NORMANHURST BOYS HIGH SCHOOL

MATHEMATICS ADVANCED

2019 Year 11 Course Assessment Task 2

y-day, xx May 2019

General instructions

- Working time – 1 hour.
  (plus 5 minutes reading time)
- Write using blue or black pen. Where diagrams are to be sketched, these may be done in pencil.
- NESA approved calculators may be used.
- Attempt **all** questions.
- At the conclusion of the examination, bundle the booklets used in the correct order within this paper and hand to examination supervisors.

SECTION I

- Mark your answers on the answer grid provided (on page 3)

SECTION II

- Commence each new question on a new booklet. Write on both sides of the paper.
- All necessary working should be shown in every question. Marks may be deducted for illegible or incomplete working.

NESA STUDENT #: ..... **# BOOKLETS USED:** .....

Marker's use only.

QUESTION	1-5	1	2	3	??	??	Total	%
MARKS	/5	/10	/6	/4	/11	/7	/43	

Section I

5 marks
Attempt Question 1 to 5
Allow approximately 10 minutes for this section

Mark your answers on the answer grid provided (labelled as page 3).

Questions **Marks**

1. What is the solution to the equation $\cos\left(\frac{\theta}{2}+30^\circ\right)=\sin\theta$ for $0^\circ\leq\theta\leq 90^\circ$? **1**

(A) $\theta=20^\circ$ (B) $\theta=30^\circ$ (C) $\theta=40^\circ$ (D) $\theta=50^\circ$

2. What are the values of a and b if $a+b\sqrt{2}\equiv\dfrac{2}{3+\sqrt{2}}$? **1**

(A) $a=\frac{6}{7}$, $b=-\frac{2}{7}$

(B) $a=\frac{6}{7}$, $b=\frac{2}{7}$

(C) $a=\frac{6}{5}$, $b=\frac{2}{5}$

(D) $a=\frac{6}{5}$, $b=-\frac{2}{5}$

3. Determine the type of roots for the following equation:

$$4x^2-4x+1=0$$

(A) Two distinct, real roots

(B) Irrational roots

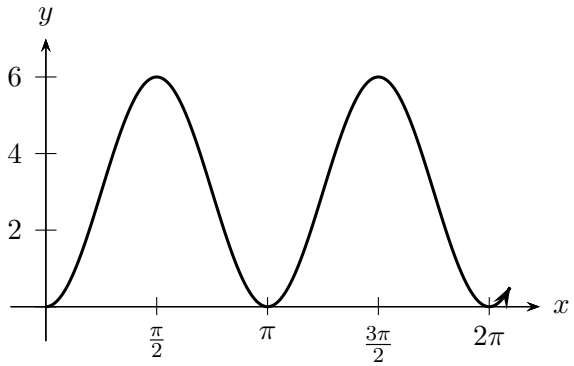
(C) One pair of unreal roots

(D) One pair of equal roots

4. What is $\dfrac{\tan\theta\sec\theta}{1+\tan^2\theta}$ in simplest form?

(A) $\sin\theta$ (B) $\cos\theta$ (C) $\tan\theta$ (D) $\sin\theta\cos\theta$

5. The equation of the graph below takes the form $y = A\cos Bx + 3$. **1**



Which of the following are the values of A and B?

(A) $A = 3, B = -2$

(B) $A = -3, B = 2$

(C) $A = 6, B = 3$

(D) $A = -6, B = \pi$

Answer grid for Questions 1 - 5

1 – Ⓐ Ⓑ Ⓒ Ⓓ
2 – Ⓐ Ⓑ Ⓒ Ⓓ
3 – Ⓐ Ⓑ Ⓒ Ⓓ
4 – Ⓐ Ⓑ Ⓒ Ⓓ
5 – Ⓐ Ⓑ Ⓒ Ⓓ

Examination continues overleaf. . .

