Name .....

Year 10
Common Task 2 2023
MATHEMATICS

Instructions

- Time allowed 95 minutes
- All questions to be attempted on the Answer booklets.
- Calculators may be used.
- All necessary working should be shown where indicated. Full marks may not be awarded for careless or badly arranged work.

Topics Covered	Syllabus Reference	Outcome Description	Part
Surds and Indices	MA5.1-5NA MA5.2-7NA MA5.3-6NA	Operates with algebraic expressions involving positive-integer and zero indices and establishes the meaning of negative indices for numerical bases. Applies index laws to operate with algebraic expressions involving integer indices. Performs operations with surds and indices.	A
Quadratic Expressions/ Equations	MA5.2-6NA MA5.3-5NA MA5.3-7NA	Simplifies algebraic fractions and expands and factorises quadratic expressions. Selects and applies appropriate algebraic techniques to operate with algebraic expressions. Solves complex linear, quadratic, simple cubic and simultaneous equations, and rearranges literal equations.	B
Trigonometry	MA5.1-10MG MA5.2-13MG MA5.3-15MG	Applies trigonometry, given diagrams, to solve problems, including problems involving angles of elevation and depression. Applies trigonometry to solve problems, including problems involving bearings. Applies Pythagoras' theorem, trigonometric relationships, the sine rule, the cosine rule and the area rule to solve problems, including problems involving three dimensions.	C
Non-Linear Graphs	MA5.2-8NA MA5.3-9NA	Solves linear and simple quadratic equations, linear inequalities and linear simultaneous equations, using analytical and graphical techniques. Sketches and interprets a variety of non-linear relationships.	D
Working Mathematically	MA5.2-1WM MA5.2-2WM MA5.3-3WM	Uses and interprets formal definitions and generalisations when explaining solutions and/or conjectures. Generalises mathematical ideas and techniques to analyse and solve problems efficiently. Uses deductive reasoning in presenting arguments and formal proofs.	E & F

Part	A	B	C	D	E	F	Total	%
Marks	(17)	(17)	(10)	(16)	(13)	(11)	(84)	

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Part A: Surds and Indices (17 marks) *Start a new booklet*

Question 1 (3 Marks)

For each of the following state if the number is rational or irrational.

a) $\frac{\pi}{2}$ **1**

b) $\frac{1}{\sqrt{49}}$ **1**

c) 0.125 **1**

Question 2 (3 Marks)

a) Simplify $\frac{\sqrt{48}-\sqrt{300}}{\sqrt{12}}$ fully. **2**

b) Hence state if it is rational or irrational. **1**

Question 3 (1 Marks)

Simplify $\sqrt{192}-5\sqrt{12}+\sqrt{75}$ fully. **1**

Question 4 (1 Marks)

Simplify $3x^{\frac{1}{2}} \times x^{\frac{5}{2}}$. **1**

Question 5 (1 Marks)

Write $\sqrt[5]{x^3}$ in index form. **1**

Part A continues on the next page.

Question 6 (3 Marks)

Rationalise the denominator for the following, (do not simplify).

a) $\frac{15}{\sqrt{6}}$ **1**

b) $\frac{\sqrt{3}}{\sqrt{3}-3}$ **2**

Question 7 (3marks)

Solve:

a) $2^{2m} = 2$ **1**

b) $49^{x} = \sqrt{7}$ **2**

Question 8 (2 marks)

Solve $2(3^{y} - 10) = 34$ for y. **2**

End of Part A. Turn the page over for part B.

Part B: Quadratic Equations (17 marks) *Start a new booklet*

Question 1 (3 Marks)

Expand and simplify each of the following:

a) $(x-4)(x+4)$ **1**

b) $(x+4)^2$ **1**

c) $-x(x+2)(x+4)$ **1**

Question 2 (5 Marks)

Factorise the following fully:

a) y^2+6y+9 **1**

b) $w^4+3w^3-18w^2$ **2**

c) x^4-16 **2**

Question 3 (2 Marks)

Solve the following for x: $x-\frac{10}{x}=3$ **2**

Question 4 (2 Marks)

Solve by using the quadratic formula: $6p^2+5p-4=0$. **2**

Question 5 (3 Marks)

Solve the following for x: $\frac{7}{x+2}-3x=2$ **3**

Question 6 (2 Marks)

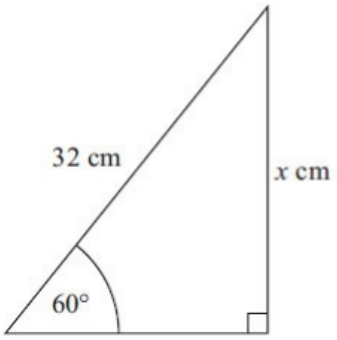
Find the values of h such that the equation hx^2+x+2 has no real roots. **2**

End of Part B. Turn the page over for part C.

