup; M2–M4 development; A1 conclusion.
5	Mutually exclusive means A∩B=∅, so P(A∩B)=0. Substitute into P(A∪B)=P(A)+P(B)-P(A∩B).	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	B total=2/9+1/6=7/18. Thus B′=11/18, but stated P(B′)=5/12 is inconsistent. The data cannot form a valid exhaustive probability model; identify the contradiction before completing it.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
7	Restrict the denominator to set B. P(A′|B)=n(A′∩B)/n(B). The sample space changes because B is known to have occurred.	**5**	M1 setup; M2–M4 development; A1 conclusion.
8	n(A∪B)=62+42-13=91. Neither=188-91=97.	**3**	M1 setup; M1 process; A1 conclusion.

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

MULTI-STEP HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
9	P(A∪B)=P(A)+P(B)-P(A∩B)=9/20.	**3**	M1 setup; M1 process; A1 conclusion.
10	(x+4)+(2x-1)+13+6=61. Hence 3x=39, so x=13. The four region frequencies are 17, 25, 13 and 6; all are non-negative integers and sum to 61.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
11	P(A∩B)=P(A)+P(B)-P(A∪B)=0.6+0.3-0.6=0.3. The intersection must lie between max(0,P(A)+P(B)-1)=0.0 and min(P(A),P(B))=0.3; therefore the data are valid.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
12	(A∩B′)∪(A′∩B), the symmetric difference. Shade the two non-overlap lenses and leave A∩B unshaded.	**3**	M1 setup; M1 process; A1 conclusion.
13	Add n(A)+n(B)+n(C), subtract each pairwise intersection, then add back n(A∩B∩C), because the triple region was added three times and subtracted three times.	**5**	M1 setup; M2–M4 development; A1 conclusion.
14	Mutually exclusive means A∩B=∅, so P(A∩B)=0. Substitute into P(A∪B)=P(A)+P(B)-P(A∩B).	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
15	B total=2/9+1/6=7/18. Thus B′=11/18, but stated P(B′)=5/12 is inconsistent. The data cannot form a valid exhaustive probability model; identify the contradiction before completing it.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 03 / P6,P9

Venn Diagrams, Set Notation and Inclusion-Exclusion

GRADE 7-9 CHALLENGE - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Restrict the denominator to set B. $P(A'\|B)=n(A'\cap B)/n(B)$. The sample space changes because B is known to have occurred.	**5**	M1 setup; M2–M4 development; A1 conclusion.
2	$n(A\cup B)=71+36-14=93$. Neither$=224-93=131$.	**3**	M1 setup; M1 process; A1 conclusion.
3	$P(A\cup B)=P(A)+P(B)-P(A\cap B)=7/12$.	**3**	M1 setup; M1 process; A1 conclusion.
4	$(x+3)+(2x-2)+10+7=63$. Hence $3x=45$, so $x=15$. The four region frequencies are 18, 28, 10 and 7; all are non-negative integers and sum to 63.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	$P(A\cap B)=P(A)+P(B)-P(A\cup B)=0.7+0.7-0.6=0.8$. The intersection must lie between $\max(0,P(A)+P(B)-1)=0.4$ and $\min(P(A),P(B))=0.7$; therefore the data are inconsistent.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	$(A\cap B')\cup(A'\cap B)$, the symmetric difference. Shade the two non-overlap lenses and leave $A\cap B$ unshaded.	**3**	M1 setup; M1 process; A1 conclusion.
7	Add $n(A)+n(B)+n(C)$, subtract each pairwise intersection, then add back $n(A\cap B\cap C)$, because the triple region was added three times and subtracted three times.	**5**	M1 setup; M2–M4 development; A1 conclusion.
8	Mutually exclusive means $A\cap B=\varnothing$, so $P(A\cap B)=0$. Substitute into $P(A\cup B)=P(A)+P(B)-P(A\cap B)$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
9	B total$=2/9+1/6=7/18$. Thus $B'=11/18$, but stated $P(B')=5/12$ is inconsistent. The data cannot form a valid exhaustive probability model; identify the contradiction before completing it.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
10	Restrict the denominator to set B. $P(A'\|B)=n(A'\cap B)/n(B)$. The sample space changes because B is known to have occurred.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

FLUENCY CHECK - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Adult members=25. Child members=20. Adult non-members=35. Final cell=120-sum of the other three.	**3**	M1 setup; M1 process; A1 conclusion.
2	P(A|female)=(31)/(81); P(A|male)=(21)/(71). Convert consistently and compare; denominators are the relevant row totals.	**3**	M1 setup; M1 process; A1 conclusion.
3	Passes=130×37/100. Premium passes=that×10/100=4.81.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	x+(2x+13)=238, so 3x=225 and x=75. Splitting 75 in the ratio 3:2 gives 45 and 30.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	The table shows association in observed frequencies. Conditional probability compares subgroups, but confounding variables, selection bias and chance may explain the association; causation needs stronger evidence.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	n(A)=145×4/5. Then n(A∩B)=n(A)×1/2=58.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
7	Use each row total and column total to express missing cells. Equate the two expressions for the final cell or use the grand total, solve for x, then verify all row/column sums and non-negative integer frequencies.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	Different subgroup sizes can weight the subgroup rates differently, producing an aggregate reversal or masking. Display counts and conditional percentages for each subgroup rather than comparing only overall percentages.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

STANDARD HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Adult members=33. Child members=20. Adult non-members=35. Final cell=160-sum of the other three.	**3**	M1 setup; M1 process; A1 conclusion.
2	P(A|female)=(39)/(89); P(A|male)=(20)/(79). Convert consistently and compare; denominators are the relevant row totals.	**3**	M1 setup; M1 process; A1 conclusion.
3	Passes=170×45/100. Premium passes=that×8/100=6.12.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	x+(2x+21)=246, so 3x=225 and x=75. Splitting 75 in the ratio 3:2 gives 45 and 30.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	The table shows association in observed frequencies. Conditional probability compares subgroups, but confounding variables, selection bias and chance may explain the association; causation needs stronger evidence.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	n(A)=185×3/5. Then n(A∩B)=n(A)×1/2=111/2.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

STANDARD HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
7	Use each row total and column total to express missing cells. Equate the two expressions for the final cell or use the grand total, solve for x, then verify all row/column sums and non-negative integer frequencies.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	Different subgroup sizes can weight the subgroup rates differently, producing an aggregate reversal or masking. Display counts and conditional percentages for each subgroup rather than comparing only overall percentages.	**5**	M1 setup; M2–M4 development; A1 conclusion.
9	Adult members=26. Child members=35. Adult non-members=50. Final cell=200-sum of the other three.	**3**	M1 setup; M1 process; A1 conclusion.
10	P(A|female)=(47)/(97); P(A|male)=(28)/(87). Convert consistently and compare; denominators are the relevant row totals.	**3**	M1 setup; M1 process; A1 conclusion.
11	Passes=210×53/100. Premium passes=that×11/100=12.2.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
12	x+(2x+29)=254, so 3x=225 and x=75. Splitting 75 in the ratio 3:2 gives 45 and 30.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