Question 1 (8 Marks) Commence a NEW booklet. **Marks**

(a) Fully simplify:

i. $8x - 2y + 4x + 9x + z - 2y$. **1**

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ii. $(2p - 5)^2 - (2p + 5)^2$. **2**

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(b) $\dfrac{5}{2k + 6} + \dfrac{k}{k^2 - 9}$. **3**

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(c) Solve for x and y: **2**

$$\begin{cases} 7x - 3y = 41 \\ 3x - y = 17 \end{cases}$$

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Question 2 (22 Marks) Commence a NEW booklet. **Marks**

(a) Is the function $f(x) = x^3 - x$ odd or even? Justify your answer with the appropriate reasoning. **2**

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(b) Find the domain and range of the following, writing in interval notation:

i. $y = 3x^2 - 1$. **1**

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ii. $y = \dfrac{1}{x-2}$. **2**

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iii. $y = -\sqrt{9 - x^2}$. **2**

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(c) Suppose $f : x \mapsto x^2 + 1$ and $g : x \mapsto 3 - x$.

Find:

i. $f \circ g(2)$. **1**

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ii. $g \circ f(x)$, in simplest form. **2**

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iii. Find the value(s) of x such that $g \circ f(x) = f(x)$. **2**

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(d) Solve for x: $|7 - 3x| = 1$. **2**

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Question 2 continues overleaf. . .

(e) Sketch the following graphs on separate number planes. Showing all important features, including x and y intercepts.

i. $y = (x-1)(x+3)(4-x)$. **2**

ii. $y = -x^2 - 4x + 5$. **2**

iii. $y = \sqrt{x+3}$ **2**

iv. $y = |x-2|+1$ **2**

Question 3 (17 Marks) Commence a NEW booklet. **Marks**

(a) In $\triangle ABC$, $\angle BAC = 50°$, $AC = 40\,\text{cm}$ and $BC = 25\,\text{cm}$. **3**

Find the size of $\angle ABC$ correct to the nearest minute.

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(b) Solve for θ: **3**

$$4\sin^2\theta - 3 = 0 \quad 0° \leq \theta \leq 360°$$

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(c) If $\sin x = -\frac{2}{5}$ and $\cos x > 0$, find the exact value of $\tan x$. **2**

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(d) Fully simplify: **3**

$$\frac{\cos\theta - 2\cos^3\theta}{\sin\theta - 2\sin^3\theta}$$

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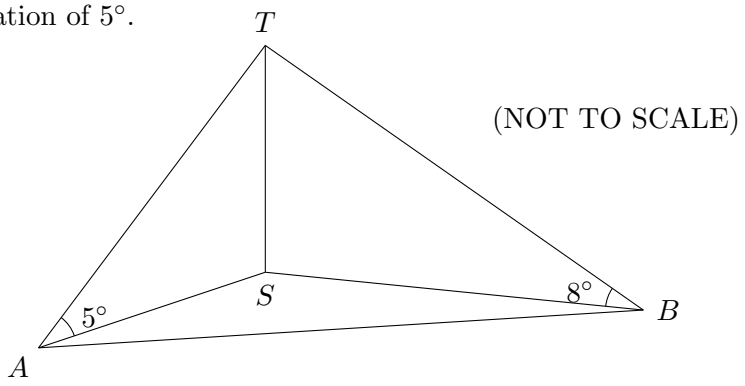
(e) A man walking along a straight road observes a spire bearing 045°T with an angle of elevation of 5°.



After travelling a distance of 5 km, the spire bears 315°T and the angle of elevation is 8°.

i. Find the size of $\angle ASB$. **1**

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ii. Show that $AS = h\tan 85°$, and write a similar expression for BS. **2**

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iii. Find the height of the spire, correct to the nearest metre. **3**

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End of paper.

2019 Mathematics Advanced (Year 11 Course) Assessment Task 2 STUDENT SELF REFLECTION

1. In hindsight, did I do the best I can? Why or why not?

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2. Which topics did I need more help with, and what parts specifically?

- Q1, 2 - Functions, absolute value inequality

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- Q3 - Trigonometric Ratios

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- Q4 - Trigonometric Ratios (Graphs, identities)

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- Q5 - Plane Geometry

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- Q6 - Appled Trigonometry

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- Q7 - Problem solving

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3. What other parts from the teacher feedback can I take away to refine my solutions for future reference?

