



eClassroom

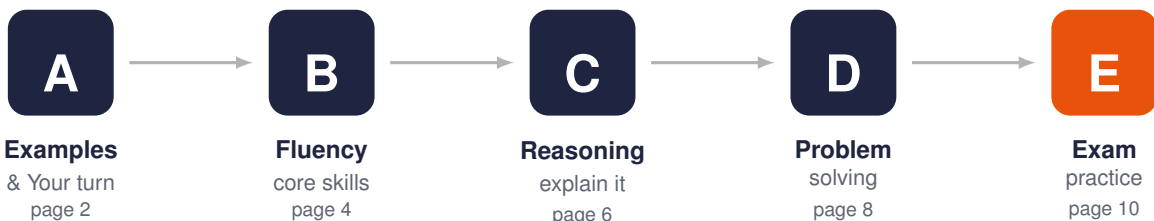
GCSE MATHEMATICS • PROBABILITY

And & Or Rules

Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • Calculator allowed

Free And & Or Rules worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: add probabilities of mutually exclusive outcomes (OR) • multiply probabilities of independent events (AND) • find “at least one”, “neither” and “exactly one” • *Higher:* events without replacement, three events, testing for independence and equations.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER The same skills where Higher papers use them: without replacement, three events, testing for independence, and equations. Grades 6 to 9.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	23	10	13	17
Higher marks	16	14	17	16
My score				

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A**Worked examples & Your turn**

Read each example carefully. Cover it up, then answer the question beside it using the same method.

FOUNDATION

Everyone starts here

Worked example A1

A spinner is spun once. $P(\text{red}) = 0.35$ and $P(\text{green}) = 0.2$. Find $P(\text{red or green})$.

One spin cannot be red and green, so the outcomes are mutually exclusive: add.

$$0.35 + 0.2 = 0.55$$

0.55

Your turn A1

A and B are mutually exclusive. $P(A) = \frac{1}{4}$ and $P(B) = \frac{1}{3}$. Find $P(A \text{ or } B)$.

Worked example A2

The probability that Jo wins her game is 0.6. The probability that Ali wins his game is 0.3. The games are independent. Find $P(\text{both win})$.

Independent events, AND: multiply.

$$0.6 \times 0.3 = 0.18$$

0.18

Your turn A2

The probability that a train is late is 0.2. The probability that a bus is late is 0.15, independently. Find $P(\text{both are late})$.

Worked example A3

Two fair dice are rolled. Find the probability of at least one 6

At least one = $1 - P(\text{none})$.

$$P(\text{no 6s}) = \frac{5}{6} \times \frac{5}{6} = \frac{25}{36} \quad 1 - \frac{25}{36}$$

$\frac{11}{36}$

Your turn A3

The probability of rain each day is 0.4, independently. Find the probability that it rains on at least one of two days.



HIGHER*Higher strategies: these are new ways of thinking, not longer sums***Worked example A4: without replacement**

A bag holds 4 red and 6 blue counters. Two are taken without replacement. Find $P(\text{both blue})$.

After one blue is taken, 5 blue are left out of 9

$$\frac{6}{10} \times \frac{5}{9} = \frac{30}{90}$$

$$\frac{1}{3}$$

Your turn A4

A bag holds 3 red and 5 green counters. Two are taken without replacement. Find $P(\text{both red})$.

Worked example A5: exactly one

$P(A) = 0.7$ and $P(B) = 0.4$, independent. Find $P(\text{exactly one of } A \text{ and } B)$.

A not B, or B not A: two ways, so add them.

$$0.7 \times 0.6 + 0.3 \times 0.4 = 0.42 + 0.12$$

$$0.54$$

Your turn A5

Kai passes maths with probability 0.9 and English with probability 0.8, independently. Find $P(\text{he passes exactly one})$.

Worked example A6: testing for independence

$P(A) = 0.3$, $P(B) = 0.5$ and $P(A \cap B) = 0.2$. Are A and B independent?

Independent only if $P(A \cap B) = P(A) \times P(B)$

$$0.3 \times 0.5 = 0.15, \text{ which is not } 0.2$$

not independent

Your turn A6

$P(A) = 0.6$, $P(B) = 0.25$ and $P(A \cap B) = 0.15$. Are A and B independent?

Worked example A7: working backwards to n

A bag holds n counters and 4 are red. Two are taken with replacement. $P(\text{both red}) = \frac{1}{9}$. Find n .

$$\left(\frac{4}{n}\right)^2 = \frac{1}{9}, \text{ so } \frac{4}{n} = \frac{1}{3}$$

$$n = 12$$

Your turn A7

A bag holds n counters and 5 are blue. Two are taken with replacement. $P(\text{both blue}) = \frac{1}{16}$. Find n .