MULTI-STEP HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	The table shows association in observed frequencies. Conditional probability compares subgroups, but confounding variables, selection bias and chance may explain the association; causation needs stronger evidence.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
2	n(A)=225×2/5. Then n(A∩B)=n(A)×1/2=45.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	Use each row total and column total to express missing cells. Equate the two expressions for the final cell or use the grand total, solve for x, then verify all row/column sums and non-negative integer frequencies.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	Different subgroup sizes can weight the subgroup rates differently, producing an aggregate reversal or masking. Display counts and conditional percentages for each subgroup rather than comparing only overall percentages.	**5**	M1 setup; M2–M4 development; A1 conclusion.
5	Adult members=34. Child members=35. Adult non-members=50. Final cell=240-sum of the other three.	**3**	M1 setup; M1 process; A1 conclusion.
6	P(A|female)=(55)/(105); P(A|male)=(27)/(95). Convert consistently and compare; denominators are the relevant row totals.	**3**	M1 setup; M1 process; A1 conclusion.
7	Passes=250×61/100. Premium passes=that×9/100=13.7.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	x+(2x+37)=262, so 3x=225 and x=75. Splitting 75 in the ratio 3:2 gives 45 and 30.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

MULTI-STEP HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
9	The table shows association in observed frequencies. Conditional probability compares subgroups, but confounding variables, selection bias and chance may explain the association; causation needs stronger evidence.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
10	n(A)=265×4/5. Then n(A∩B)=n(A)×1/2=106.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
11	Use each row total and column total to express missing cells. Equate the two expressions for the final cell or use the grand total, solve for x, then verify all row/column sums and non-negative integer frequencies.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
12	Different subgroup sizes can weight the subgroup rates differently, producing an aggregate reversal or masking. Display counts and conditional percentages for each subgroup rather than comparing only overall percentages.	**5**	M1 setup; M2–M4 development; A1 conclusion.
13	Adult members=27. Child members=50. Adult non-members=65. Final cell=280-sum of the other three.	**3**	M1 setup; M1 process; A1 conclusion.
14	P(A|female)=(63)/(113); P(A|male)=(26)/(103). Convert consistently and compare; denominators are the relevant row totals.	**3**	M1 setup; M1 process; A1 conclusion.
15	Passes=290×69/100. Premium passes=that×12/100=24.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 04 / P1,P6,P9

Two-way Tables, Frequency Trees and Expected Frequencies

GRADE 7-9 CHALLENGE - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	x+(2x+45)=270, so 3x=225 and x=75. Splitting 75 in the ratio 3:2 gives 45 and 30.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
2	The table shows association in observed frequencies. Conditional probability compares subgroups, but confounding variables, selection bias and chance may explain the association; causation needs stronger evidence.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	n(A)=305×3/5. Then n(A∩B)=n(A)×1/2=183/2.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	Use each row total and column total to express missing cells. Equate the two expressions for the final cell or use the grand total, solve for x, then verify all row/column sums and non-negative integer frequencies.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	Different subgroup sizes can weight the subgroup rates differently, producing an aggregate reversal or masking. Display counts and conditional percentages for each subgroup rather than comparing only overall percentages.	**5**	M1 setup; M2–M4 development; A1 conclusion.
6	Adult members=35. Child members=50. Adult non-members=65. Final cell=320-sum of the other three.	**3**	M1 setup; M1 process; A1 conclusion.
7	P(A|female)=(71)/(121); P(A|male)=(25)/(111). Convert consistently and compare; denominators are the relevant row totals.	**3**	M1 setup; M1 process; A1 conclusion.
8	Passes=330×77/100. Premium passes=that×10/100=25.4.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
9	x+(2x+53)=278, so 3x=225 and x=75. Splitting 75 in the ratio 3:2 gives 45 and 30.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
10	The table shows association in observed frequencies. Conditional probability compares subgroups, but confounding variables, selection bias and chance may explain the association; causation needs stronger evidence.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

FLUENCY CHECK - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Multiply along the branch: $(3/8)^2=9/64$.	**2**	M1 method; A1 answer.
2	Intersection$=2/5\times2/5=4/25$. Union$=16/25$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	There are $C(3,2)=3$ orders. Probability$=3(5/12)^2(7/12)=175/576$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	Use the complement: $1\text{-}P(\text{no successes})=1\text{-}(4/7)^6=113553/117649$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	$P(+)=P(D)P(+\|D)+P(D')P(+\|D')=(2/100)(74/100)+(98/100)(8/100)$.	**5**	M1 setup; M2–M4 development; A1 conclusion.
6	Independence gives $P(A\cap B)=P(A)P(B)$, so $P(B)=3/4$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
7	Check whether $P(A\cap B)=P(A)P(B)$, equivalently $P(A\|B)=P(A)$ when defined. Non-zero mutually exclusive events have $P(A\cap B)=0$ but $P(A)P(B)>0$, so they are not independent.	**5**	M1 setup; M2–M4 development; A1 conclusion.
8	The first 4 rounds are losses, then a win: $(5/9)^4(4/9)=2500/59049$.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

STANDARD HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Multiply along the branch: $(5/11)^2=25/121$.	**2**	M1 method; A1 answer.
2	Intersection$=6/13\times2/5=12/65$. Union$=44/65$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	There are $C(3,2)=3$ orders. Probability$=3(7/15)^2(8/15)=392/1125$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	Use the complement: $1-P(\text{no successes})=1-(9/17)^6=23606128/24137569$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	$P(+)=P(D)P(+\|D)+P(D')P(+\|D')=(2/100)(82/100)+(98/100)(4/100)$.	**5**	M1 setup; M2–M4 development; A1 conclusion.
6	Independence gives $P(A\cap B)=P(A)P(B)$, so $P(B)=1/2$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

STANDARD HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
7	Check whether P(A∩B)=P(A)P(B), equivalently P(A|B)=P(A) when defined. Non-zero mutually exclusive events have P(A∩B)=0 but P(A)P(B)>0, so they are not independent.	**5**	M1 setup; M2–M4 development; A1 conclusion.
8	The first 2 rounds are losses, then a win: (1/2)^2(1/2)=1/8.	**5**	M1 setup; M2–M4 development; A1 conclusion.
9	Multiply along the branch: $(1/2)^2=1/4$.	**2**	M1 method; A1 answer.
10	Intersection=1/2×2/5=1/5. Union=7/10.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
11	There are C(3,2)=3 orders. Probability=$3(1/4)^2(3/4)=9/64$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
12	Use the complement: 1-P(no successes)=1-(5/7)^6=102024/117649.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

MULTI-STEP HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	P(+)=P(D)P(+|D)+P(D′)P(+|D′)=(2/100)(70/100)+(98/100)(6/100).	**5**	M1 setup; M2–M4 development; A1 conclusion.
2	Independence gives P(A∩B)=P(A)P(B), so P(B)=1/4.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	Check whether P(A∩B)=P(A)P(B), equivalently P(A|B)=P(A) when defined. Non-zero mutually exclusive events have P(A∩B)=0 but P(A)P(B)>0, so they are not independent.	**5**	M1 setup; M2–M4 development; A1 conclusion.
4	The first 5 rounds are losses, then a win: (7/15)^5(8/15)=134456/11390625.	**5**	M1 setup; M2–M4 development; A1 conclusion.
5	Multiply along the branch: $(3/11)^2$=9/121.	**2**	M1 method; A1 answer.
6	Intersection=4/13×2/5=8/65. Union=38/65.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
7	There are C(3,2)=3 orders. Probability=$3(1/3)^2(2/3)$=2/9.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	Use the complement: 1-P(no successes)=1-(11/17)^6=22366008/24137569.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