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SOLUTIONS

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SECTION I

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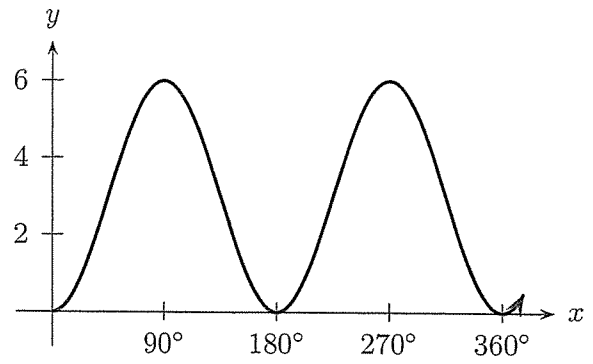
- All necessary working should be shown in every question. Marks may be deducted for illegible or incomplete working.

NESA STUDENT #: ..... **# BOOKLETS USED:** .....

Marker's use only.

QUESTION	1-5	6	7	8	Total	%
MARKS	/5	/8	/22	/16	/51	

5. The equation of the graph below takes the form $y = A\cos Bx + 3$. 1



Which of the following are the values of A and B?

(A) $A = 3, B = -2$

(B) $A = -3, B = 2$

(C) $A = 6, B = 3$

(D) $A = -6, B = 180°$

Answer grid for Questions 1 - 5

1 –	Ⓐ	Ⓑ	●	Ⓓ
2 –	●	Ⓑ	Ⓒ	Ⓓ
3 –	Ⓐ	Ⓑ	Ⓒ	●
4 –	●	Ⓑ	Ⓒ	Ⓓ
5 –	Ⓐ	●	Ⓒ	Ⓓ

Examination continues overleaf...

Section II

46 marks
Attempt Question 6 to 8
Allow approximately 50 minutes for this section

Write your answers in the space provided.

Question 6 (8 Marks) **Marks**

(a) Fully simplify:

i. $8x - 2y + 4z + 9x + z - 2y$. **1**

$= 17x - 4y + 5z$ ✓

ii. $(2p-5)^2 - (2p+5)^2$. **2**

$= [2p-5+2p+5][2p-5-2p-5]$ ✓

$= 4p(-10)$

$= -40p$ ✓

iii. $\dfrac{5}{2k+6} + \dfrac{k}{k^2-9}$. **3**

$= \dfrac{5}{2(k+3)} + \dfrac{k}{(k+3)(k-3)}$ ✓

$= \dfrac{5(k-3)+2k}{2(k+3)(k-3)}$ ✓

$= \dfrac{7k-15}{2(k+3)(k-3)}$ ✓

(b) Solve for x and y: **2**

$$\begin{cases} 7x - 3y = 41 & \text{—①} \\ 3x - y = 17 & \text{—②} \end{cases}$$

②×3,

$9x - 3y = 51$ —③

③ − ①,

$2x = 10$

$x = 5$ ✓

Sub into ②,

$15 - y = 17$

$y = -2$ ✓

$\therefore x = 5, y = -2$

Question 7 (22 Marks) **Marks**

(a) Is the function $f(x) = x^3 - x$ odd or even? Justify your answer with the appropriate reasoning. **2**

$f(x) = x^3 - x$ $\therefore f(x)$ is odd ✓

$f(-x) = (-x)^3 - (-x)$

$= -x^3 + x$

$= -f(x)$ ✓

(b) Find the domain and range of the following, writing in interval notation:

i. $y = 3x^2 - 1$. **2**

$D: \{x : x \in R\}$ ✓

$R: \{y : y \in [-1, \infty)\}$ ✓

ii. $y = \dfrac{1}{x-2}$. **2**

$D: \{x : x \in R \setminus 2\}$ ✓

$R: \{y : y \in R \setminus 0\}$ ✓

iii. $y = -\sqrt{9 - x^2}$. **2**

$D: \{x : x \in [-3, 3]\}$ ✓

$R: \{y : y \in [-3, 0]\}$ ✓

Q7(b) Deduct 1 mark if answers not written in interval notation.

(c) Suppose $f : x \mapsto x^2 + 1$ and $g : x \mapsto 3 - x$.