B**Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

FOUNDATION

Everyone starts here

B1 A spinner is spun once. $P(A) = 0.2$, $P(B) = 0.35$, $P(C) = 0.15$, $P(D) = 0.3$. Find

- (a) $P(A \text{ or } B)$ (b) $P(B \text{ or } D)$ (c) $P(A \text{ or } B \text{ or } C)$ (d) $P(\text{not } D)$

[4 marks]

B2 The events are independent. Find the probability that they all happen.

- (a) 0.5 and 0.4 (b) 0.3 and 0.3 (c) $\frac{1}{6}$ and $\frac{1}{2}$ (d) 0.2, 0.5 and 0.1

[4 marks]

B3 A fair dice is rolled. Find the probability of

- (a) two 6s in two rolls (b) no 6s in two rolls
(c) at least one 6 in two rolls (d) three 6s in three rolls

[4 marks]

B4 $P(\text{Sam is late}) = 0.1$ and $P(\text{Jo is late}) = 0.25$, independently. Find the probability that

- (a) both are late (b) neither is late (c) at least one is late (d) exactly one is late

[4 marks]

B5 (a) A fair coin is thrown twice. Find $P(\text{heads then tails})$.

(b) A fair dice is rolled once. Find $P(3 \text{ or } 4)$.

(c) A card is chosen from cards numbered 1 to 10. Find $P(\text{the number is even and greater than 5})$.

[3 marks]



FOUNDATION

continued: expected numbers

- B6** $P(A) = 0.3$ and $P(B) = 0.4$, independently. The two events are tested 200 times.
- (a) Find $P(A \text{ and } B)$. (b) How many times would you expect A and B both to happen?
- (c) Find $P(\text{at least one of } A \text{ and } B)$. (d) How many times would you expect at least one to happen?
- [4 marks]

HIGHER

Higher tier only

- B7** A bag holds 3 red and 7 blue counters. Two are taken without replacement. Find
- (a) $P(\text{both red})$ (b) $P(\text{both blue})$ (c) $P(\text{same colour})$ (d) $P(\text{red then blue})$
- [4 marks]
- B8** (a) A fair coin is thrown three times. Find $P(\text{three heads})$.
- (b) A fair coin is thrown three times. Find $P(\text{exactly two heads})$.
- (c) A fair coin is thrown three times. Find $P(\text{at least one head})$.
- (d) Three fair dice are rolled. Find $P(\text{exactly one } 6)$.
- [4 marks]
- B9** Are A and B independent? Give a reason.
- (a) $P(A) = 0.4$, $P(B) = 0.5$, $P(A \cap B) = 0.2$ (b) $P(A) = 0.4$, $P(B) = 0.5$, $P(A \cap B) = 0.25$
- (c) $P(A) = 0.3$, $P(B) = 0.6$, $P(A \cap B) = 0.18$ (d) $P(A) = 0.6$, $P(B) = 0.5$, $P(A \cup B) = 0.8$
- [4 marks]
- B10** (a) Two independent events have the same probability p . $P(\text{both}) = 0.09$. Find p .
- (b) $P(A) = 0.6$ and $P(A \text{ and } B) = 0.24$, independently. Find $P(B)$.
- (c) Two independent events each have probability p . $P(\text{at least one}) = 0.75$. Find p .
- (d) A bag holds n counters and 3 are red. Two are taken with replacement. $P(\text{both red}) = \frac{1}{25}$. Find n .
- [4 marks]



C**Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

- C1** Two fair dice are rolled. Tom says, " $P(\text{at least one 6}) = \frac{1}{6} + \frac{1}{6} = \frac{1}{3}$ ".
Explain why Tom is wrong and find the correct probability. [2 marks]
- C2** A fair dice is rolled once. Jo says, " $P(\text{a 2 or an even number}) = \frac{1}{6} + \frac{1}{2} = \frac{2}{3}$ ".
Explain Jo's mistake and find the correct probability. [2 marks]
- C3** The probability that it rains on any day is 0.3, independently.
Mia says, "The probability that it rains on both Saturday and Sunday is $0.3 + 0.3 = 0.6$ ".
Explain Mia's mistake and find the correct probability. [3 marks]
- C4** A fair coin is thrown three times. Show that the probability of at least one head is $\frac{7}{8}$. [3 marks]



HIGHER*Higher tier only*

- C5** A bag holds 4 red and 6 blue counters. Two are taken without replacement.

Kai writes $P(\text{both red}) = \frac{4}{10} \times \frac{4}{10}$

Explain Kai's mistake and find the correct probability.

[3 marks]

- C6** $P(A) = 0.5$, $P(B) = 0.4$ and $P(A \cup B) = 0.8$

Show that A and B are not independent.