MULTI-STEP HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
9	P(+)=P(D)P(+|D)+P(D′)P(+|D′)=(2/100)(78/100)+(98/100)(8/100).	**5**	M1 setup; M2–M4 development; A1 conclusion.
10	Independence gives P(A∩B)=P(A)P(B), so P(B)=3/4.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
11	Check whether P(A∩B)=P(A)P(B), equivalently P(A|B)=P(A) when defined. Non-zero mutually exclusive events have P(A∩B)=0 but P(A)P(B)>0, so they are not independent.	**5**	M1 setup; M2–M4 development; A1 conclusion.
12	The first 3 rounds are losses, then a win: (2/3)^3(1/3)=8/81.	**5**	M1 setup; M2–M4 development; A1 conclusion.
13	Multiply along the branch: $(5/14)^2$=25/196.	**2**	M1 method; A1 answer.
14	Intersection=3/8×2/5=3/20. Union=5/8.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
15	There are C(3,2)=3 orders. Probability=$3(7/18)^2(11/18)$=539/1944.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 05 / P8

Independent Events, Repeated Trials and Complements

GRADE 7-9 CHALLENGE - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Use the complement: 1-P(no successes)=1-(5/13)^6=4811184/4826809.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
2	P(+)=P(D)P(+|D)+P(D′)P(+|D′)=(2/100)(86/100)+(98/100)(4/100).	**5**	M1 setup; M2–M4 development; A1 conclusion.
3	Independence gives P(A∩B)=P(A)P(B), so P(B)=1/2.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	Check whether P(A∩B)=P(A)P(B), equivalently P(A|B)=P(A) when defined. Non-zero mutually exclusive events have P(A∩B)=0 but P(A)P(B)>0, so they are not independent.	**5**	M1 setup; M2–M4 development; A1 conclusion.
5	The first 6 rounds are losses, then a win: (3/5)^6(2/5)=1458/78125.	**5**	M1 setup; M2–M4 development; A1 conclusion.
6	Multiply along the branch: $(7/17)^2$=49/289.	**2**	M1 method; A1 answer.
7	Intersection=8/19×2/5=16/95. Union=62/95.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	There are C(3,2)=3 orders. Probability=$3(3/8)^2(5/8)$=135/512.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
9	Use the complement: 1-P(no successes)=1-(3/5)^6=14896/15625.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
10	P(+)=P(D)P(+|D)+P(D′)P(+|D′)=(2/100)(74/100)+(98/100)(6/100).	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

FLUENCY CHECK - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	3/8×2/7=3/28.	**3**	M1 setup; M1 process; A1 conclusion.
2	RB or BR: 4/10×6/9+6/10×4/9=8/15.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	P(RRR)+P(BBB)=C(5,3)/C(12,3)+C(7,3)/C(12,3)=9/44.	**5**	M1 setup; M2–M4 development; A1 conclusion.
4	x/(x+8)×(x-1)/(x+8-1)=1/6. Cross-multiply, solve the resulting quadratic, and retain only a positive integer solution consistent with the bag.	**5**	M1 setup; M2–M4 development; A1 conclusion.
5	Complement: 1-P(no defective)=1-[9/16×8/15]=7/10.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	The process is dependent. After red, the bag has r red and b+2 blue; after blue, it has r+2 red and b blue. Put these conditional fractions on the corresponding second branches.	**5**	M1 setup; M2–M4 development; A1 conclusion.
7	With replacement, composition and branch probabilities stay constant and draws are independent. Without replacement, totals and colour counts change, so second probabilities depend on the first result.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	First two must be B then A: 5/9×4/8×4/7=10/63.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

STANDARD HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	5/11×4/10=2/11.	**3**	M1 setup; M1 process; A1 conclusion.
2	RB or BR: 6/13×7/12+7/13×6/12=7/13.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	P(RRR)+P(BBB)=C(7,3)/C(15,3)+C(8,3)/C(15,3)=1/5.	**5**	M1 setup; M2–M4 development; A1 conclusion.
4	x/(x+9)×(x-1)/(x+9-1)=1/6. Cross-multiply, solve the resulting quadratic, and retain only a positive integer solution consistent with the bag.	**5**	M1 setup; M2–M4 development; A1 conclusion.
5	Complement: 1-P(no defective)=1-[10/13×9/12]=11/26.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	The process is dependent. After red, the bag has r red and b+2 blue; after blue, it has r+2 red and b blue. Put these conditional fractions on the corresponding second branches.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

STANDARD HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
7	With replacement, composition and branch probabilities stay constant and draws are independent. Without replacement, totals and colour counts change, so second probabilities depend on the first result.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	First two must be B then A: 6/12×5/11×6/10=3/22.	**5**	M1 setup; M2–M4 development; A1 conclusion.
9	7/14×6/13=3/13.	**3**	M1 setup; M1 process; A1 conclusion.
10	RB or BR: 8/16×8/15+8/16×8/15=8/15.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
11	P(RRR)+P(BBB)=C(3,3)/C(12,3)+C(9,3)/C(12,3)=17/44.	**5**	M1 setup; M2–M4 development; A1 conclusion.
12	x/(x+10)×(x-1)/(x+10-1)=1/6. Cross-multiply, solve the resulting quadratic, and retain only a positive integer solution consistent with the bag.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

MULTI-STEP HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Complement: 1-P(no defective)=1-[11/16×10/15]=13/24.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
2	The process is dependent. After red, the bag has r red and b+2 blue; after blue, it has r+2 red and b blue. Put these conditional fractions on the corresponding second branches.	**5**	M1 setup; M2–M4 development; A1 conclusion.
3	With replacement, composition and branch probabilities stay constant and draws are independent. Without replacement, totals and colour counts change, so second probabilities depend on the first result.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	First two must be B then A: 7/15×6/14×8/13=8/65.	**5**	M1 setup; M2–M4 development; A1 conclusion.
5	3/11×2/10=3/55.	**3**	M1 setup; M1 process; A1 conclusion.
6	RB or BR: 4/13×9/12+9/13×4/12=6/13.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
7	P(RRR)+P(BBB)=C(5,3)/C(15,3)+C(10,3)/C(15,3)=2/7.	**5**	M1 setup; M2–M4 development; A1 conclusion.
8	x/(x+11)×(x-1)/(x+11-1)=1/6. Cross-multiply, solve the resulting quadratic, and retain only a positive integer solution consistent with the bag.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

