Secondary 3 Mathematics
WA3 Revision Time Trial — Broadrick (2023)

Duration: 36 minutes **Score: _____ / 24**

Topics tested: Graphs of Functions; Further Trigonometry.

Section A: Graphs of Functions [10 marks]

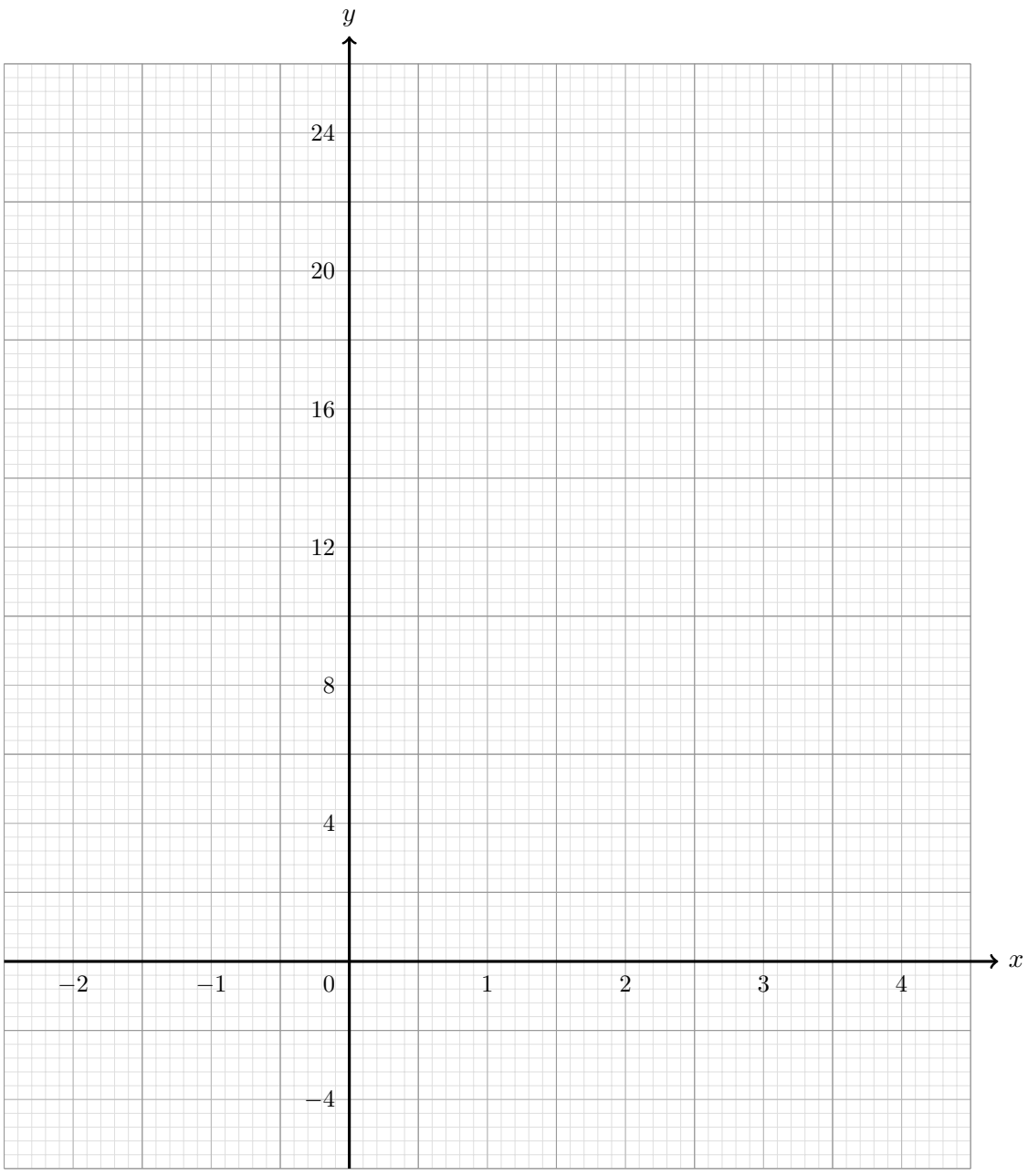
1. The variables x and y are connected by the equation $y = -x^3 + 4x^2 - 3$.
Some corresponding values of x and y are given in the table below.

x	-2	-1.5	-1	0	1	2	2.5	3	4
y	21	a	2	-3	0	5	6.4	6	-3

(a) Find the value of a, correct to 1 decimal place. *[1]*

Answer $a =$ .....