Part C: Trigonometry (10 marks) *Start a new booklet*

Question 1 (1 Marks)

Find the exact value of x. **1**

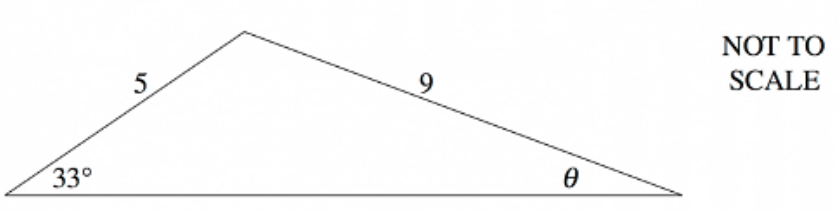


Question 2 (2 Marks)

Evaluate $\cos 120° \times \sin 210°$, showing all working. **2**

Question 3 (3 Marks)

Find the value of θ in the diagram, giving your answer to the nearest degree. **3**



Question 4 (4 Marks)

Triangle ABC is an isosceles triangle in which $AB = BC = \sqrt{3}$ cm.

a) Draw this information on a diagram. **1**

b) By first finding the value of $\angle ABC$ find length AC when the area is 2.25 cm^2. **3**

End of Part C. Turn the page over for part D.

Part D: Non-linear Graphs (16 marks) *Start a new booklet*

Question 1 (9 Marks)

For each of the following

i. sketch the relation showing all important points (each graph should be about 1/3 of the page) and

ii. identify if it is a function.

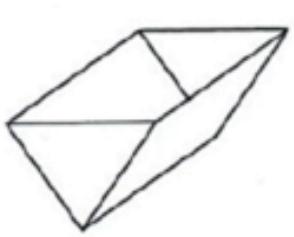
a) $y = x^2 - 4$ **3**

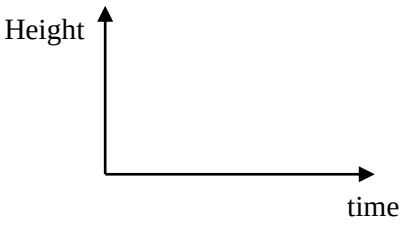
b) $x^2 + (y-6)^2 = 9$ **3**

c) $y = 3^{-x}$ **3**

Question 2 (2 Marks)

The empty container shown is bring filled with water flowing at a constant rate.





a) Draw a set of axis as shown above and sketch the graph of the height of water with respect to time. **1**

b) Describe the rate of change of the curve **1**

Question 3 (4 Marks)

a) Sketch $y = \dfrac{1}{4-x}$ showing all important points **3**

b) Explain why it is a function. **1**

Question 4 (1 Marks)

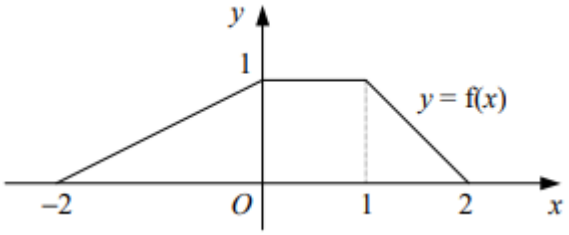
Describe a single transformation that would map the graph of $y = x^3 + 2$ onto the graph of $y = x^3 - 5$. **1**

End of Part D. Turn the page over for part E.

Part E: Working Mathematically (13 marks)

Question 1 (2 Marks)

The graph of the function $f(x)$ is shown below. Draw the graph of $y = f(x-3)$. **2**



Question 2 (2 Marks)

Explain why $\tan\theta$ is positive in the third quadrant **2**

Question 3 (4 Marks)

By first finding any point(s) of intersection, sketch the following equations on the same axis. **4**

$$xy = 6 \quad ; \quad x - y = 5$$

Question 4 (2 Marks)

Sketch a curve of the form $y = ax^2 + bx + c$ which satisfies the conditions, $a > 0$ and $b^2 - 4ac = 0$. **2**

Show all important points.