$f(x) = x^2 + 1$
$g(x) = 3 - x$

Find:

i. $\big(f \circ g\big)(2)$. 1

$= f(g(2))$
$= f(1)$
$= 2$ ✓

ii. $\big(g \circ f\big)(x)$, in simplest form. 1

$= g(f(x))$
$= g(x^2+1)$
$= 3 - (x^2+1)$
$= 2 - x^2$ ✓

iii. Find the value(s) of x such that $\big(g \circ f\big)(x) = f(x)$. 2

$g(f(x)) = f(x)$
$2 - x^2 = x^2 + 1$ ✓
$2x^2 = 1$
$x = \pm \frac{1}{\sqrt{2}}$ ✓

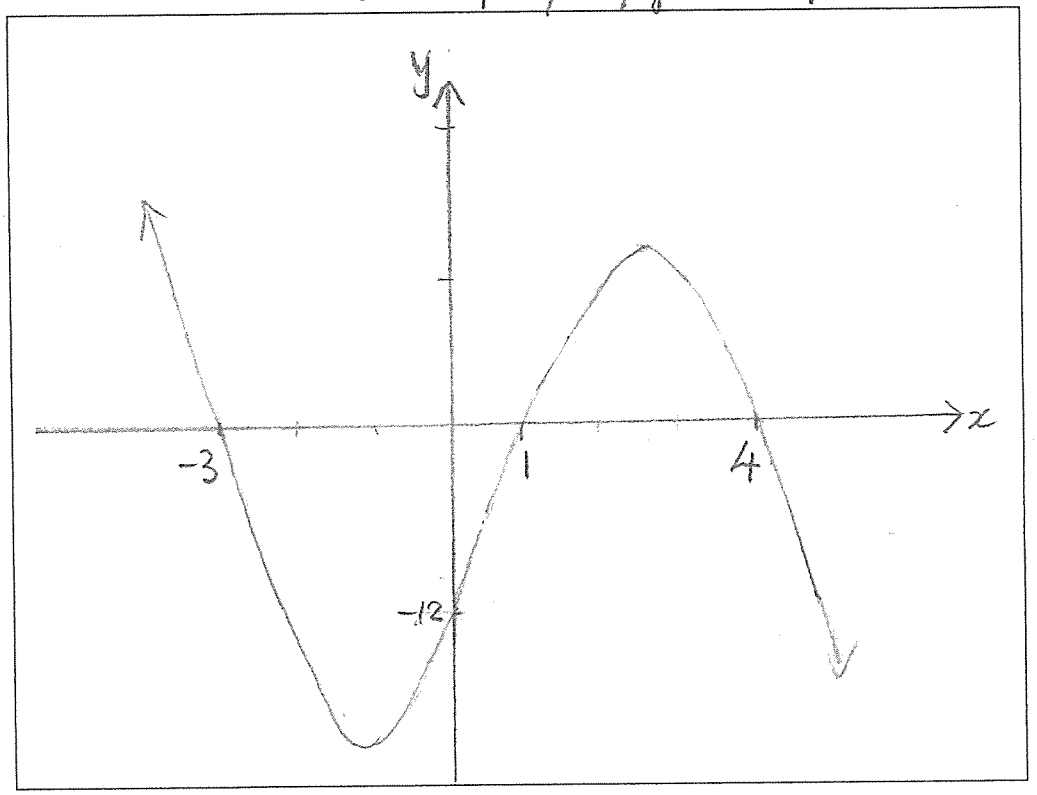
