MARKING GUIDELINE

MARKS	DURATION	QUESTIONS
46	1 hour 10 minutes	4

Name: _____ Class: _____

Date: _____

MARK ____ / 46

INSTRUCTIONS AND INFORMATION

1. Answer **ALL** the questions in this question paper.
2. Answer QUESTION 1 by **circling** the letter (A–D) in the answer grid at the end of that section.
3. Show **ALL** calculations clearly.
4. Show all units where applicable.
5. Number the answers correctly according to the numbering system used in this question paper.
6. A non-programmable calculator may be used, unless stated otherwise.
7. Write neatly and legibly.

QUESTION 1 [10 MARKS]

Four options are given as possible answers to the following questions. Choose the correct answer and circle the letter (A–D) in the grid at the end of this section. If you want to change your choice, put a cross through the wrong letter and circle your new choice.

1.1 P(A or B) = ... (1)

A) P(A) + P(B) – P(A and B) ✓ **B)** P(A) + P(B)

C) P(A) + P(B) + P(A and B) **D)** P(A) × P(B)

Answer: A — Without the subtraction the overlap would be counted twice.

- **B** — that holds only when the events are MUTUALLY EXCLUSIVE
- **C** — the overlap must be SUBTRACTED, not added again
- **D** — that gives P(A and B) for INDEPENDENT events, not P(A or B)

1.2 Events A and B are INDEPENDENT when ... (1)

A) P(A) + P(B) = 1 **B)** P(A) = P(B)

C) P(A and B) = P(A) × P(B) ✓ **D)** P(A and B) = 0

Answer: C — Independence means one event happening does not change the probability of the other.

- **A** — that describes COMPLEMENTARY events
- **B** — equal probabilities say nothing about independence
- **D** — that is MUTUALLY EXCLUSIVE, which is a different idea

1.3 P(A) = 0,6 and P(B) = 0,5, and A and B are independent. Then P(A and B) = ... (1)

A) 0,8 **B)** 0,1

C) 0,3 ✓ **D)** 1,1

Answer: C — For independent events the probabilities multiply: $0{,}6 \times 0{,}5 = 0{,}3$.

- **A** — used the addition rule, which gives P(A or B)
- **B** — subtracted them
- **D** — ADDED the probabilities instead of multiplying them

1.4 Mutually exclusive events with non-zero probabilities are ... (1)

A) always independent
B) never independent ✓
C) always complementary
D) independent only if P(A) = P(B)

> **Answer: B** — If A happens then B cannot — which is exactly a change in B's probability.
>
> - **A** — P(A and B) = 0 while P(A) × P(B) is not 0, so they cannot be independent
> - **C** — complementary events must fill the whole sample space, which these need not do
> - **D** — equal probabilities do not help — the overlap is still zero

1.5 Of 100 people, 60 like tea, 45 like coffee and 20 like both. The number liking NEITHER is ... (1)

A) 5
B) 15 ✓
C) 35
D) 25

> **Answer: B** — $60 + 45 - 20 = 85$ like at least one, so $100 - 85 = 15$ like neither.
>
> - **A** — worked out $60 + 45 - 100$ — the overlap there would be if NOBODY liked neither
> - **C** — subtracted the overlap twice: $100 - (60 + 45 - 40)$
> - **D** — that is the number who like coffee ONLY: $45 - 20$

1.6 For that same group, P(likes tea ONLY) = ... (1)

A) 0,2
B) 0,85
C) 0,4 ✓
D) 0,6

> **Answer: C** — Tea only is $60 - 20 = 40$ out of 100.
>
> - **A** — used the 20 who like both
> - **B** — that is P(likes at least one of the two)
> - **D** — used all 60 tea-drinkers instead of only those who like tea alone

1.7 If P(A) = 0,4 and P(A and B) = 0,1, then P(A but NOT B) = ... (1)

A) 0,5
B) 0,4
C) 0,1
D) 0,3 ✓

> **Answer: D** — P(A only) = P(A) − P(A and B) = 0,4 − 0,1 = 0,3.
>
> - **A** — ADDED the overlap instead of subtracting it
> - **B** — that is P(A), before the overlap is removed
> - **C** — that is the overlap itself

1.8 A bag holds 4 red and 6 blue marbles. Two are drawn WITHOUT replacement. P(both red) = ... (1)

A) $\frac{2}{5}$
B) $\frac{12}{100}$
C) $\frac{4}{25}$
D) $\frac{2}{15}$ ✓

> **Answer: D** — $\frac{4}{10} \times \frac{3}{9} = \frac{12}{90} = \frac{2}{15}$ — the second draw has one fewer red and one fewer marble.
>
> - **A** — gave the probability of ONE red only
> - **B** — reduced the reds but not the total: $\frac{4}{10} \times \frac{3}{10}$
> - **C** — treated the draws as WITH replacement: $\frac{4}{10} \times \frac{4}{10}$