Question 5 (3 Marks)

A plane follows a parabolic path that can be modelled using the equation $h = -x^2 + 6x - 5$ where h is the height of the plane in kilometres, and x is the horizontal distance travelled in kilometres.

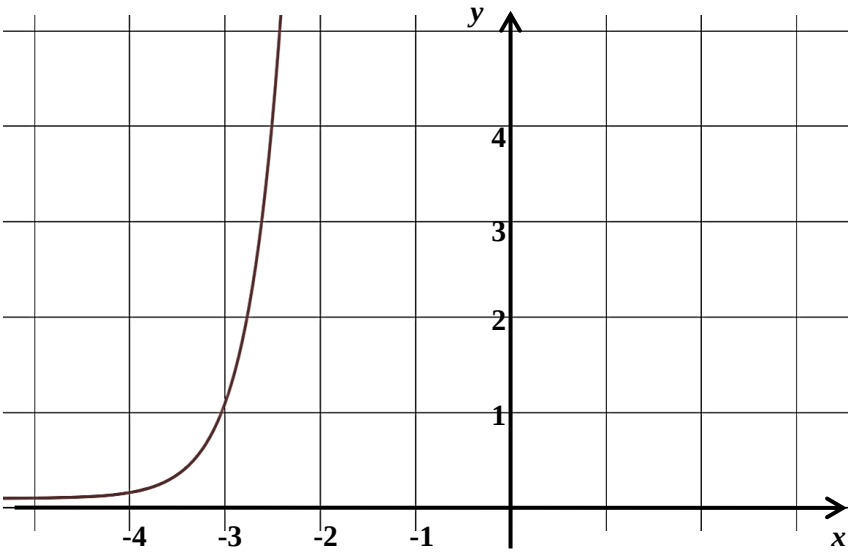
By the method of completing the square or otherwise find the maximum height of the plane. **3**

End of Part E. Turn the page over for part F.

Part F: Further Working Mathematically (11 marks)

Question 2 (2 Marks)

The graph of $y = 4^{2x+6}$ is shown below.



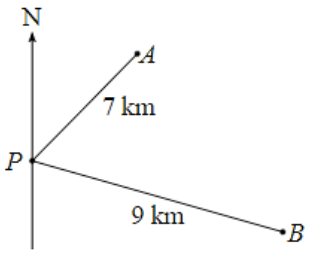
Sketch the graph $y = 8^{x+3}$ on the same axis, labelling any point of intersection. **2**

Question 3 (4 Marks)

Find all 4 values of x that make the $(x^2 + 2x)^{x^2+3x} = 1$ true. **4**

Question 3 (5 Marks)

Alan and Brandon were camping at the site labelled *P*. Alan walked on a bearing of 035° for 7 km to location labelled *A* while Brandon walked on a bearing of 100° for 9 km to location labelled *B*.



a) Copy the diagram in your booklet, showing all given information. **1**

b) Find the bearing of *B* from *A*. Give your answer correct to the nearest degree. **4**

End of the examination.

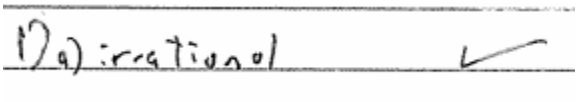
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Section A

Question 1

a)

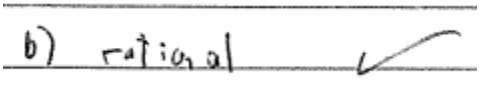
Criteria	Marks
Correct answer	1



Done Well

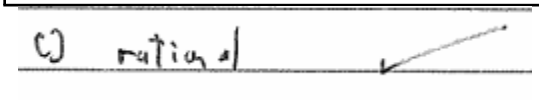
b)

Criteria	Marks
Correct answer	1



c)