MULTI-STEP HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
9	Complement: 1-P(no defective)=1-[5/12×4/11]=28/33.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
10	The process is dependent. After red, the bag has r red and b+2 blue; after blue, it has r+2 red and b blue. Put these conditional fractions on the corresponding second branches.	**5**	M1 setup; M2–M4 development; A1 conclusion.
11	With replacement, composition and branch probabilities stay constant and draws are independent. Without replacement, totals and colour counts change, so second probabilities depend on the first result.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
12	First two must be B then A: 8/12×7/11×4/10=28/165.	**5**	M1 setup; M2–M4 development; A1 conclusion.
13	5/14×4/13=10/91.	**3**	M1 setup; M1 process; A1 conclusion.
14	RB or BR: 6/16×10/15+10/16×6/15=1/2.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
15	P(RRR)+P(BBB)=C(7,3)/C(18,3)+C(11,3)/C(18,3)=25/102.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 06 / P8,P9

Dependent Events and Sampling Without Replacement

GRADE 7-9 CHALLENGE - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	x/(x+5)×(x-1)/(x+5-1)=1/6. Cross-multiply, solve the resulting quadratic, and retain only a positive integer solution consistent with the bag.	**5**	M1 setup; M2–M4 development; A1 conclusion.
2	Complement: 1-P(no defective)=1-[6/9×5/8]=7/12.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	The process is dependent. After red, the bag has r red and b+2 blue; after blue, it has r+2 red and b blue. Put these conditional fractions on the corresponding second branches.	**5**	M1 setup; M2–M4 development; A1 conclusion.
4	With replacement, composition and branch probabilities stay constant and draws are independent. Without replacement, totals and colour counts change, so second probabilities depend on the first result.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	First two must be B then A: 9/15×8/14×6/13=72/455.	**5**	M1 setup; M2–M4 development; A1 conclusion.
6	7/17×6/16=21/136.	**3**	M1 setup; M1 process; A1 conclusion.
7	RB or BR: 8/19×11/18+11/19×8/18=88/171.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	P(RRR)+P(BBB)=C(3,3)/C(8,3)+C(5,3)/C(8,3)=11/56.	**5**	M1 setup; M2–M4 development; A1 conclusion.
9	x/(x+6)×(x-1)/(x+6-1)=1/6. Cross-multiply, solve the resulting quadratic, and retain only a positive integer solution consistent with the bag.	**5**	M1 setup; M2–M4 development; A1 conclusion.
10	Complement: 1-P(no defective)=1-[7/12×6/11]=15/22.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

FLUENCY CHECK - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	P(A|B)=n(A∩B)/n(B)=15/45=1/3.	**3**	M1 setup; M1 process; A1 conclusion.
2	P(A∩B)=2/5×3/7=6/35. P(B)=6/35+3/5×1/4=9/28. Therefore P(A|B)=(6/35)/(9/28)=8/15.	**5**	M1 setup; M2–M4 development; A1 conclusion.
3	P(trained|success)=trained successes/all successes=(32)/[32+22].	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	P(A|B)=(1/6)/(5/12)=2/5. This equals P(A), so the data are consistent with independence.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	Sensitivity is P(+|D). The requested reverse conditional is P(D|+), which also depends on disease prevalence and false positives. Use an expected-frequency table, e.g. out of 10,000, then diseased positives/all positives.	**5**	M1 setup; M2–M4 development; A1 conclusion.
6	P(A)=P(A|B)P(B)+P(A|B′)P(B′)=1/3×3/5+1/8×2/5=1/4.	**5**	M1 setup; M2–M4 development; A1 conclusion.
7	Choose a convenient total, multiply down branches to obtain expected counts, then restrict to the conditioning group. Conditional probability becomes desired count/conditioning count, making the changed denominator explicit.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	Both sides equal P(A∩B) by the multiplication rule. This identity underlies reversal of conditional probability.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

STANDARD HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	P(A|B)=n(A∩B)/n(B)=23/53=23/53.	**3**	M1 setup; M1 process; A1 conclusion.
2	P(A∩B)=2/5×3/7=6/35. P(B)=6/35+3/5×1/4=9/28. Therefore P(A|B)=(6/35)/(9/28)=8/15.	**5**	M1 setup; M2–M4 development; A1 conclusion.
3	P(trained|success)=trained successes/all successes=(40)/[40+30].	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	P(A|B)=(1/6)/(5/12)=2/5. This equals P(A), so the data are consistent with independence.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	Sensitivity is P(+|D). The requested reverse conditional is P(D|+), which also depends on disease prevalence and false positives. Use an expected-frequency table, e.g. out of 10,000, then diseased positives/all positives.	**5**	M1 setup; M2–M4 development; A1 conclusion.
6	P(A)=P(A|B)P(B)+P(A|B′)P(B′)=1/3×3/5+1/8×2/5=1/4.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

STANDARD HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
7	Choose a convenient total, multiply down branches to obtain expected counts, then restrict to the conditioning group. Conditional probability becomes desired count/conditioning count, making the changed denominator explicit.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	Both sides equal P(A∩B) by the multiplication rule. This identity underlies reversal of conditional probability.	**5**	M1 setup; M2–M4 development; A1 conclusion.
9	P(A|B)=n(A∩B)/n(B)=21/61=21/61.	**3**	M1 setup; M1 process; A1 conclusion.
10	P(A∩B)=2/5×3/7=6/35. P(B)=6/35+3/5×1/4=9/28. Therefore P(A|B)=(6/35)/(9/28)=8/15.	**5**	M1 setup; M2–M4 development; A1 conclusion.
11	P(trained|success)=trained successes/all successes=(48)/[48+26].	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
12	P(A|B)=(1/6)/(5/12)=2/5. This equals P(A), so the data are consistent with independence.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

MULTI-STEP HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Sensitivity is P(+|D). The requested reverse conditional is P(D|+), which also depends on disease prevalence and false positives. Use an expected-frequency table, e.g. out of 10,000, then diseased positives/all positives.	**5**	M1 setup; M2–M4 development; A1 conclusion.
2	$P(A)=P(A\|B)P(B)+P(A\|B')P(B')=1/3\times3/5+1/8\times2/5=1/4$.	**5**	M1 setup; M2–M4 development; A1 conclusion.
3	Choose a convenient total, multiply down branches to obtain expected counts, then restrict to the conditioning group. Conditional probability becomes desired count/conditioning count, making the changed denominator explicit.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	Both sides equal $P(A\cap B)$ by the multiplication rule. This identity underlies reversal of conditional probability.	**5**	M1 setup; M2–M4 development; A1 conclusion.
5	$P(A\|B)=n(A\cap B)/n(B)=19/49=19/49$.	**3**	M1 setup; M1 process; A1 conclusion.
6	$P(A\cap B)=2/5\times3/7=6/35$. $P(B)=6/35+3/5\times1/4=9/28$. Therefore $P(A\|B)=(6/35)/(9/28)=8/15$.	**5**	M1 setup; M2–M4 development; A1 conclusion.
7	P(trained|success)=trained successes/all successes=(56)/[56+22].	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	$P(A\|B)=(1/6)/(5/12)=2/5$. This equals P(A), so the data are consistent with independence.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