(b) Using the grid on the next page, draw the graph of $y = -x^3 + 4x^2 - 3$ for $-2 \leq x \leq 4$. *[2]*


y
x
24
20
16
12
8
4
−4
−2
−1
0
1
2
3
4

(c) By drawing a tangent, find the gradient of the curve at the point where $x = -1$. *[2]*

Answer .....

(d) The horizontal line $y = k$ touches the curve $y = -x^3 + 4x^2 - 3$ at only one point.
State one possible positive integer value of k. *[1]*

Answer $k =$ .....

(e) The equation $-2x^3 + 8x^2 - 3x - 4 = 0$ can be solved by drawing a suitable straight line on the grid.

(i) Find the equation of this straight line. *[1]*

Answer .....

(ii) By drawing the line in **(e)(i)**, find the three solutions to the equation $-2x^3 + 8x^2 - 3x - 4 = 0$.
[3]

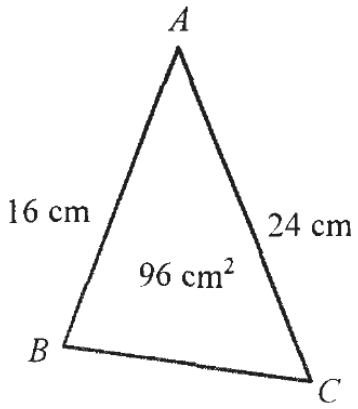
Answer $x =$ ..... *or* ..... *or* .....

Section B: Further Trigonometry [14 marks]

2. Given that $6 \sin x = 4$, find the two possible values for angle x, where $0° \leq x \leq 180°$. *[2]*

Answer $x =$ ..... ° *or* ..... °

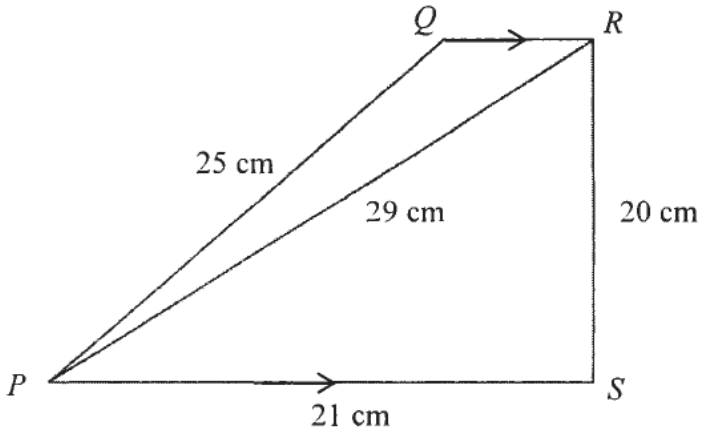
3. The area of triangle ABC is 96 cm^2.
Two of the sides are of length 24 cm and 16 cm respectively.



Find the length of the third side. *[4]*

Answer ..... cm

4. In trapezium $PQRS$, $PQ = 25$ cm, $PS = 21$ cm, $PR = 29$ cm and $RS = 20$ cm. QR is parallel to PS.



(a) Show that triangle PRS is a right-angled triangle. *[2]*

Answer .....

.....

.....

(b) (i) Write down the value of tan $\angle PRS$. *[1]*

Answer tan $\angle PRS =$ .....

