Name	Date started	Target end date

GCE AS / A LEVEL — APPLIED MATHEMATICS A QUESTION PACK

0983-01 (Legacy S1) · New spec Unit 2 Topic 1 · AS unit, 25% of A-level, 75 marks, 1h 45min paper

REVISE
.wales

MATHEMATICS — APPLIED A · PROBABILITY - EVENTS & INDEPENDENCE

Probability - Events, Mutual Exclusion and Independence

Probability questions on events, mutual exclusion and independence from the legacy WJEC S1 papers (2011-2017)

LEGACY 2008 SPECIFICATION

Estimated time for entire question pack: ~2 hours 11 minutes

*Derived from the legacy S1 paper's pace of **~1.25 min/mark** (105 marks over 15 questions).*

*You are advised to **not** attempt to complete all of this in one sitting.*

ABOUT THIS QUESTION PACK

This is a **comprehensive practice question pack**, not a single mock paper. It contains questions from the legacy WJEC S1 papers (2008 modular spec) that map onto new-spec AS Unit 2 Topic 1 (2.2.3).

Questions are ordered chronologically.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working — method marks are awarded for clear setup.

A calculator is allowed (except where specified by individual questions). The WJEC Formula Booklet and statistical tables may be referred to. Take $g = 9.8\,\text{ms}^{-2}$ for mechanics.

For Examiner's use only

Q	Source	Max	Mark
1	Jun 11 Q3	7	
2	Jan 12 Q4	6	
3	Jun 12 Q1	8	
4	Jun 12 Q6	7	
5	Jan 13 Q1	7	
6	Jun 13 Q1	5	
7	Jun 13 Q6	6	
8	Jan 14 Q1	5	

Q	Source	Max	Mark
9	Jan 14 Q3	7	
10	Jun 14 Q1	6	
11	Jun 14 Q8	7	
12	Jun 15 Q2	7	
13	Jun 15 Q8	9	
14	Jun 16 Q1	9	
15	Jun 17 Q1	9	
Total		**105**	

Probability - Events, Mutual Exclusion and Independence — what the new spec asks

WJEC GCE AS / A Level Mathematics (from 2017) · Unit 2: Applied Mathematics A · Topic 2.2.3.

Probability axioms 2.2.3

- $0 \leq P(A) \leq 1$ for every event A.
- $P(\text{sample space}) = 1$, $P(\emptyset) = 0$.
- $P(A') = 1 - P(A)$.

Addition, independence, conditional 2.2.3

- General addition: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$.
- Mutually exclusive: $P(A \cap B) = 0$.
- Independent: $P(A \cap B) = P(A)P(B)$; equivalently $P(A \mid B) = P(A)$.

Crib sheet »

Probability - Events & Independence in one page

Quick-reference notes — revisit before each section. Don’t use during questions.

Axioms and basics

$0 \leq P(A) \leq 1$; $P(A') = 1 - P(A)$.
Sample space probability is 1; impossible event is 0.

Union (addition rule)

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$.
Mutually exclusive $\Rightarrow P(A \cap B) = 0$.

Independence

A, B independent $\iff P(A \cap B) = P(A)P(B)$.
Equivalent: $P(A \mid B) = P(A)$ and $P(B \mid A) = P(B)$.

Mutually exclusive vs independent

Mutually exclusive events with $P(A), P(B) > 0$ are *never* independent.
If exclusive: $P(A \cup B) = P(A) + P(B)$.

Complement

$P(A \cap B') = P(A) - P(A \cap B)$.
$P(A' \cap B') = 1 - P(A \cup B)$ (De Morgan).

Common pitfalls

Don't assume independence unless stated or computed.
Always check whether 'or' is inclusive vs exclusive in context.

SECTION T1

Probability - Events, Mutual Exclusion and Independence

Questions 1–15 · 105 marks

3. The events A and B are such that

$$P(A) = 0{\cdot}25,\ P(B) = 0{\cdot}4 \text{ and } P(A' \cap B') = 0{\cdot}45.$$

Determine whether

(a) A and B are mutually exclusive, [3]

(b) A and B are independent. [4]

4. The events A and B are such that

$$P(A) = 0{\cdot}4,\ P(B) = 0{\cdot}2 \text{ and } P(A|B) = 0{\cdot}3.$$

Calculate

(a) $P(A \cap B)$, [2]

(b) $P(A \cup B)$, [2]

(c) $P(B \mid A)$. [2]

1. The events A and B are such that

$$P(A) = 0{\cdot}5,\ P(B) = 0{\cdot}3.$$

(a) Evaluate $P(A \cup B)$ when

(i) A, B are mutually exclusive,
(ii) A, B are independent. [5]

(b) Given that $P(A \cup B) = 0{\cdot}7$, find the value of $P(B|A)$. [3]

6. Sue and Tim play the following game. They throw a fair dice alternately, starting with Sue, and the winner is the first to obtain a 6.