MULTI-STEP HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
9	Sensitivity is P(+|D). The requested reverse conditional is P(D|+), which also depends on disease prevalence and false positives. Use an expected-frequency table, e.g. out of 10,000, then diseased positives/all positives.	**5**	M1 setup; M2–M4 development; A1 conclusion.
10	P(A)=P(A|B)P(B)+P(A|B′)P(B′)=1/3×3/5+1/8×2/5=1/4.	**5**	M1 setup; M2–M4 development; A1 conclusion.
11	Choose a convenient total, multiply down branches to obtain expected counts, then restrict to the conditioning group. Conditional probability becomes desired count/conditioning count, making the changed denominator explicit.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
12	Both sides equal P(A∩B) by the multiplication rule. This identity underlies reversal of conditional probability.	**5**	M1 setup; M2–M4 development; A1 conclusion.
13	P(A|B)=n(A∩B)/n(B)=17/57=17/57.	**3**	M1 setup; M1 process; A1 conclusion.
14	P(A∩B)=2/5×3/7=6/35. P(B)=6/35+3/5×1/4=9/28. Therefore P(A|B)=(6/35)/(9/28)=8/15.	**5**	M1 setup; M2–M4 development; A1 conclusion.
15	P(trained|success)=trained successes/all successes=(64)/[64+30].	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 07 / P9

Conditional Probability and Reverse Conditionals

GRADE 7-9 CHALLENGE - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	P(A|B)=(1/6)/(5/12)=2/5. This equals P(A), so the data are consistent with independence.	4	M1 setup; M1 development; A1 accuracy; A1 conclusion.
2	Sensitivity is P(+|D). The requested reverse conditional is P(D|+), which also depends on disease prevalence and false positives. Use an expected-frequency table, e.g. out of 10,000, then diseased positives/all positives.	5	M1 setup; M2–M4 development; A1 conclusion.
3	P(A)=P(A|B)P(B)+P(A|B′)P(B′)=1/3×3/5+1/8×2/5=1/4.	5	M1 setup; M2–M4 development; A1 conclusion.
4	Choose a convenient total, multiply down branches to obtain expected counts, then restrict to the conditioning group. Conditional probability becomes desired count/conditioning count, making the changed denominator explicit.	4	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	Both sides equal P(A∩B) by the multiplication rule. This identity underlies reversal of conditional probability.	5	M1 setup; M2–M4 development; A1 conclusion.
6	P(A|B)=n(A∩B)/n(B)=15/45=1/3.	3	M1 setup; M1 process; A1 conclusion.
7	P(A∩B)=2/5×3/7=6/35. P(B)=6/35+3/5×1/4=9/28. Therefore P(A|B)=(6/35)/(9/28)=8/15.	5	M1 setup; M2–M4 development; A1 conclusion.
8	P(trained|success)=trained successes/all successes=(72)/[72+26].	4	M1 setup; M1 development; A1 accuracy; A1 conclusion.
9	P(A|B)=(1/6)/(5/12)=2/5. This equals P(A), so the data are consistent with independence.	4	M1 setup; M1 development; A1 accuracy; A1 conclusion.
10	Sensitivity is P(+|D). The requested reverse conditional is P(D|+), which also depends on disease prevalence and false positives. Use an expected-frequency table, e.g. out of 10,000, then diseased positives/all positives.	5	M1 setup; M2–M4 development; A1 conclusion.

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

FLUENCY CHECK - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	$x^2=1/9$. Since $0\le x\le 1$, $x=1/3$.	**3**	M1 setup; M1 process; A1 conclusion.
2	$x/(x+9)=2/5$; $5x=2x+18$; $x=6$ counters.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	$1-(1-x)^2=1/2$; $(1-x)^2=1/2$; $x=1-\sqrt{(1/2)}$, taking $0\le x\le 1$.	**5**	M1 setup; M2–M4 development; A1 conclusion.
4	$4x+0.3=1$, so $x=0.175$. Probabilities are 0.175,0.275,0.35,0.2; all lie in [0,1] and sum to 1.	**3**	M1 setup; M1 process; A1 conclusion.
5	$7/(x+7)\times 6/(x+7-1)=7/16$. Cross-multiply, solve the quadratic, then reject non-positive/non-integer roots.	**5**	M1 setup; M2–M4 development; A1 conclusion.
6	$x+(x+1/5)-x(x+1/5)=3/5$. Rearrange to a quadratic. Keep only roots satisfying $0\le x\le 1$ and $0\le x+1/5\le 1$.	**5**	M1 setup; M2–M4 development; A1 conclusion.
7	Algebra may produce extraneous probability roots or non-integer object counts. Substitute into the original model; probabilities must lie in [0,1], denominators must be non-zero, and counts must be non-negative integers.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	Expected net$=(5)x-2(1-x)=0$. $(7)x=2$, so $x=2/7=2/7$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

STANDARD HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	$x^2=1/16$. Since $0\le x\le 1$, $x=1/4$.	**3**	M1 setup; M1 process; A1 conclusion.
2	$x/(x+9)=2/5$; $5x=2x+18$; $x=6$ counters.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	$1-(1-x)^2=3/5$; $(1-x)^2=2/5$; $x=1-\sqrt{(2/5)}$, taking $0\le x\le 1$.	**5**	M1 setup; M2–M4 development; A1 conclusion.
4	$4x+0.3=1$, so $x=0.175$. Probabilities are 0.175,0.275,0.35,0.2; all lie in [0,1] and sum to 1.	**3**	M1 setup; M1 process; A1 conclusion.
5	$8/(x+8)\times 7/(x+8-1)=4/9$. Cross-multiply, solve the quadratic, then reject non-positive/non-integer roots.	**5**	M1 setup; M2–M4 development; A1 conclusion.
6	$x+(x+1/5)-x(x+1/5)=3/5$. Rearrange to a quadratic. Keep only roots satisfying $0\le x\le 1$ and $0\le x+1/5\le 1$.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

STANDARD HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
7	Algebra may produce extraneous probability roots or non-integer object counts. Substitute into the original model; probabilities must lie in [0,1], denominators must be non-zero, and counts must be non-negative integers.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	Expected net=(6)x-2(1-x)=0. (8)x=2, so x=2/8=1/4.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
9	$x^2=1/25$. Since $0\le x\le 1$, $x=1/5$.	**3**	M1 setup; M1 process; A1 conclusion.
10	x/(x+9)=2/5; 5x=2x+18; x=6 counters.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
11	$1-(1-x)^2=7/10$; $(1-x)^2=3/10$; $x=1-\sqrt{3/10}$, taking $0\le x\le 1$.	**5**	M1 setup; M2–M4 development; A1 conclusion.
12	4x+0.3=1, so x=0.175. Probabilities are 0.175,0.275,0.35,0.2; all lie in [0,1] and sum to 1.	**3**	M1 setup; M1 process; A1 conclusion.