Criteria	Marks
Correct answer	1

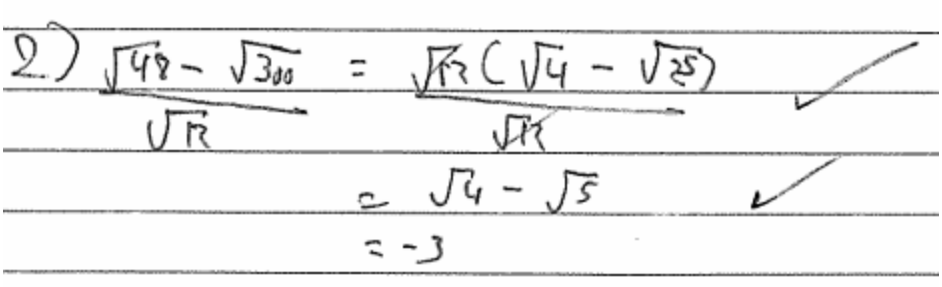


Done well

Question 2

a)

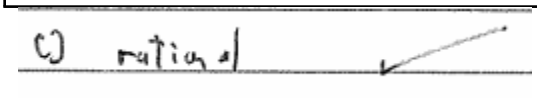
Criteria	Marks
Ratioanlises denominator and fully factorise and simplifies answer	2
Rationalises denominator OR factorises numerator	1



Done poorly.
Many students found $-6\sqrt{3}-2\sqrt{3}=-3\sqrt{3}$ and received only 1 mark

b)

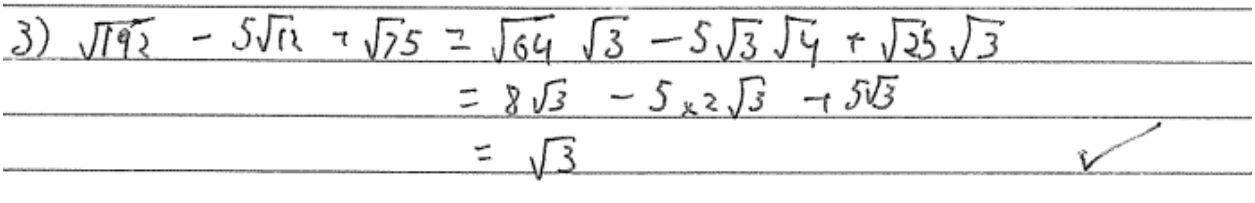
Criteria	**Marks**
Correct answer	1



Done well

Question 3

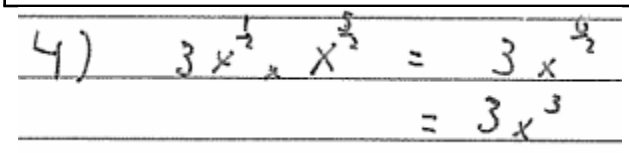
Criteria	**Marks**
Correct answer	1



Poorly set out, but done well.