1.9 From that same bag, but WITH replacement, P(both red) = ... (1)

A) $\frac{4}{25}$ ✓ **B)** $\frac{2}{15}$

C) $\frac{8}{10}$ **D)** $\frac{2}{5}$

> **Answer: A** — With replacement the bag is unchanged, so it is $\frac{4}{10} \times \frac{4}{10} = \frac{4}{25}$.
>
> - **B** — that is the WITHOUT-replacement answer
> - **C** — ADDED the two probabilities instead of multiplying them
> - **D** — gave the probability of ONE red only

1.10 If P(not A) = 0,35, then P(A) = ... (1)

A) 0,3 **B)** 1,35

C) 0,35 **D)** **0,65** ✓

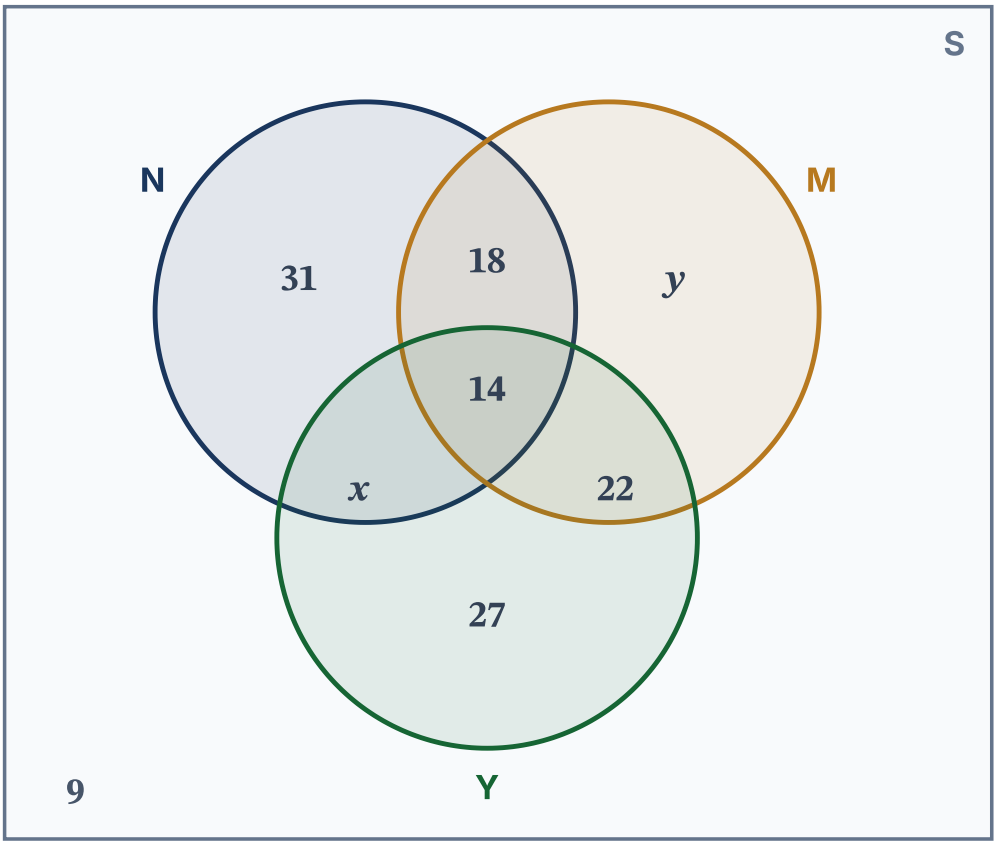
> **Answer: D** — P(A) = 1 − P(not A) = 0,65.
>
> - **A** — subtracted 0,35 from 0,65 rather than from 1
> - **B** — ADDED to 1 instead of subtracting from it
> - **C** — that is P(not A) itself

ANSWER GRID — MARKING GUIDELINE

1.1	(A)	B	C	D
1.2	A	B	(C)	D
1.3	A	B	(C)	D
1.4	A	(B)	C	D
1.5	A	(B)	C	D
1.6	A	B	(C)	D
1.7	A	B	C	(D)
1.8	A	B	C	(D)
1.9	(A)	B	C	D
1.10	A	B	C	(D)

QUESTION 2 **[13 MARKS]**

150 Grade 11 learners were asked which of three streaming services they use: Netflix (N), Showmax (M) or YouTube (Y). The results are shown in the Venn diagram below, where x and y represent numbers of learners. It is further given that $n(\text{N}) = 75$.



2.1 Calculate the value of x. **(3)**

$n(\text{N}) = 31 + 18 + 14 + x$ *(1)*
$75 = 63 + x$ *(1)*
$x = \mathbf{12}$ *(1)*

2.2 Hence calculate the value of y. **(3)**

All eight regions must add up to 150 *(1)*
$31 + 18 + 14 + 12 + 22 + 27 + 9 + y = 150$ *(1)*
$133 + y = 150$, so $y = \mathbf{17}$ *(1)*

2.3 Calculate the probability that a learner chosen at random from this group uses EXACTLY ONE of the three services. **(3)**