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

MULTI-STEP HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: ______________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	9/(x+9)×8/(x+9-1)=9/20. Cross-multiply, solve the quadratic, then reject non-positive/non-integer roots.	**5**	M1 setup; M2–M4 development; A1 conclusion.
2	x+(x+1/5)-x(x+1/5)=3/5. Rearrange to a quadratic. Keep only roots satisfying 0≤x≤1 and 0≤x+1/5≤1.	**5**	M1 setup; M2–M4 development; A1 conclusion.
3	Algebra may produce extraneous probability roots or non-integer object counts. Substitute into the original model; probabilities must lie in [0,1], denominators must be non-zero, and counts must be non-negative integers.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	Expected net=(7)x-2(1-x)=0. (9)x=2, so x=2/9=2/9.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	x^2=1/36. Since 0≤x≤1, x=1/6.	**3**	M1 setup; M1 process; A1 conclusion.
6	x/(x+9)=2/5; 5x=2x+18; x=6 counters.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
7	1-$(1-x)^2$=4/5; $(1-x)^2$=1/5; x=1-√(1/5), taking 0≤x≤1.	**5**	M1 setup; M2–M4 development; A1 conclusion.
8	4x+0.3=1, so x=0.175. Probabilities are 0.175,0.275,0.35,0.2; all lie in [0,1] and sum to 1.	**3**	M1 setup; M1 process; A1 conclusion.

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

MULTI-STEP HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
9	$3/(x+3)\times 2/(x+3-1)=3/8$. Cross-multiply, solve the quadratic, then reject non-positive/non-integer roots.	**5**	M1 setup; M2–M4 development; A1 conclusion.
10	$x+(x+1/5)-x(x+1/5)=3/5$. Rearrange to a quadratic. Keep only roots satisfying $0\le x\le 1$ and $0\le x+1/5\le 1$.	**5**	M1 setup; M2–M4 development; A1 conclusion.
11	Algebra may produce extraneous probability roots or non-integer object counts. Substitute into the original model; probabilities must lie in $[0,1]$, denominators must be non-zero, and counts must be non-negative integers.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
12	Expected net$=(8)x-2(1-x)=0$. $(10)x=2$, so $x=2/10=1/5$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
13	$x^2=1/49$. Since $0\le x\le 1$, $x=1/7$.	**3**	M1 setup; M1 process; A1 conclusion.
14	$x/(x+9)=2/5$; $5x=2x+18$; $x=6$ counters.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
15	$1-(1-x)^2=9/10$; $(1-x)^2=1/10$; $x=1-\sqrt{1/10}$, taking $0\le x\le 1$.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 08 / P4,P8,P9

Algebraic Probability and Model Constraints

GRADE 7-9 CHALLENGE - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	4x+0.3=1, so x=0.175. Probabilities are 0.175,0.275,0.35,0.2; all lie in [0,1] and sum to 1.	**3**	M1 setup; M1 process; A1 conclusion.
2	4/(x+4)×3/(x+4-1)=2/5. Cross-multiply, solve the quadratic, then reject non-positive/non-integer roots.	**5**	M1 setup; M2–M4 development; A1 conclusion.
3	x+(x+1/5)-x(x+1/5)=3/5. Rearrange to a quadratic. Keep only roots satisfying 0≤x≤1 and 0≤x+1/5≤1.	**5**	M1 setup; M2–M4 development; A1 conclusion.
4	Algebra may produce extraneous probability roots or non-integer object counts. Substitute into the original model; probabilities must lie in [0,1], denominators must be non-zero, and counts must be non-negative integers.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	Expected net=(9)x-2(1-x)=0. (11)x=2, so x=2/11=2/11.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	x^2=1/64. Since 0≤x≤1, x=1/8.	**3**	M1 setup; M1 process; A1 conclusion.
7	x/(x+9)=2/5; 5x=2x+18; x=6 counters.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	1-(1-x)²=3/10; (1-x)²=7/10; x=1-√(7/10), taking 0≤x≤1.	**5**	M1 setup; M2–M4 development; A1 conclusion.
9	4x+0.3=1, so x=0.175. Probabilities are 0.175,0.275,0.35,0.2; all lie in [0,1] and sum to 1.	**3**	M1 setup; M1 process; A1 conclusion.
10	5/(x+5)×4/(x+5-1)=5/12. Cross-multiply, solve the quadratic, then reject non-positive/non-integer roots.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

FLUENCY CHECK - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: ______________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	C(4,2)(1/5)²(4/5)^2=96/625.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
2	P(0)+P(1)=(3/5)^5+5(2/5)(3/5)^4=1053/3125.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	More heads means 5 to 8 heads. P=[C(8,5) + C(8,6) + C(8,7) + C(8,8)]/2^8=93/256=93/256.	**5**	M1 setup; M2–M4 development; A1 conclusion.
4	Exactly two scores in first 8, then score: C(8,2)(1/5)³(4/5)^6=114688/1953125.	**5**	M1 setup; M2–M4 development; A1 conclusion.
5	Calculate exact p from the model and experimental p-hat=frequency/trials. Compare absolute difference |p-hat-p| or relative difference when appropriate; interpret in light of random variation and the event rarity.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	One specified order with r successes has probability p^r(1-p)^(n-r). There are C(n,r) distinct positions for the r successes, and these orders are mutually exclusive, so their probabilities add.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
7	Complement: 1-(3/4)^7.	**3**	M1 setup; M1 process; A1 conclusion.
8	Use equally likely random digits with 2×(10/5) success digits when compatible, or a random integer 1 to 5 with 2 success values. Run 7 trials per experiment, record successes, and repeat many experiments.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

STANDARD HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	$C(4,2)(3/5)^2(2/5)^2=216/625$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
2	$P(0)+P(1)=(4/5)^5+5(1/5)(4/5)^4=2304/3125$.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	More heads means 5 to 8 heads. $P=[C(8,5) + C(8,6) + C(8,7) + C(8,8)]/2^8=93/256=93/256$.	**5**	M1 setup; M2–M4 development; A1 conclusion.
4	Exactly two scores in first 8, then score: $C(8,2)(3/5)^3(2/5)^6=48384/1953125$.	**5**	M1 setup; M2–M4 development; A1 conclusion.
5	Calculate exact p from the model and experimental p-hat=frequency/trials. Compare absolute difference |p-hat-p| or relative difference when appropriate; interpret in light of random variation and the event rarity.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	One specified order with r successes has probability $p^r(1-p)^{(n-r)}$. There are $C(n,r)$ distinct positions for the r successes, and these orders are mutually exclusive, so their probabilities add.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

STANDARD HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
7	Complement: 1-(3/4)^7.	**3**	M1 setup; M1 process; A1 conclusion.
8	Use equally likely random digits with 1×(10/5) success digits when compatible, or a random integer 1 to 5 with 1 success values. Run 7 trials per experiment, record successes, and repeat many experiments.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
9	C(4,2)(2/5)²(3/5)^2=216/625.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
10	P(0)+P(1)=(2/5)^5+5(3/5)(2/5)^4=272/3125.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
11	More heads means 5 to 8 heads. P=[C(8,5) + C(8,6) + C(8,7) + C(8,8)]/2^8=93/256=93/256.	**5**	M1 setup; M2–M4 development; A1 conclusion.
12	Exactly two scores in first 8, then score: C(8,2)(2/5)³(3/5)^6=163296/1953125.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