(d) Solve for x: $|7 - 3x| = 1$. 2

$7 - 3x = 1$ or $7 - 3x = -1$
$3x = 6$ $3x = 8$
$x = 2$ ✓ $x = \frac{8}{3}$ ✓

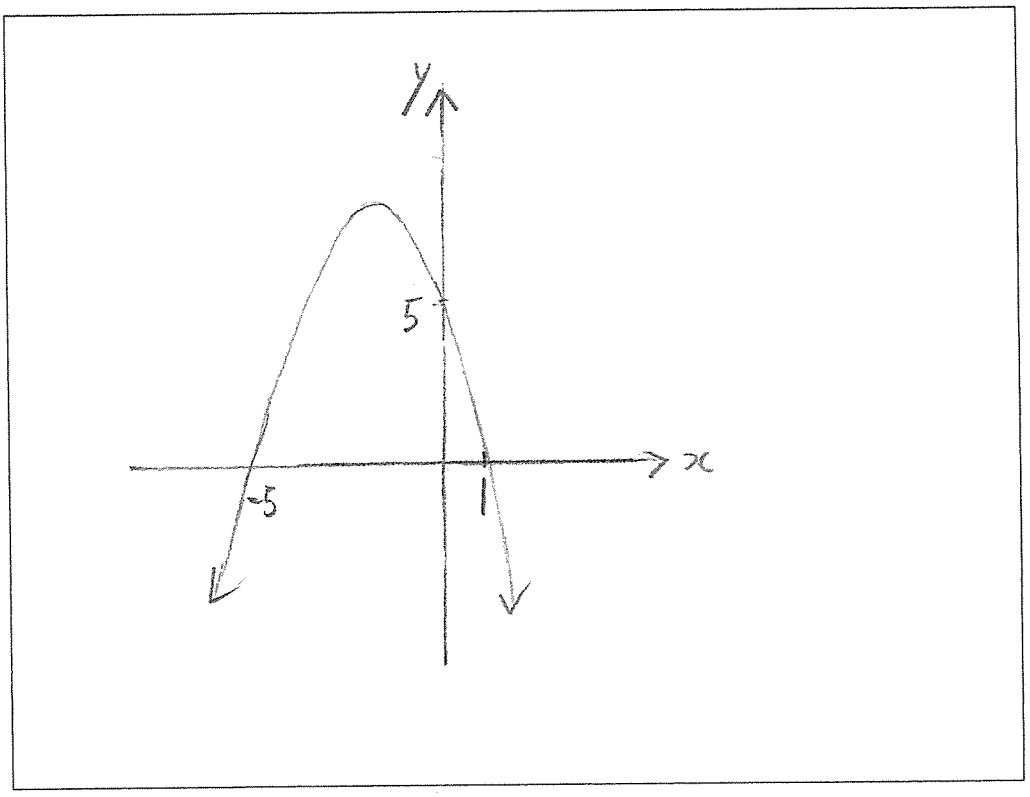
Question 7 continues overleaf...

(e) Sketch the following graphs on separate number planes. Showing all important features, including x and y intercepts.

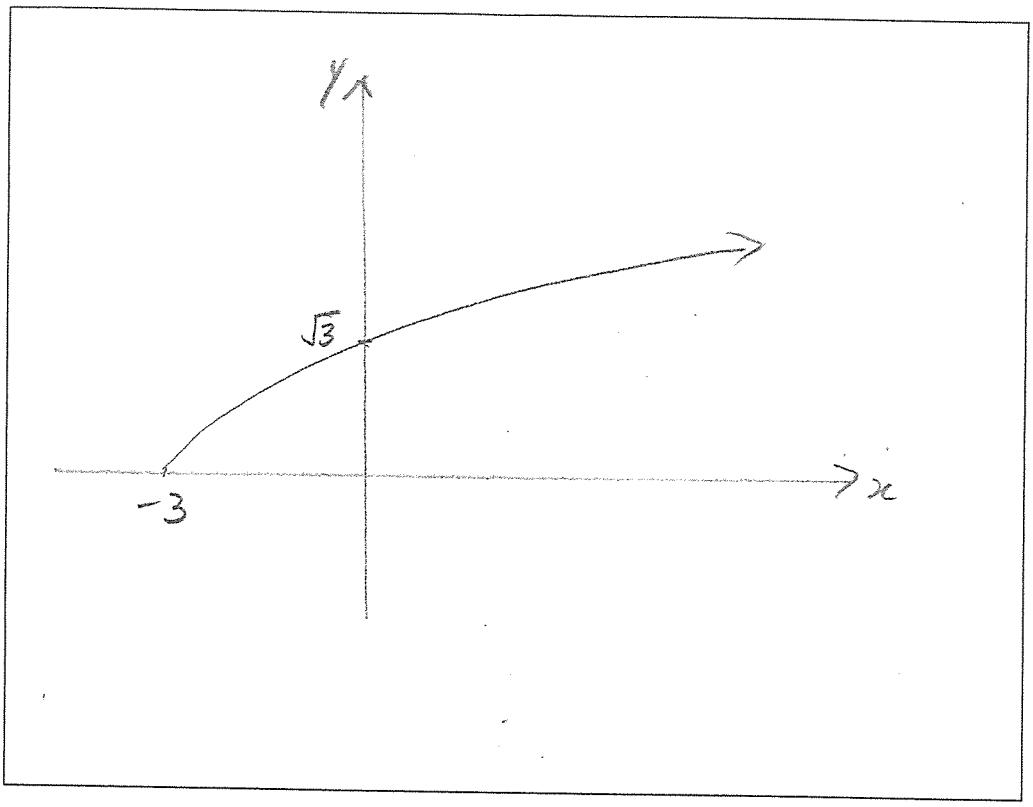
i. $y = (x-1)(x+3)(4-x)$. shape ✓ Critical point / x/y intercepts labelled ✓ **2**