(a) Write down the probability that Sue wins with her first throw. [1]

(b) Find the probability that Sue wins with her second throw. [2]

(c) Write down the first three terms of the infinite geometric series for the probability that Sue wins the game. [2]

(d) Hence find the probability that Sue wins the game. [2]

1. The independent events A, B are such that

$$P(A) = 0{\cdot}2,\ P(A \cup B) = 0{\cdot}4.$$

(a) Determine the value of $P(B)$. [4]

(b) Calculate the probability that exactly one of the events A, B occurs. [3]

1. The events A and B are such that

$$P(A) = 0{\cdot}25,\ P(A \cup B) = 0{\cdot}4.$$

Evaluate $P(B)$ when

(a) A, B are mutually exclusive, [2]

(b) A, B are independent. [3]

6. When Mike fires his gun at a target, he hits it with probability 0·7. Successive shots are independent. When he starts to fire his gun at the target, calculate the probability that he hits the target

(a) for the first time on his fourth shot, [3]

(b) for the second time on his third shot. [3]

1. The events A and B are such that

$$P(A) = 0{\cdot}5,\ P(B) = 0{\cdot}2,\ P(A|B) = 0{\cdot}4.$$

(a) Calculate

(i) $P(A \cap B)$,

(ii) $P(B|A)$. [4]

(b) Giving a reason, state whether or not A and B are mutually exclusive. [1]

3. When Catrin shoots an arrow at a target, she hits it with probability 0·4. When Rhiannon shoots an arrow at the target, she hits it with probability 0·3. Successive shots are independent. One morning, they decide to shoot arrows alternately at the target, starting with Rhiannon. The winner is the first to hit the target.

(a) Show that the probability that Catrin wins with her first shot is 0·28. [2]

(b) Show that the probability that Catrin wins with her second shot can be written in the form $k \times 0{\cdot}28$, and state the value of k. [2]

(c) Hence, by summing an infinite geometric series, find the probability that Catrin wins. [3]

1. The events A and B are such that

$$P(A) = 0{\cdot}3,\ P(B) = 0{\cdot}4,\ P(A \cup B) = 0{\cdot}5.$$

(a) Determine whether or not A and B are independent. [3]

(b) Evaluate $P(A|B')$. [3]

8. Ann and Brenda each have a calculator which can generate a single digit random number from the set {1, 2, 3, 4, 5, 6, 7, 8}. They each generate a random number on their calculator.

(a) Find the probability that the two numbers are equal. [2]

(b) Find the probability that the sum of the two numbers is 12. [3]

(c) Given that the sum of the two numbers is 12, find the probability that the two numbers are equal. [2]

2. The events A and B are such that

$$P(A) = 0{\cdot}4,\ P(B) = 0{\cdot}5 \text{ and } P(A \cup B) = 2 \times P(A \cap B).$$

(a) Show that $P(A \cap B) = 0{\cdot}3$. [2]

(b) Evaluate $P(A|B)$. [2]

(c) Evaluate $P(B|A')$. [3]

8. Fred is a cricket player. When he throws a ball at the wicket from a point *P*, he hits it with probability 0·3. You may assume that successive throws are independent.

(a) One morning, he goes out to practise his throwing from the point *P*. Calculate the probability that he hits the wicket for the first time with his third throw. [2]

George is also a cricket player. When he throws a ball at the wicket from the point *P*, he hits it with probability 0·2. You may again assume that successive throws are independent.

(b) On another morning, Fred and George decide to play a game in which they throw balls, alternately, at the wicket from the point *P*. The winner is the player who is first to hit the wicket. Given that George throws first, calculate the probability that Fred

(i) wins the game with his first throw,

(ii) wins the game with his second throw,

(iii) wins the game. [7]

1. The events A and B are such that

$$P(A) = 0{\cdot}3,\ P(B) = 0{\cdot}4.$$

Evaluate $P(A \cup B)$ in each of the following cases.

(a) A and B are mutually exclusive. [2]

(b) A and B are independent. [3]

(c) $P(A|B) = 0{\cdot}25$. [4]

1. The events A and B are such that

$$P(A) = 0{\cdot}2,\ P(B) = 0{\cdot}3,\ P(A \cup B) = 0{\cdot}4.$$

(a) Show that A and B are not independent. [3]

(b) Determine the value of

(i) $P(A'|B)$,

(ii) $P(A \cup B')$. [6]

END OF PROBABILITY - EVENTS & INDEPENDENCE PACK

Source: WJEC S1 (2008 modular spec) · 2011–2017
Curated for WJEC Maths 2017 spec AS Unit 2 — Topic 1 (2.2.3)