MULTI-STEP HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Calculate exact p from the model and experimental p-hat=frequency/trials. Compare absolute difference |p-hat-p| or relative difference when appropriate; interpret in light of random variation and the event rarity.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
2	One specified order with r successes has probability p^r(1-p)^(n-r). There are C(n,r) distinct positions for the r successes, and these orders are mutually exclusive, so their probabilities add.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	Complement: 1-(3/4)^7.	**3**	M1 setup; M1 process; A1 conclusion.
4	Use equally likely random digits with 3×(10/5) success digits when compatible, or a random integer 1 to 5 with 3 success values. Run 7 trials per experiment, record successes, and repeat many experiments.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	C(4,2)(1/5)^2(4/5)^2=96/625.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	P(0)+P(1)=(3/5)^5+5(2/5)(3/5)^4=1053/3125.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
7	More heads means 5 to 8 heads. P=[C(8,5) + C(8,6) + C(8,7) + C(8,8)]/2^8=93/256=93/256.	**5**	M1 setup; M2–M4 development; A1 conclusion.
8	Exactly two scores in first 8, then score: C(8,2)(1/5)^3(4/5)^6=114688/1953125.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

MULTI-STEP HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
9	Calculate exact p from the model and experimental p-hat=frequency/trials. Compare absolute difference |p-hat-p| or relative difference when appropriate; interpret in light of random variation and the event rarity.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
10	One specified order with r successes has probability p^r(1-p)^(n-r). There are C(n,r) distinct positions for the r successes, and these orders are mutually exclusive, so their probabilities add.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
11	Complement: 1-(3/4)^7.	**3**	M1 setup; M1 process; A1 conclusion.
12	Use equally likely random digits with 2×(10/5) success digits when compatible, or a random integer 1 to 5 with 2 success values. Run 7 trials per experiment, record successes, and repeat many experiments.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
13	C(4,2)(3/5)^2(2/5)^2=216/625.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
14	P(0)+P(1)=(4/5)^5+5(1/5)(4/5)^4=2304/3125.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
15	More heads means 5 to 8 heads. P=[C(8,5) + C(8,6) + C(8,7) + C(8,8)]/2^8=93/256=93/256.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 09 / P2,P3,P6-P8

Repeated Independent Trials, Counting Orders and Simulation

GRADE 7-9 CHALLENGE - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Exactly two scores in first 8, then score: C(8,2)(3/5)^3(2/5)^6=48384/1953125.	**5**	M1 setup; M2–M4 development; A1 conclusion.
2	Calculate exact p from the model and experimental p-hat=frequency/trials. Compare absolute difference |p-hat-p| or relative difference when appropriate; interpret in light of random variation and the event rarity.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
3	One specified order with r successes has probability p^r(1-p)^(n-r). There are C(n,r) distinct positions for the r successes, and these orders are mutually exclusive, so their probabilities add.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	Complement: 1-(3/4)^7.	**3**	M1 setup; M1 process; A1 conclusion.
5	Use equally likely random digits with 1×(10/5) success digits when compatible, or a random integer 1 to 5 with 1 success values. Run 7 trials per experiment, record successes, and repeat many experiments.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
6	C(4,2)(2/5)^2(3/5)^2=216/625.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
7	P(0)+P(1)=(2/5)^5+5(3/5)(2/5)^4=272/3125.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
8	More heads means 5 to 8 heads. P=[C(8,5) + C(8,6) + C(8,7) + C(8,8)]/2^8=93/256=93/256.	**5**	M1 setup; M2–M4 development; A1 conclusion.
9	Exactly two scores in first 8, then score: C(8,2)(2/5)^3(3/5)^6=163296/1953125.	**5**	M1 setup; M2–M4 development; A1 conclusion.
10	Calculate exact p from the model and experimental p-hat=frequency/trials. Compare absolute difference |p-hat-p| or relative difference when appropriate; interpret in light of random variation and the event rarity.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

FLUENCY CHECK - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	P(RB)=4/10×6/9; P(BR)=6/10×4/9. These are equal, so P(first red | different colours)=P(RB)/[P(RB)+P(BR)]=1/2.	**5**	M1 setup; M2–M4 development; A1 conclusion.
2	Use the complement: 1-P(0 heads)-P(1 head)=1-(4/5)^5-5(1/5)(4/5)^4=821/3125.	**5**	M1 setup; M2–M4 development; A1 conclusion.
3	n(F∪S)=80+90-30=140. Every French student is in the union, so P(F|F∪S)=80/140=4/7.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
4	Out of 10,000, diseased positives=200×0.8=160. Non-diseased positives=9800×0.1=980. Hence P(condition|positive)=160/1140=8/57.	**5**	M1 setup; M2–M4 development; A1 conclusion.
5	Fairness requires 6p-2=0, so p=2/6=1/3. At actual probability 1/4, expected profit per play=6×1/4-2=-1/2 pounds; over 120 plays this is £-60.	**5**	M1 setup; M2–M4 development; A1 conclusion.
6	P(R then B)=x/(3x)×2x/(3x-1)=2x/[3(3x-1)]. Set this equal to 1/4. Cross-multiplication gives x=3; substitution confirms the probability.	**5**	M1 setup; M2–M4 development; A1 conclusion.
7	There are 15 equally likely ordered pairs with first>second. Of these, 4 meet the sum condition. Therefore the conditional probability is 4/15=4/15.	**5**	M1 setup; M2–M4 development; A1 conclusion.
8	P(A)P(B)=1/5×3/10=3/50=P(A∩B), so they are independent. P(exactly one)=P(A)+P(B)-2P(A∩B)=19/50.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

STANDARD HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: _____ / _____

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Total codes=5×4×9=180. P(specified first letter)=1/5; P(even final digit)=4/9. The events are independent, so P(union)=1/5+4/9-4/45=5/9.	**5**	M1 setup; M2–M4 development; A1 conclusion.
2	P(RB)=5/12×7/11; P(BR)=7/12×5/11. These are equal, so P(first red | different colours)=P(RB)/[P(RB)+P(BR)]=1/2.	**5**	M1 setup; M2–M4 development; A1 conclusion.
3	Use the complement: 1-P(0 heads)-P(1 head)=1-(7/10)^6-6(3/10)(7/10)^5=23193/40000.	**5**	M1 setup; M2–M4 development; A1 conclusion.
4	n(F∪S)=90+100-35=155. Every French student is in the union, so P(F|F∪S)=90/155=18/31.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	Out of 10,000, diseased positives=300×0.82=246. Non-diseased positives=9700×0.09=873. Hence P(condition| positive)=246/1119=82/373.	**5**	M1 setup; M2–M4 development; A1 conclusion.
6	Fairness requires 7p-2=0, so p=2/7=2/7. At actual probability 2/9, expected profit per play=7×2/9-2=-4/9 pounds; over 120 plays this is £-160/3.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