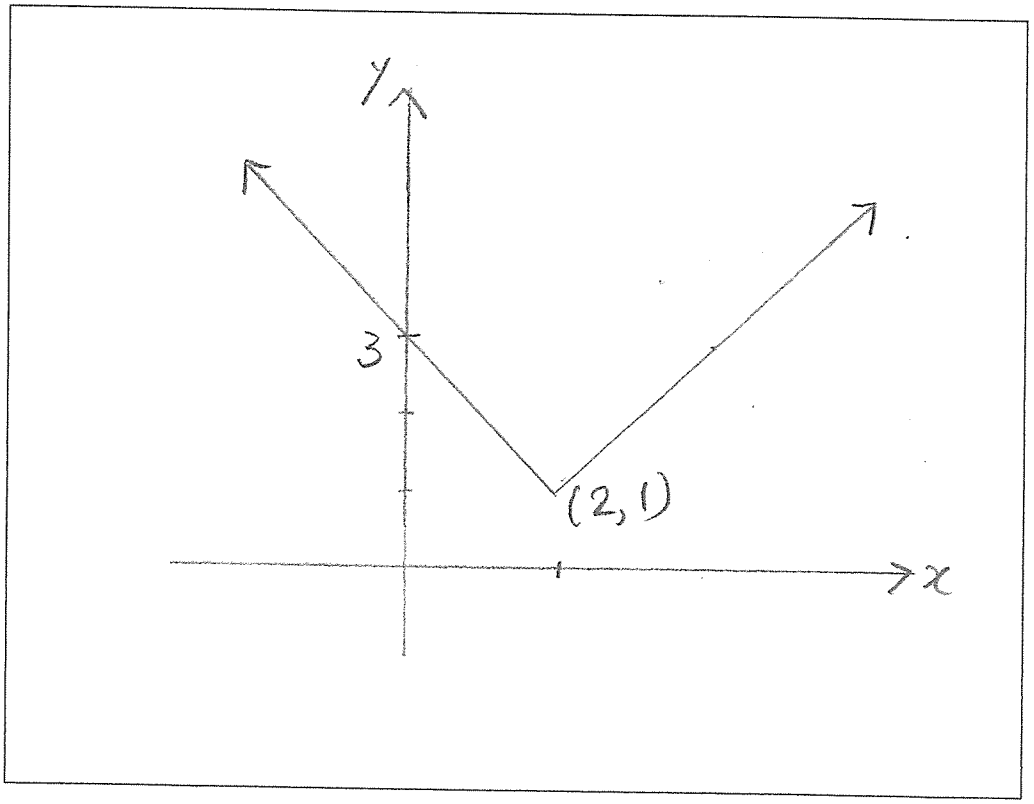
ii. $y = -x^2 - 4x + 5$. $= (x+5)(1-x)$ **2**



iii. $y = \sqrt{x+3}$ **2**



iv. $y = |x-2|+1$ **2**



Question 8 (16 Marks) **Marks**

(a) In $\triangle ABC$, $\angle BAC = 50°$, $AC = 30$ cm and $BC = 25$ cm. **3**

Find the size of $\angle ABC$ correct to the nearest minute.