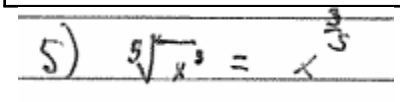
Question 4

Criteria	**Marks**
Correct answer	1



Done very poorly. Students who wrote $3\sqrt{x^6}$ received a mark.
Question 5

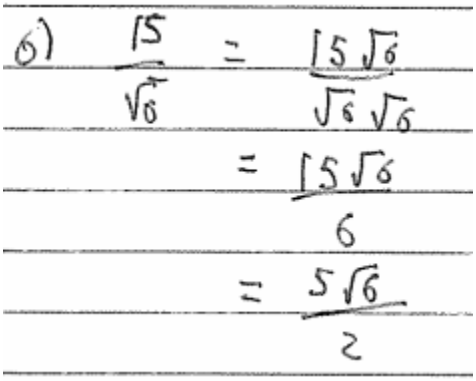
Criteria	Marks
Correct answer	1



Done well

Question 6

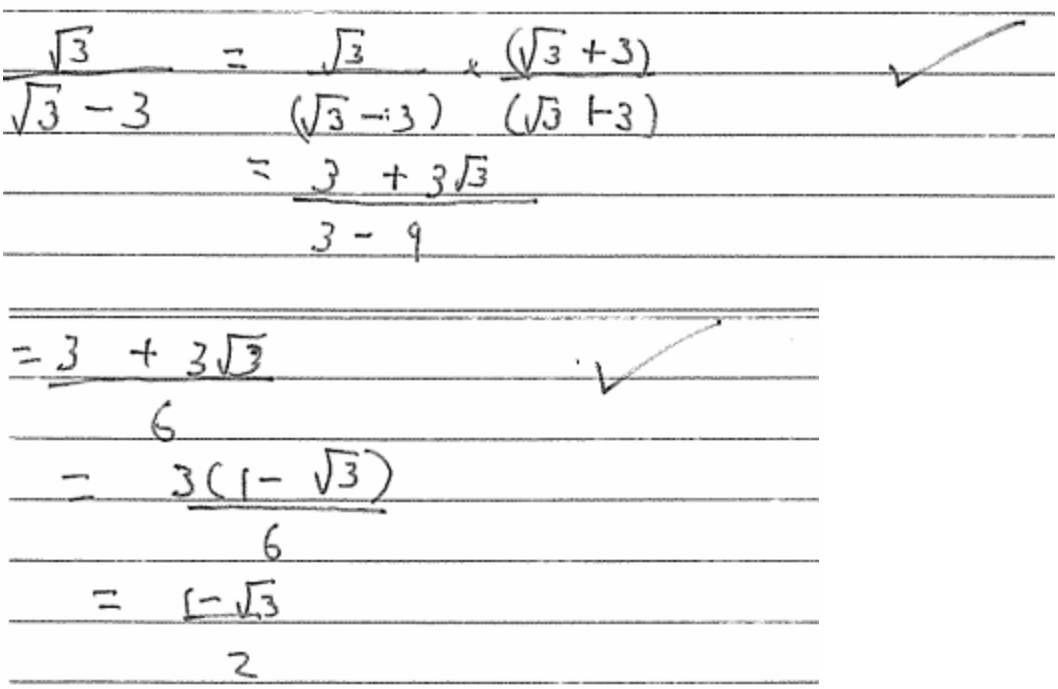
Criteria	Marks
Correct answer (in surd form)	1



Done well

b)

Criteria	Marks
Multiplies by $\sqrt{3}+3$ and simplifies with a rational denominator	2
Multiplies by $\sqrt{3}+3$	1

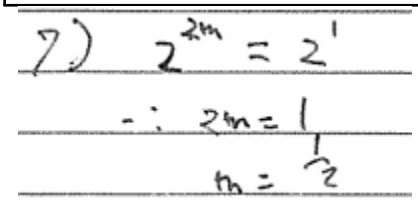


Students needed to have a rational denominator to receive both marks. Some students who did not show adequate working made silly mistakes and lost a mark.

Question 7

a)

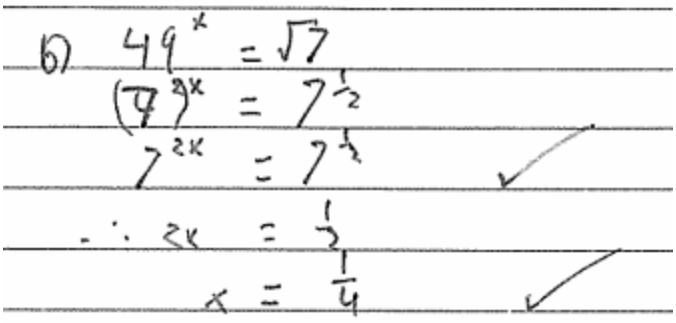
Criteria	**Marks**
Correct answer	1



Done well

b)

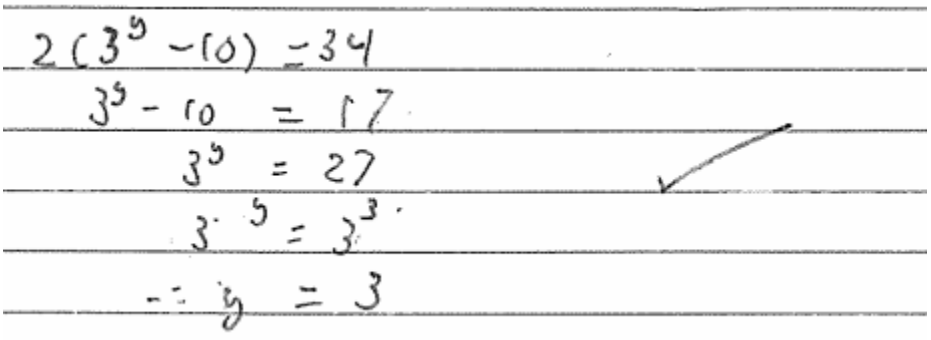
Criteria	**Marks**
Equates indexes to solve	2
Writes both numbers with base of 7	1