STANDARD HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
7	P(R then B)=x/(3x)×2x/(3x-1)=2x/[3(3x-1)]. Set this equal to 8/33. Cross-multiplication gives x=4; substitution confirms the probability.	**5**	M1 setup; M2–M4 development; A1 conclusion.
8	There are 15 equally likely ordered pairs with first>second. Of these, 2 meet the sum condition. Therefore the conditional probability is 2/15=2/15.	**5**	M1 setup; M2–M4 development; A1 conclusion.
9	P(A)P(B)=3/10×2/5=3/25=P(A∩B), so they are independent. P(exactly one)=P(A)+P(B)-2P(A∩B)=23/50.	**5**	M1 setup; M2–M4 development; A1 conclusion.
10	Total codes=6×5×9=270. P(specified first letter)=1/6; P(even final digit)=4/9. The events are independent, so P(union)=1/6+4/9-4/54=29/54.	**5**	M1 setup; M2–M4 development; A1 conclusion.
11	P(RB)=6/14×8/13; P(BR)=8/14×6/13. These are equal, so P(first red | different colours)=P(RB)/[P(RB)+P(BR)]=1/2.	**5**	M1 setup; M2–M4 development; A1 conclusion.
12	Use the complement: 1-P(0 heads)-P(1 head)=1-(3/5)^7-7(2/5)(3/5)^6=65732/78125.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

MULTI-STEP HIGHER • PART A - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	n(F∪S)=100+110-40=170. Every French student is in the union, so P(F|F∪S)=100/170=10/17.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
2	Out of 10,000, diseased positives=400×0.84=336. Non-diseased positives=9600×0.08=768. Hence P(condition|positive)=336/1104=7/23.	**5**	M1 setup; M2–M4 development; A1 conclusion.
3	Fairness requires 8p-2=0, so p=2/8=1/4. At actual probability 1/5, expected profit per play=8×1/5-2=-2/5 pounds; over 120 plays this is £-48.	**5**	M1 setup; M2–M4 development; A1 conclusion.
4	P(R then B)=x/(3x)×2x/(3x-1)=2x/[3(3x-1)]. Set this equal to 5/21. Cross-multiplication gives x=5; substitution confirms the probability.	**5**	M1 setup; M2–M4 development; A1 conclusion.
5	There are 15 equally likely ordered pairs with first>second. Of these, 1 meet the sum condition. Therefore the conditional probability is 1/15=1/15.	**5**	M1 setup; M2–M4 development; A1 conclusion.
6	P(A)P(B)=2/5×1/2=1/5=P(A∩B), so they are independent. P(exactly one)=P(A)+P(B)-2P(A∩B)=1/2.	**5**	M1 setup; M2–M4 development; A1 conclusion.
7	Total codes=7×6×9=378. P(specified first letter)=1/7; P(even final digit)=4/9. The events are independent, so P(union)=1/7+4/9-4/63=11/21.	**5**	M1 setup; M2–M4 development; A1 conclusion.
8	P(RB)=7/16×9/15; P(BR)=9/16×7/15. These are equal, so P(first red | different colours)=P(RB)/[P(RB)+P(BR)]=1/2.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

MULTI-STEP HIGHER • PART B - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: _____________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
9	Use the complement: 1-P(0 heads)-P(1 head)=1-(1/2)^8-8(1/2)(1/2)^7=247/256.	**5**	M1 setup; M2–M4 development; A1 conclusion.
10	n(F∪S)=110+120-45=185. Every French student is in the union, so P(F|F∪S)=110/185=22/37.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
11	Out of 10,000, diseased positives=500×0.86=430. Non-diseased positives=9500×0.07=665. Hence P(condition|positive)=430/1095=86/219.	**5**	M1 setup; M2–M4 development; A1 conclusion.
12	Fairness requires 9p-2=0, so p=2/9=2/9. At actual probability 2/11, expected profit per play=9×2/11-2=-4/11 pounds; over 120 plays this is £-480/11.	**5**	M1 setup; M2–M4 development; A1 conclusion.
13	P(R then B)=x/(3x)×2x/(3x-1)=2x/[3(3x-1)]. Set this equal to 4/17. Cross-multiplication gives x=6; substitution confirms the probability.	**5**	M1 setup; M2–M4 development; A1 conclusion.
14	There are 15 equally likely ordered pairs with first>second. Of these, 0 meet the sum condition. Therefore the conditional probability is 0/15=0.	**5**	M1 setup; M2–M4 development; A1 conclusion.
15	P(A)P(B)=1/2×3/5=3/10=P(A∩B), so they are independent. P(exactly one)=P(A)+P(B)-2P(A∩B)=1/2.	**5**	M1 setup; M2–M4 development; A1 conclusion.

MODULE 10 / P1-P9 synthesis

Mixed Higher Probability Problem Solving

GRADE 7-9 CHALLENGE - ANSWERS

HIGHER TIER • SHOW CLEAR WORKING • KEEP EXACT VALUES WHERE REQUIRED

Name: ______________________________ Date: ______________ Score: ______ / ______

Use the formula/method guides in the consolidated solutions section. Award method marks where the setup is correct.

Q	Answer / concise method	Marks	Check
1	Total codes=8×7×9=504. P(specified first letter)=1/8; P(even final digit)=4/9. The events are independent, so P(union)=1/8+4/9-4/72=37/72.	**5**	M1 setup; M2–M4 development; A1 conclusion.
2	P(RB)=8/18×10/17; P(BR)=10/18×8/17. These are equal, so P(first red | different colours)=P(RB)/[P(RB)+P(BR)]=1/2.	**5**	M1 setup; M2–M4 development; A1 conclusion.
3	Use the complement: 1-P(0 heads)-P(1 head)=1-(2/5)^9-9(3/5)(2/5)^8=1945701/1953125.	**5**	M1 setup; M2–M4 development; A1 conclusion.
4	n(F∪S)=120+130-50=200. Every French student is in the union, so P(F|F∪S)=120/200=3/5.	**4**	M1 setup; M1 development; A1 accuracy; A1 conclusion.
5	Out of 10,000, diseased positives=600×0.88=528. Non-diseased positives=9400×0.06=564. Hence P(condition| positive)=528/1092=44/91.	**5**	M1 setup; M2–M4 development; A1 conclusion.
6	Fairness requires 10p-2=0, so p=2/10=1/5. At actual probability 1/6, expected profit per play=10×1/6-2=-1/3 pounds; over 120 plays this is £-40.	**5**	M1 setup; M2–M4 development; A1 conclusion.
7	P(R then B)=x/(3x)×2x/(3x-1)=2x/[3(3x-1)]. Set this equal to 7/30. Cross-multiplication gives x=7; substitution confirms the probability.	**5**	M1 setup; M2–M4 development; A1 conclusion.
8	There are 15 equally likely ordered pairs with first>second. Of these, 0 meet the sum condition. Therefore the conditional probability is 0/15=0.	**5**	M1 setup; M2–M4 development; A1 conclusion.
9	P(A)P(B)=3/5×7/10=21/50=P(A∩B), so they are independent. P(exactly one)=P(A)+P(B)-2P(A∩B)=23/50.	**5**	M1 setup; M2–M4 development; A1 conclusion.
10	Total codes=9×8×9=648. P(specified first letter)=1/9; P(even final digit)=4/9. The events are independent, so P(union)=1/9+4/9-4/81=41/81.	**5**	M1 setup; M2–M4 development; A1 conclusion.