revise.wales - Mark Scheme

Mock Paper A - Unit 2: Non-calculator (Higher Tier)

80 marks. R.WM-MNH-U2-001 (MS).

Notation. Mn = method mark; An = accuracy / answer mark; Bn = independent unsupported correct value; Cn = communication (OCW); ft = follow through from a prior error; oe = or equivalent; cao = correct answer only.

Question 1 **(5 marks)**

(a) **B1** LCM $= \mathbf{2^4} \times \mathbf{3^3} \times \mathbf{5} \times \mathbf{7}$ (take highest power of each prime; cao).
B1 HCF $= \mathbf{2^2} \times \mathbf{3^2}$ (take lowest power of each shared prime; cao). Do not award if a non-shared prime (5 or 7) appears in the HCF.

(b) **(i)** **B1** $2^{10-3-4} = \mathbf{2^3}$ (cao). Accept 2^3 unevaluated; do not penalise $= 8$.

(ii) **B1** $(3^2)^4 \times 3^{-5} = 3^8 \times 3^{-5} = \mathbf{3^3}$ (cao). Award M1 not B1 if $(3^2)^4 = 3^6$ is seen (adding instead of multiplying indices).

(c) **B1** Rewrite $6{\cdot}4 \times 10^{-7} = 64 \times 10^{-8}$ (so the index is even and the mantissa is a perfect square); then $\sqrt{64 \times 10^{-8}} = 8 \times 10^{-4}$. Answer: $\mathbf{8 \times 10^{-4}}$ (cao). Reject $\sqrt{6{\cdot}4} \times 10^{-3{\cdot}5}$ — must be in proper standard form with integer index. Award 0 for $0{\cdot}0008$ without index form.

Question 2 **(7 marks)**

(a) **M1** $\sqrt{50} = 5\sqrt{2}$, $\sqrt{8} = 2\sqrt{2}$ so $3\sqrt{8} = 6\sqrt{2}$, and $\sqrt{72} = 6\sqrt{2}$. At least two of three simplified correctly.
A1 $5\sqrt{2} + 6\sqrt{2} - 6\sqrt{2} = \mathbf{5\sqrt{2}}$ (cao; $k = 5$).

(b) **M1** Expand all four products: $\sqrt{3}\cdot 2\sqrt{3} - \sqrt{3}\cdot\sqrt{2} + 2\sqrt{2}\cdot 2\sqrt{3} - 2\sqrt{2}\cdot\sqrt{2} = 6 - \sqrt{6} + 4\sqrt{6} - 4$. Award for at least three of four terms correct (in particular $2\sqrt{3}\cdot\sqrt{3} = 6$ and $2\sqrt{2}\cdot\sqrt{2} = 4$, not $\sqrt{6}$ or $\sqrt{4}$).
A1 Collect: $\mathbf{2 + 3\sqrt{6}}$ (cao; $a = 2$, $b = 3$).

(c) *"Show that" - algebra must be visible.* **M1** Let $x = 0{\cdot}18383\ldots$; state $10x = 1{\cdot}8383\ldots$ and $1000x = 183{\cdot}8383\ldots$ (multiplying by powers chosen so the recurring tails align).
M1 Subtract: $1000x - 10x = 183{\cdot}8383\ldots - 1{\cdot}8383\ldots = 182$, so $990x = 182$.
A1 $x = \dfrac{182}{990} = \mathbf{\dfrac{91}{495}}$ (divide top and bottom by 2). Both lines of working required for full marks - final answer alone earns at most A1.

Question 3 **(8 marks)**

(a) **M1** Expand: $2x^2 + 10x - 3x - 15$ (at least three of four terms correct).
A1 $\mathbf{2x^2 + 7x - 15}$ (cao).

(b) **M1** Identify common factor $3x$ (must take out both the 3 and the x for M1).
A1 $\mathbf{3x(2x - 5)}$ (cao). Award M1 only for partial factoring such as $3(2x^2 - 5x)$ or $x(6x - 15)$.

(c) **M1** Identify two numbers with product $2 \times (-12) = -24$ and sum $+5$: $+8$ and -3; split middle term $2x^2 + 8x - 3x - 12$ or equivalent trial.

A1 $(\mathbf{2x} - \mathbf{3})(\mathbf{x} + \mathbf{4})$ (cao). Accept $(x+4)(2x-3)$.

(d) **M1** Factorise numerator and denominator: $2x^2 + x - 6 = (2x-3)(x+2)$ (non-monic — find two numbers with product $2 \times (-6) = -12$ and sum $+1$: $+4$ and -3, splitting middle term); $x^2 - 4 = (x-2)(x+2)$ (difference of two squares).

A1 Cancel $(x+2)$: $\mathbf{\dfrac{2x-3}{x-2}}$ (cao; oe). Do not award A1 if cancellation is performed before factorisation (e.g. "cancelling the x^2 terms").

