Probability: Venn Diagrams & the Addition Rule (Grade 10)

MARKING GUIDELINE

MARKS	DURATION	QUESTIONS
35	55 minutes	3

Name: _____ Class: _____

Date: _____

MARK ____ / 35

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 A fair die is rolled once. P(an even number) = ... (1)

A) $\frac{1}{3}$ **B)** $\frac{1}{2}$ ✓

C) $\frac{2}{3}$ **D)** $\frac{1}{6}$

Answer: B — Three of the six faces — 2, 4 and 6 — are even.

- **A** — counted only two even faces instead of three
- **C** — counted four even faces instead of three
- **D** — that is the probability of ONE particular face

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

A) 1,35 **B)** 0,7

C) 0,35 **D)** **0,65** ✓

Answer: D — Complementary probabilities add up to 1.

- **A** — ADDED to 1 instead of subtracting from it
- **B** — doubled P(A) instead of subtracting it from 1
- **C** — that is P(A) itself

1.3 Two events are MUTUALLY EXCLUSIVE when ... (1)

A) **they cannot happen together, so P(A and B) = 0** ✓

B) P(A) = P(B)

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

D) they always happen together

> **Answer: A** — Mutually exclusive events share no outcomes at all.
> - **B** — equal probabilities say nothing about whether the events overlap
> - **C** — that describes COMPLEMENTARY events, a special case
> - **D** — that is the opposite of mutually exclusive

1.4 P(A) = 0,4 and P(B) = 0,3, and A and B are mutually exclusive. Then P(A or B) = ... (1)

A) 0,1

B) 0,12

C) **0,7** ✓

D) 1

> **Answer: C** — For mutually exclusive events P(A or B) = P(A) + P(B), with no overlap to subtract.
> - **A** — subtracted instead of adding
> - **B** — MULTIPLIED the probabilities instead of adding them
> - **D** — assumed the two events fill the whole sample space

1.5 P(A) = 0,5, P(B) = 0,4 and P(A and B) = 0,2. Then P(A or B) = ... (1)

A) 0,9

B) **0,7** ✓

C) 0,2

D) 1,1

> **Answer: B** — P(A or B) = P(A) + P(B) − P(A and B) = 0,5 + 0,4 − 0,2.
> - **A** — forgot to subtract the overlap P(A and B)
> - **C** — that is the overlap itself, not the union
> - **D** — ADDED the overlap instead of subtracting it

1.6 In a class of 60, 8 take History, 41 take Mathematics and 16 take neither. The number taking BOTH is ... (1)

A) 49

B) 16

C) 11

D) **5** ✓

> **Answer: D** — 8 + 41 − both + 16 = 60, so both = 5.
> - **A** — added 8 and 41 without subtracting the overlap
> - **B** — that is the number taking NEITHER subject
> - **C** — left out the 16 who take neither subject

1.7 In that same class, P(a learner takes History ONLY) = ... (1)

A) $\frac{1}{60}$

B) $\frac{1}{12}$

C) $\frac{1}{20}$ ✓

D) $\frac{2}{15}$

> **Answer: C** — History only is 8 − 5 = 3 learners, so the probability is $\frac{3}{60} = \frac{1}{20}$.
> - **A** — used one learner instead of three
> - **B** — used the 5 who take both subjects
> - **D** — used all 8 History learners instead of only those taking History alone

1.8 In that same class, P(a learner does NOT take Mathematics) = ... (1)

A) $\frac{19}{41}$ **B)** $\frac{19}{60}$ ✓

C) $\frac{41}{60}$ **D)** $\frac{16}{60}$

Answer: B — $60 - 41 = 19$ learners do not take Mathematics.

- **A** — divided by 41 instead of by the class total of 60
- **C** — that is P(takes Mathematics), not its complement
- **D** — that counts only those taking NEITHER, leaving out the History-only learners

1.9 Two coins are tossed. The sample space has ... (1)

A) 3 outcomes **B)** 2 outcomes

C) 4 outcomes ✓ **D)** 8 outcomes

Answer: C — HH, HT, TH and TT — two choices for each of the two coins.

- **A** — counted HT and TH as a single outcome
- **B** — that is the number of outcomes for ONE coin
- **D** — that is the count for THREE coins

1.10 A bag holds 5 red, 3 blue and 2 green marbles. P(not red) = ... (1)

A) $\frac{1}{2}$ ✓ **B)** $\frac{1}{5}$

C) $\frac{1}{10}$ **D)** $\frac{3}{10}$

Answer: A — $3 + 2 = 5$ marbles are not red, out of 10 altogether.

- **B** — counted only the green marbles
- **C** — used one marble instead of the five that are not red
- **D** — counted only the blue marbles

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]

In a school of 70 Grade 10 learners, 32 learners take Economics (E), 43 take Mathematics (M) and 15 take NEITHER of these two subjects. Let the number of learners who take both subjects be x.

2.1 Show that $x = 20$. **(4)**

> Learners taking at least one subject: $70 - 15 = 55$ *(1)*
> $(32 - x) + x + (43 - x) = 55$ *(2)*
> $75 - x = 55$, so $\boldsymbol{x = 20}$ *(1)*

2.2 Write down the number of learners who take Economics ONLY and the number who take Mathematics ONLY, and show that all 70 learners are accounted for. **(3)**

> Economics only $= 32 - 20 = \mathbf{12}$ *(1)*
> Mathematics only $= 43 - 20 = \mathbf{23}$ *(1)*
> $12 + 20 + 23 + 15 = 70$ ✓ — every learner is in exactly one region *(1)*

2.3 Determine the probability that a learner chosen at random takes BOTH subjects. **(3)**

> P(E and M) $= \frac{20}{70}$ *(2)* $= \frac{\mathbf{2}}{\mathbf{7}}$ *(1)*

2.4 Determine the probability that a learner chosen at random takes AT LEAST ONE of the two subjects. **(3)**

> $12 + 20 + 23 = 55$ *(1)*
> P $= \frac{55}{70}$ *(1)* $= \frac{\mathbf{11}}{\mathbf{14}}$ *(1)*

QUESTION 3 [12 MARKS]

A and B are two events. It is given that P(A) $= 0{,}4$; P(B) $= 0{,}35$; P(A and B) $= 0{,}1$.

3.1 Calculate P(A or B). **(3)**

> P(A or B) = P(A) + P(B) − P(A and B) *(1)*
> $= 0{,}4 + 0{,}35 - 0{,}1$ *(1)* $= \mathbf{0{,}65}$ *(1)*

3.2 Are A and B mutually exclusive? Give a reason for your answer. **(3)**

> **No** *(1)*
> P(A and B) $= 0{,}1$ *(1)*
> $0{,}1 \neq 0$, so A and B can happen at the same time *(1)*

3.3 Calculate the probability that EXACTLY ONE of the events A and B occurs. **(4)**

> P(A only) $= 0{,}4 - 0{,}1$ *(1)* $= 0{,}3$ *(1)*
> P(B only) $= 0{,}35 - 0{,}1 = 0{,}25$ *(1)*
> P(exactly one) $= 0{,}3 + 0{,}25 = \mathbf{0{,}55}$ *(1)*

3.4 Calculate the probability that NEITHER A nor B occurs. **(2)**

> $1 - 0{,}65$ *(1)* $= \mathbf{0{,}35}$ *(1)*

TOTAL: 35 marks

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