[3 marks]

- C7** Two independent events each have probability p .

Prove that the probability that at least one of them happens is $2p - p^2$

[3 marks]

- C8** A and B are independent. $P(A) = x$ and $P(B) = x + 0.1$

The probability that exactly one of A and B happens is 0.5

(a) Show that $x^2 - 0.9x + 0.2 = 0$

(b) Find the two possible values of x .

[5 marks]



D**Problem solving**

You decide the method. Read the whole question first, and show every step.

FOUNDATION

Everyone starts here

- D1** In a game, a player wins if a spinner lands on red on two spins in a row. $P(\text{red}) = 0.4$ on each spin. Sam plays the game 50 times. How many times would you expect Sam to win? **[3 marks]**
- D2** A house has two alarms. Each alarm works with probability 0.9, independently. The system works if at least one alarm works. Is this system more reliable than a single alarm that works with probability 0.98? You must show your working. **[3 marks]**
- D3** The probability that Kim scores a penalty is 0.8. She takes three penalties, independently.
(a) Find the probability that she scores all three. (b) Find the probability that she misses all three. **[3 marks]**
- D4** Spinner A lands on red with probability 0.3 and on blue otherwise. Spinner B lands on red with probability 0.6 and on blue otherwise. Both are spun. Find the probability that the two spinners land on different colours. **[4 marks]**



HIGHER*Higher tier only*

- D5** A bag holds 4 red, 3 blue and 3 green counters. Two are taken without replacement.
Find the probability that both counters are the same colour. [4 marks]
- D6** $P(A) = 0.5$, $P(B) = 0.4$ and $P(C) = 0.3$. The three events are independent.
Find the probability that exactly one of them happens. [4 marks]
- D7** A fair dice is rolled n times.
Find the smallest value of n for which the probability of at least one 6 is more than 0.9 [4 marks]
- D8** A bag holds x red counters and 3 blue counters. Two counters are taken without replacement.
The probability of getting one red and one blue counter is $\frac{1}{2}$
Find the two possible values of x . [5 marks]



E**Exam practice**

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

FOUNDATION*Foundation and Higher crossover*

E1 A spinner is spun once. $P(\text{red}) = 0.3$ and $P(\text{blue}) = 0.25$

(a) Find the probability that it lands on red or blue.

.....
(1)

(b) Find the probability that it lands on neither red nor blue.

.....
(1)

(Total for Question E1 is 2 marks)

E2 (a) A fair coin is thrown and a fair dice is rolled. Find the probability of heads and a 6

.....
(1)

(b) Spinner A lands on 3 with probability 0.2. Spinner B lands on 3 with probability 0.4. Both are spun. Find the probability that both land on 3

.....
(2)

(Total for Question E2 is 3 marks)

E3 The probability that a bus is late on any day is 0.1, independently.

(a) Find the probability that the bus is late on both Monday and Tuesday.

.....
(1)

(b) Find the probability that the bus is not late on either day.

.....
(2)

(Total for Question E3 is 3 marks)



- E4** A card is chosen at random from cards numbered 1 to 20
Find the probability that the number is a prime number or a multiple of 10

.....
(Total for Question E4 is 3 marks)

- E5** A biased spinner is numbered 1 to 4

Number	1	2	3	4
Probability	0.2	0.35		0.15

- (a) Find the probability that it lands on 3

.....
(1)

- (b) The spinner is spun twice. Find the probability that it lands on 2 both times.

.....
(2)

(Total for Question E5 is 3 marks)

- E6** The probability that Ali passes a test is 0.8. The probability that Ben passes a different test is 0.6. These are independent.
Find the probability that exactly one of them passes.

.....
(Total for Question E6 is 3 marks)



HIGHER*Higher tier only*

- E7** A bag holds 5 red and 3 blue counters. Two counters are taken without replacement.
Find the probability that both counters are red.

.....
(Total for Question E7 is 3 marks)

- E8** $P(A) = 0.4$, $P(B) = 0.5$ and $P(A \cap B) = 0.2$
(a) Show that A and B are independent.

(2)

- (b) Find $P(A \cup B)$.

.....
(2)
(Total for Question E8 is 4 marks)

- E9** The probability that it rains on any day is 0.3, independently.
Find the probability that it rains on exactly one of three days.

.....
(Total for Question E9 is 4 marks)



E10 A bag holds n counters. 6 of the counters are red. Two counters are taken without replacement.

The probability that both counters are red is $\frac{1}{3}$

(a) Show that $n^2 - n - 90 = 0$

(3)

(b) Find the number of counters in the bag.

(2)

(Total for Question E10 is 5 marks)

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