Question 4 **(9 marks)**

(a) **M1** Multiply throughout by 12: $3(3x+1) - 4(x-2) = 24$.

M1 Expand and collect: $9x + 3 - 4x + 8 = 24 \Rightarrow 5x + 11 = 24$.

A1 $\mathbf{x} = \mathbf{\dfrac{13}{5}}$ (oe; accept $2{\cdot}6$ or $2\frac{3}{5}$; cao).

(b) **M1** Rearrange: $5 - 2x \leq 4x - 13 \Rightarrow 18 \leq 6x$ (oe).

A1 $\mathbf{x} \geq \mathbf{3}$ (cao). Award M1 not A1 for $x > 3$ or $3 \leq x$ written without re-orientation.

B1 Number line: closed (filled) circle at 3 with arrow extending to the right. Open circle scores 0 here.

(c) **M1** Divide by 2π then square both sides: $\dfrac{T}{2\pi} = \sqrt{\dfrac{L}{g}} \Rightarrow \dfrac{T^2}{4\pi^2} = \dfrac{L}{g}$. (Award equivalently for squaring first to give $T^2 = 4\pi^2 \dfrac{L}{g}$.)

M1 Make g the subject: multiply both sides by g, then divide by $\dfrac{T^2}{4\pi^2}$ (or rearrange directly from $T^2 g = 4\pi^2 L$).

A1 $\mathbf{g} = \mathbf{\dfrac{4\pi^2 L}{T^2}}$ (cao; oe). Award M1M0A0 if the candidate cancels the square root without squaring (common error: $g = \dfrac{4\pi^2 L}{T}$).

Question 5 **(10 (incl. 2 OCW) marks)**

(a) **M1** Identify common difference $d = 4$ and first term $a = 5$; form $a + (n-1)d$ or equivalent $4n + c$.

A1 nth term $=$ $\mathbf{4n} + \mathbf{1}$ (cao).

M1 Substitute $n = 50$: $4(50) + 1$.

A1 Pattern 50 has **201** tiles (ft from their linear nth term).

(b) *OCW - working must be in connected sentences.* **M1** State the nth term of the new sequence: $4n + 3$ (common difference 4, first term 7).

M1 Form the equation $4n + 3 = 2025$.

M1 Solve: $4n = 2022$, so $n = 505{\cdot}5$.

A1 Conclusion: since n must be a positive integer and $505{\cdot}5$ is not, **2,025** is not a term in the sequence; the student is **not correct**. (cao - must explicitly reject the claim.)

C1 (OCW) Working reads as connected English sentences: defines the nth term, sets up the equation, states the solution and draws a conclusion.

C1 (OCW) Correct mathematical notation throughout (equals signs aligned, n clearly defined as the pattern number; conclusion references integer values explicitly).

Question 6 **(11 marks)**

(a) **M1** Factorise: $(x-7)(x+2)=0$ (two numbers with product -14, sum -5).

A1 **x** $=$ **7** or **x** $=-$**2** (both required; cao).

(b) *"Show that" - algebra must be visible.* **M1** Area equation: $(2x+1)(x-1)=20$; expand to $2x^2-2x+x-1=20$.

A1 Rearrange to $\mathbf{2x^2}-\mathbf{x}-\mathbf{21}=\mathbf{0}$ (with at least one intermediate line shown).

M1 Factorise $(2x-7)(x+3)=0$ so $x=\frac{7}{2}$ or $x=-3$; reject $x=-3$ because width $x-1$ would be negative (a length cannot be negative).

A1 Length $=2(\frac{7}{2})+1=$ **8** m; width $=\frac{7}{2}-1=$ **2·5** m (or $\frac{5}{2}$). Justification of choice of root is required.

(c) **B1** Table completed: $x=1\Rightarrow y=-4$; $x=2\Rightarrow y=-3$; $x=4\Rightarrow y=5$ (all three required; one error costs the B1).

M1 Plot all seven points correctly to within half a small square (at least five of seven correct for the M1).

A1 Smooth parabolic curve through all seven points (no straight-line segments; symmetric about $x=1$).

B1 Recognise $x^2-2x=0\Leftrightarrow x^2-2x-3=-3$, so draw the horizontal line **y** $=-$**3** on the same grid. Award only if the line is drawn (not merely stated).

B1 Read off intersections of the parabola with $y=-3$: **x** $=$ **0** and **x** $=$ **2** (ft from their curve, accept $\pm 0{\cdot}1$). Both roots required.

Question 7 **(11 marks)**

(a) **M1** Exterior angle $=180-156=24°$; number of sides $=360/24$.

A1 **15** sides (cao). Accept direct route via $\frac{(n-2)\times 180}{n}=156$.

(b) **M1** Identify the relationship: angles marked $(3x+10)°$ and $(5x-30)°$ are alternate angles between parallels $AB \parallel CD$, hence equal.

A1 Form $3x+10=5x-30\Rightarrow 2x=40$; so **x** $=$ **20** (cao).