$\frac{30}{\sin \angle ABC} = \frac{25}{\sin 50°}$ ✓

$\sin \angle ABC = \frac{30 \sin 50°}{25}$

$= 0.91925\ldots$

$\angle ABC = 66°49'$ or $113°11'$ ✓ ✓

(b) Solve for θ: **2**

$$4\sin^2\theta - 3 = 0 \quad 0° \leq \theta \leq 360°$$

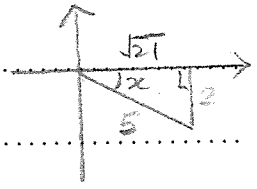
$\sin^2\theta = \frac{3}{4}$

$\sin\theta = \pm\frac{\sqrt{3}}{2}$ ✓

$\theta = 60°, 120°, 240°, 300°$ ✓

(c) If $\sin x = -\frac{2}{5}$ and $\cos x > 0$, find the exact value of $\tan x$. **2**

$\tan x = -\frac{2}{\sqrt{21}}$ ✓ ✓



(d) Fully simplify: **3**

$$\frac{\cos\theta - 2\cos^3\theta}{\sin\theta - 2\sin^3\theta}$$

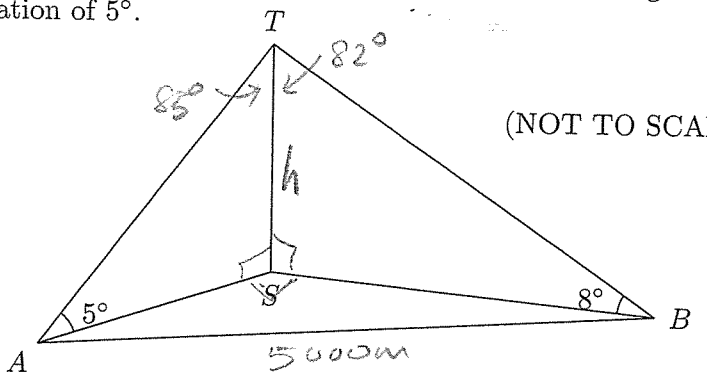
$= \dfrac{\cos\theta(1-2\cos^2\theta)}{\sin\theta(1-2\sin^2\theta)}$ ✓

$= \dfrac{\cot\theta[1-2(1-\sin^2\theta)]}{1-2\sin^2\theta}$ ✓

$= \dfrac{\cot\theta(-1+2\sin^2\theta)}{1-2\sin^2\theta}$

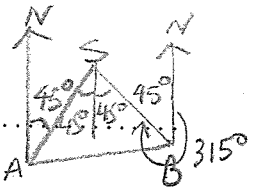
$= -\cot\theta$ ✓

(e) A man walking along a straight road observes a spire bearing 045°T with an angle of elevation of 5°.



After travelling a distance of 5 km, the spire bears 315°T and the angle of elevation is 8°.

i. Find the size of $\angle ASB$. **1**



$\angle ASB = 45° + 45°$

$= 90°$ ✓

ii. Show that $AS = h\tan 85°$ where h is the height of the spire, in metre. Write a similar expression for BS. **2**

In $\triangle AST$, $\angle ATS = 90° - 3° = 85°$

$\tan 85° = \dfrac{AS}{h}$

$\therefore AS = h\tan 85°$ ✓

In $\triangle BST$,

$\angle STB = 90° - 8°$

$= 82°$

$\tan 82° = \dfrac{BS}{h}$

$\therefore BS = h\tan 82°$ ✓

iii. Find the height of the spire, correct to the nearest metre. **3**

In $\triangle ABC$

$AS^2 + BS^2 = AB^2$

$h^2 \tan^2 85° + h^2 \tan^2 82° = 5000^2$ ✓

$h^2 (\tan^2 85° + \tan^2 82°) = 5000^2$

$h = \dfrac{5000}{(\tan^2 85° + \tan^2 82°)^{\frac{1}{2}}}$ ✓

$= 371$ m (nearest m) ✓

End of paper.