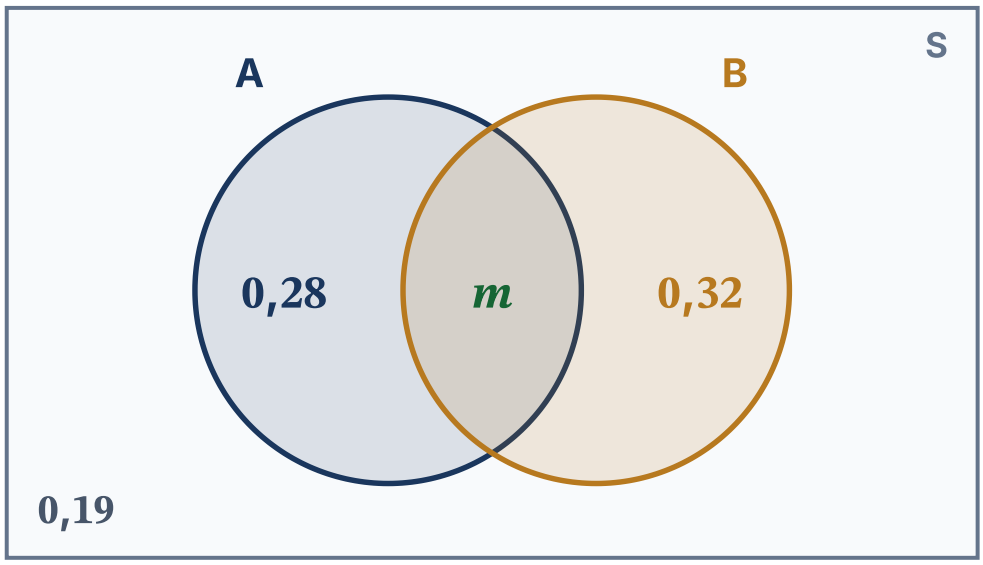
Only the three outer regions count: $31 + 17 + 27$ *(1)*
$= 75$ learners *(1)*
$\text{P} = \frac{75}{150} = \mathbf{0{,}50}$ *(1)*

2.4 Calculate the probability that a learner chosen at random uses Showmax OR YouTube. **(4)**

$n(\text{M}) = 18 + 14 + 22 + 17 = 71$ *(1)*
$n(\text{Y}) = 27 + 22 + 14 + 12 = 75$ *(1)*
$n(\text{M or Y}) = 71 + 75 - 36 = 110$ *(the addition rule)* *(1)*
$\text{P(M or Y)} = \frac{110}{150} = \mathbf{0,73}$ *(1)*

QUESTION 3 [13 MARKS]

The Venn diagram below shows the PROBABILITIES associated with two events A and B in a sample space S. The probability that both A and B occur is m.



3.1 Calculate the value of m. **(3)**

The four regions of a Venn diagram cover the whole sample space, so they add up to 1 *(1)*
$0,28 + m + 0,32 + 0,19 = 1$ *(1)*
$m = \mathbf{0,21}$ *(1)*

3.2 Determine, showing ALL calculations, whether A and B are independent events. **(4)**

$\text{P(A)} = 0,28 + 0,21 = 0,49$ *(1)*
$\text{P(B)} = 0,32 + 0,21 = 0,53$ *(1)*
$\text{P(A)} \times \text{P(B)} = 0,2597$ *(1)*
but $\text{P(A and B)} = 0,21 \neq 0,2597$, so A and B are **NOT independent** *(1)*

3.3 Are A and B mutually exclusive? Give a reason for your answer. **(2)**

No *(1)*
$\text{P(A and B)} = 0,21 \neq 0$, so the two events CAN happen together — the circles overlap *(1)*

3.4 Calculate P(not A or not B). **(4)**

"not A or not B" fails only when A and B BOTH occur *(1)*
$\therefore \text{P(not A or not B)} = 1 - \text{P(A and B)}$ *(1)*
$= 1 - 0,21$ *(1)*
$= \mathbf{0,79}$ *(1)*

QUESTION 4 [10 MARKS]

Two events A and B are such that $P(A) = 0{,}4$ and $P(A \text{ or } B) = 0{,}7$.

4.1 Determine P(B) if A and B are mutually exclusive. **(3)**

> Mutually exclusive means $P(A \text{ and } B) = 0$ *(1)*
> $P(A \text{ or } B) = P(A) + P(B)$: $0{,}7 = 0{,}4 + P(B)$ *(1)*
> $P(B) = \mathbf{0{,}3}$ *(1)*

4.2 Determine P(B) if A and B are independent. **(4)**

> Independent means $P(A \text{ and } B) = P(A) \times P(B)$ *(1)*
> $0{,}7 = 0{,}4 + P(B) - 0{,}4P(B)$ *(1)*
> $0{,}3 = 0{,}6P(B)$ *(1)*
> $P(B) = \mathbf{0{,}5}$ *(1)*

4.3 Hence, for the independent case, calculate P(A and B) and the probability that B occurs but A does NOT. **(3)**

> $P(A \text{ and } B) = 0{,}4 \times 0{,}5 = \mathbf{0{,}2}$ *(1)*
> $P(\text{only B}) = P(B) - P(A \text{ and } B)$ *(1)*
> $= 0{,}5 - 0{,}2 = \mathbf{0{,}3}$ *(1)*

TOTAL: 46 marks

This question paper consists of 4 questions.

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