(ii) Find angle PRQ. *[2]*

Answer $\angle PRQ =$ .... $^\circ$

(iii) Hence, or otherwise, find angle QPR, given that angle PQR is obtuse. *[3]*

Answer $\angle QPR =$ .... $^\circ$

— END OF PAPER —

Answer Key
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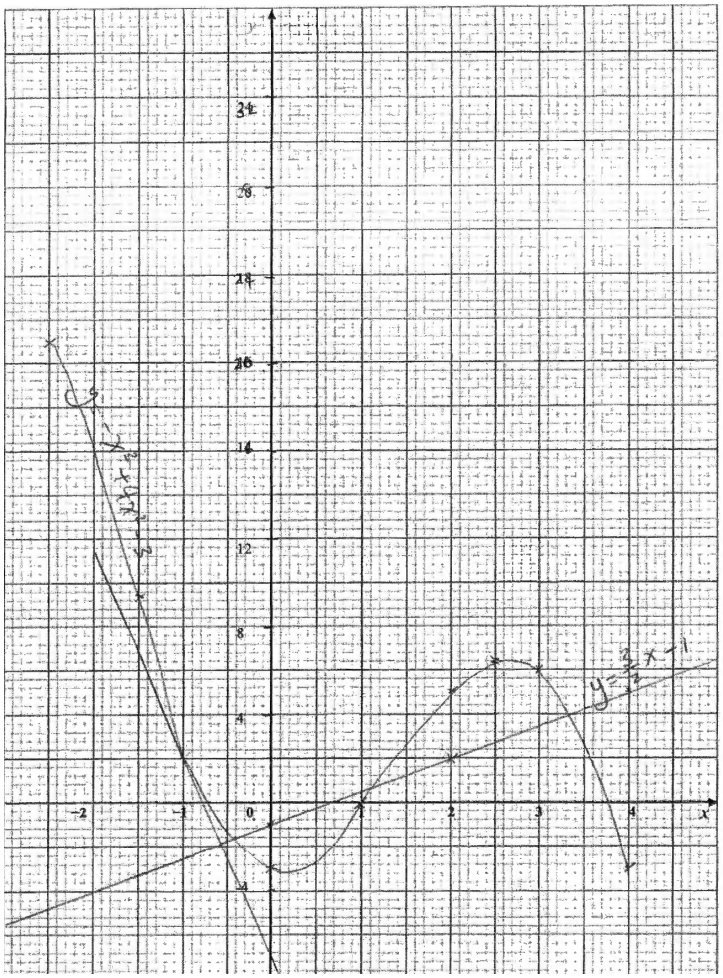
Section A: Graphs of Functions [10 marks]

1(a) At $x = -1.5$: $y = -(-3.375) + 4(2.25) - 3 = 9.375$. $\therefore a =$ **9.4** (1 d.p.). *[1]*

1(b) All nine points plotted and joined with a smooth curve: falling from $(-2,\ 21)$ to a local minimum at $(0,\ -3)$, rising to a local maximum $\approx (2.7,\ 6.5)$, then falling to $(4,\ -3)$. *[2]*



(Marking scheme graph shown, including the line $y = \frac{3}{2}x - 1$ for (e).)

1(c) Tangent drawn at $x = -1$.
Exact gradient: $\dfrac{dy}{dx} = -3x^2 + 8x = -3 - 8 = -$**11** (accept -8 to -13.5). *[2]*

1(d) $y = k$ meets the curve only once when k is above the local maximum (≈ 6.5):
e.g. **k** $=$ **8** (accept $k = 7$ or any larger integer within the grid). *[1]*

1(e)(i) $-2x^3 + 8x^2 - 3x - 4 = 0 \ \Rightarrow\ -x^3 + 4x^2 - \dfrac{3}{2}x - 2 = 0$
$\Rightarrow\ -x^3 + 4x^2 - 3 = \dfrac{3}{2}x - 1$. So draw **y** $= \dfrac{\mathbf{3}}{\mathbf{2}}$**x** $-$ **1**. *[1]*

1(e)(ii) Where the line cuts the curve: **x** $\approx$ **3.9**, **1.1** and $-$**0.5** (accept ± 0.1 each). *[3]*

Section B: Further Trigonometry [14 marks]

2. $\sin x = \frac{4}{6} \Rightarrow x = 41.8°$ or $180° - 41.8° = 138.2°$ (1 d.p.). *[2]*

3. $\frac{1}{2}(24)(16)\sin\angle BAC = 96 \Rightarrow \sin\angle BAC = \frac{1}{2} \Rightarrow \angle BAC = 30°$ (acute, from the diagram).
By the Cosine Rule: $BC^2 = 16^2 + 24^2 - 2(16)(24)\cos 30° = 166.89\ldots$
$BC =$ **12.9** cm (3 s.f.). *[4]*

4(a) $PR^2 = 29^2 = 841$ and $RS^2 + PS^2 = 20^2 + 21^2 = 841$.
Since $PR^2 = RS^2 + PS^2$, $\angle RSP$ is a right angle and triangle PRS is right-angled
(by the **Converse of Pythagoras' Theorem**). *[2]*

4(b)(i) $\tan\angle PRS = \frac{PS}{RS} =$ **$\frac{21}{20}$**. *[1]*

4(b)(ii) $\angle PRS = \tan^{-1}\frac{21}{20} = 46.397\ldots°$
$QR \parallel PS$, so $\angle QRS = 90°$ and $\angle PRQ = 90° - 46.397\ldots° =$ **43.6**° (1 d.p.). *[2]*

4(b)(iii) By the Sine Rule in triangle PQR: $\frac{\sin\angle PQR}{29} = \frac{\sin 43.602\ldots°}{25}$
$\sin\angle PQR = 0.8000\ldots \Rightarrow \angle PQR = 53.1°$ or $126.9°$; given obtuse, $\angle PQR = 126.869\ldots°$.
$\angle QPR = 180° - 126.869\ldots° - 43.602\ldots° =$ **9.5**° (1 d.p.). *[3]*