MARKING GUIDELINE

MARKS	DURATION	QUESTIONS
31	50 minutes	3

Name: _____ Class: _____

Date: _____

MARK _____ / 31

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 The AMPLITUDE of $y = 3\sin x$ is ... (1)

A) 1 **B)** 0

C) 6 **D)** 3 ✓

Answer: D — In $y = a\sin x$ the amplitude is the size of a.

- **A** — that is the amplitude of $y = \sin x$, before the stretch
- **B** — 0 is the vertical shift here, not the amplitude
- **C** — that is the full distance from minimum to maximum, which is TWICE the amplitude

1.2 The RANGE of $y = \sin x$ is ... (1)

A) $y \in \mathbb{R}$ **B)** $-360° \leq y \leq 360°$

C) $-1 \leq y \leq 1$ ✓ **D)** $0 \leq y \leq 1$

Answer: C — The sine curve oscillates between -1 and 1.

- **A** — the sine curve is bounded, so its range is not all of R
- **B** — that is a range of x-values, not of y-values
- **D** — the curve dips BELOW the x-axis as well

1.3 The RANGE of $y = 2\cos x + 1$ is ... (1)

A) $-2 \leq y \leq 2$ **B)** $-1 \leq y \leq 3$ ✓

C) $0 \leq y \leq 3$ **D)** $1 \leq y \leq 3$

Answer: B — $2\cos x$ runs from -2 to 2, and the $+1$ lifts both ends.

- **A** — forgot the vertical shift of $+1$
- **C** — the minimum is $-2 + 1 = -1$, not 0
- **D** — the minimum is -1; 1 is the shift, not the lowest value

1.4 On $[0° ; 360°]$, $y = \tan x$ has asymptotes at ... (1)

A) $x = 90°$ **and** $x = 270°$ ✓ **B)** $x = 0°$ and $x = 180°$

C) it has no asymptotes **D)** $x = 180°$ and $x = 360°$

> **Answer: A** — $\tan x$ is undefined wherever $\cos x = 0$, which happens at $90°$ and $270°$.
> - **B** — $\tan 0°$ and $\tan 180°$ are both 0 — those are x-intercepts
> - **C** — $\tan x$ is undefined twice inside this interval
> - **D** — $\tan 180°$ and $\tan 360°$ are both 0 — those are x-intercepts

1.5 The PERIOD of $y = \sin x$ is ... (1)

A) $180°$ **B)** 1

C) $90°$ **D)** $360°$ ✓

> **Answer: D** — The sine curve repeats itself every $360°$.
> - **A** — that is the period of $y = \tan x$
> - **B** — 1 is the amplitude, not the period
> - **C** — that is a quarter of the sine curve, not a whole one

1.6 The graph of $y = \cos x$ cuts the y-axis at ... (1)

A) $(0 ; 1)$ ✓ **B)** $(0 ; 0)$

C) $(1 ; 0)$ **D)** $(0 ; -1)$

> **Answer: A** — $\cos 0° = 1$.
> - **B** — that is where $y = \sin x$ cuts the y-axis
> - **C** — the coordinates are the wrong way round
> - **D** — $\cos 180° = -1$, but the y-axis is at $x = 0$

1.7 On $[0° ; 360°]$, $y = \sin x$ equals ZERO at ... (1)

A) $0°$, $180°$ **and** $360°$ ✓ **B)** $0°$ and $360°$ only

C) $180°$ only **D)** $90°$ and $270°$

> **Answer: A** — The sine curve crosses the x-axis at the start, the middle and the end of the interval.
> - **B** — it crosses at $180°$ as well
> - **C** — it crosses at $0°$ and at $360°$ as well
> - **D** — at $90°$ and $270°$ the curve is at its maximum and minimum, not at zero

1.8 The graph of $y = \sin x + 2$ ... (1)

A) cuts the x-axis twice **B)** **never cuts the** x**-axis** ✓

C) has amplitude 2 **D)** cuts the x-axis once

> **Answer: B** — Its range is $1 \leq y \leq 3$, so the whole curve stays above the x-axis.
> - **A** — the lowest point is $y = 1$, which is still above the axis
> - **C** — 2 is the vertical SHIFT; the amplitude is still 1
> - **D** — there is no value of x for which $y = 0$ at all

1.9 Compared with $y = \sin x$, the graph of $y = -\sin x$ is ... (1)

A) shifted down 1 unit
B) reflected in the x-axis ✓
C) reflected in the y-axis
D) shifted $90°$ to the right

> **Answer: B** — A minus in front of the whole function turns every y-value into its negative.
> - **A** — a reflection is not a shift — the maximum is still 1, not 0
> - **C** — a reflection in the y-axis would need $-x$ INSIDE the function
> - **D** — that would be a horizontal shift, written $\sin(x - 90°)$

1.10 The MAXIMUM value of $y = 4 \sin x - 1$ is ... (1)

A) 5
B) 4
C) 3 ✓
D) -1

> **Answer: C** — $\sin x$ is at most 1, so the maximum is $4(1) - 1 = 3$.
> - **A** — ADDED the 1 instead of subtracting it
> - **B** — forgot to subtract the 1
> - **D** — that is the vertical shift, not the maximum

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 [11 MARKS]

Consider $f(x) = 2 \sin x$ and $g(x) = \cos x - 1$ for $x \in [0° ; 360°]$.

2.1 Write down the amplitude and the period of f. (2)

> Amplitude **2** *(1)*; period **360°** *(1)*

2.2 Write down the range of f and the range of g. (3)

> f: $\mathbf{-2 \leq y \leq 2}$ *(1)*
> g: $\mathbf{-2 \leq y \leq 0}$ *(2)*

2.3 Write down the coordinates of the maximum turning point of f and the minimum turning point of g. (3)

> f: **(90° ; 2)** *(1)*
> g: **(180° ; −2)** *(2)*

2.4 Determine the values of x for which $f(x) = 0$ on this interval. **(3)**

> $2 \sin x = 0$ *(1)*
> $\sin x = 0$ *(1)*
> **$x = 0°$, $180°$ or $360°$** *(1)*

QUESTION 3 [10 MARKS]

Answer the questions below.

3.1 Describe the transformation from $y = \cos x$ to $y = \cos x + 3$, and write down the new range. **(3)**

> A vertical shift of **3 units UP** *(1)*
> Range: **$2 \leq y \leq 4$** *(2)*

3.2 Write down the equations of the asymptotes of $y = \tan x$ for $x \in [0° ; 360°]$, and explain why they occur there. **(4)**

> **$x = 90°$** and **$x = 270°$** *(2)*
> $\tan x = \frac{\sin x}{\cos x}$ *(1)*, and $\cos x = 0$ at those values *(1)*

3.3 Explain the difference between the effect of a and the effect of q in $y = a \sin x + q$. **(3)**

> a changes the AMPLITUDE — how far the wave rises and falls from its middle *(1)*
> q shifts the whole wave UP or DOWN *(1)*
> a stretches it, q moves it *(1)*

TOTAL: 31 marks

This question paper consists of 3 questions.

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