B1 Reason explicitly stated: "alternate angles between parallel lines are equal" (oe; "Z-angles" alone is insufficient at higher tier).

(c) **A1** Angle $ACB=$ **64**° (cao).

B1 Reason: "the alternate segment theorem" - the angle between the tangent TA and chord AB equals the angle in the alternate segment (ACB) (oe).

B1 Statement of which two angles are being equated, not just the value (e.g. "$\angle TAB=\angle ACB$ by alternate segment").

(d) **M1** Recognise $ABCD$ is a cyclic quadrilateral, so opposite angles sum to $180°$: $\angle ABC+\angle ADC=180$.

A1 $\angle ADC=180-48=$ **132**° (cao).

B1 Reason: "opposite angles of a cyclic quadrilateral sum to $180°$" explicitly stated.

Question 8 **(8 marks)**

(a) **M1** Reflection in $y=1-x$ maps $(x,y)\rightarrow(1-y,1-x)$ (not through the origin - candidates who use $(x, y) \to (-y, -x)$ have used the wrong axis; cap at M0). Apply to at least two vertices: $(1, 1) \to (0, 0)$, $(4, 1) \to (0, -3)$, $(1, 3) \to (-2, 0)$.

A1 Triangle A drawn correctly with all three vertices at $(0, 0)$, $(0, -3)$, $(-2, 0)$ and labelled A (cao).

(b) **M1** Rotation $90°$ anticlockwise about $(-1, 1)$ maps $(x, y) \to (-1-(y-1),\ 1+(x-(-1))) = (-y, x+2)$. Apply to at least two vertices: $(1, 1) \to (-1, 3)$, $(4, 1) \to (-1, 6)$, $(1, 3) \to (-3, 3)$. (Candidates who rotate about the origin and then translate equivalently also score M1.)

A1 Three image vertices at $(-1, 3)$, $(-1, 6)$, $(-3, 3)$ correctly plotted.

B1 Triangle B drawn and labelled B (cao).

(c) **M1** Test mapping: $(1, 1) \to (-2, -2)$, $(4, 1) \to (-8, -2)$, $(1, 3) \to (-2, -6)$ - each image vertex is -2 times the corresponding original vertex.

A1 Identify as an **enlargement** with **scale factor** -2 and **centre** $(0, 0)$ (the origin).

B1 All three descriptors stated together - type, scale factor (with sign), and centre. Missing any one descriptor caps at A1.

Question 9 (11 marks)

(a) **B1** Sample space table completed correctly:

$+$	$B=2$	$B=3$	$B=5$	$B=7$
$A=1$	3	4	6	8
$A=2$	4	5	7	9
$A=3$	5	6	8	10
$A=4$	6	7	9	11

(at least 14 of 16 entries correct for B1).

M1 Identify primes among the 16 sums: $\{3, 5, 7, 5, 7, 5, 7, 11\}$ - six entries are prime ($3, 5, 5, 5, 7, 7, 7, 11$; count = 6). Award for any clear indication that exactly 6 outcomes are prime.

A1 $P(\text{prime}) = \dfrac{6}{16} = \mathbf{\dfrac{3}{8}}$ (cao; must be in simplest form).

(b) **B1** Tree-diagram second-draw probabilities all correct: from R: $\frac{4}{7}$ (R), $\frac{3}{7}$ (B); from B: $\frac{5}{7}$ (R), $\frac{2}{7}$ (B).

M1 Identify "different colours" as RB or BR: $P(RB) = \frac{5}{8} \times \frac{3}{7}$, $P(BR) = \frac{3}{8} \times \frac{5}{7}$.

M1 Sum: $\frac{15}{56} + \frac{15}{56} = \frac{30}{56}$.

A1 $\mathbf{\dfrac{15}{28}}$ (cao; must be in simplest form - $\frac{30}{56}$ alone scores M1A0).

(c) *"Show that" - algebra must be visible.* **M1** State $P(\text{both green}) = \dfrac{n}{n+4} \times \dfrac{n-1}{n+3} = \dfrac{1}{3}$.

M1 Cross-multiply: $3n(n-1) = (n+4)(n+3)$; expand to $3n^2 - 3n = n^2 + 7n + 12$.

A1 Rearrange to $2n^2 - 10n - 12 = 0$; divide by 2 to obtain $\mathbf{n^2 - 5n - 6 = 0}$ (intermediate line required).

A1 Factorise $(n-6)(n+1) = 0$; reject $n = -1$ (a count of counters cannot be negative); so $\mathbf{n = 6}$. Justification required for full marks.

Total: $5 + 7 + 8 + 9 + 10 + 11 + 11 + 8 + 11 = $ **80 marks.**

OCW marks (Q5): the 2 *OCW marks are included in the question total of* 10. *To award full OCW the candidate's working must read as connected English sentences with correct mathematical notation throughout, including an explicit conclusion that addresses the student's claim.*