Done poorly. Students needed to look at the marks the question is worth and do sufficient working out to receive both marks. Students who used trial and error AND showed they equated bases could receive both marks

Question 8

Criteria	**Marks**
Solves for y	2
Makes 3^y the subject	1



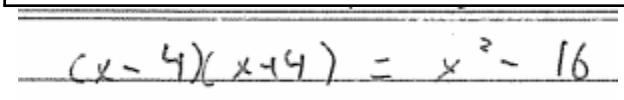
Done well

Part B

Question 1

a)

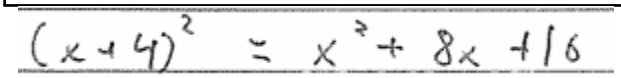
Criteria	**Marks**
Correct answer	1



Completed well

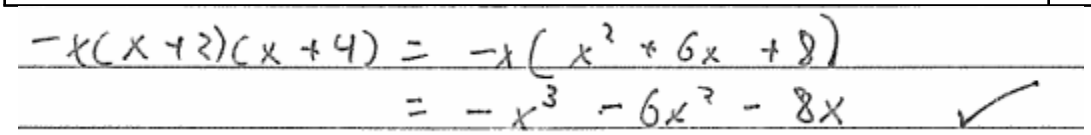
b)

Criteria	**Marks**
Correct answer	1



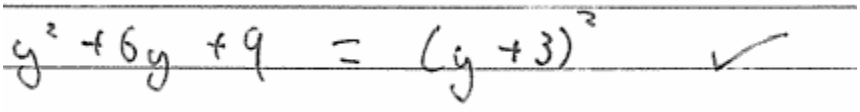
c)

Criteria	**Marks**
Correct answer	1



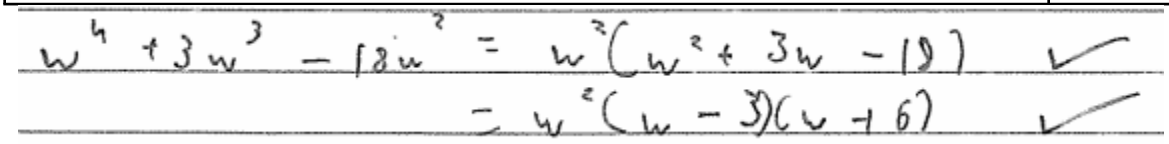
Question 2

Criteria	**Marks**
Correct answer	1



b)

Criteria	Marks
Simplifies fully	2
Takes w as a factor or equivalent	1

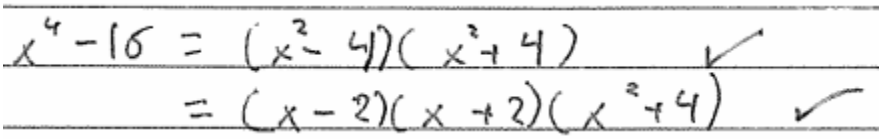


Most students who did not first take out the HCF of struggled with this question.

Many also saw it as an expression that was reducible to a quadratic and tried to use a substitution.

c)

Criteria	Marks
Simplifies using difference of two squares twice	2
Simplifies using difference of two squares once	1

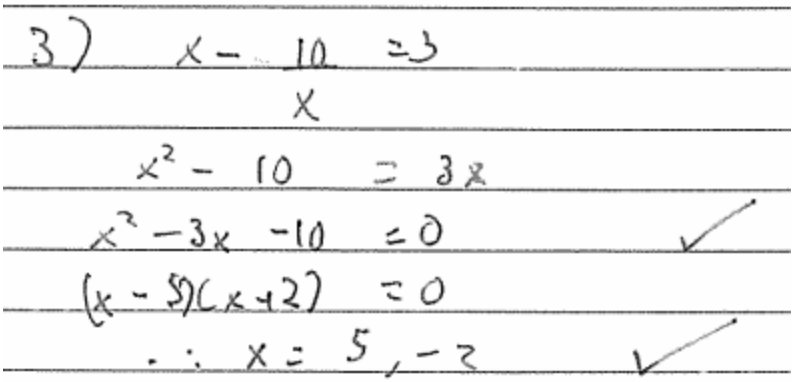


Most students did not see the second difference of 2 squares.

Question 3

a)

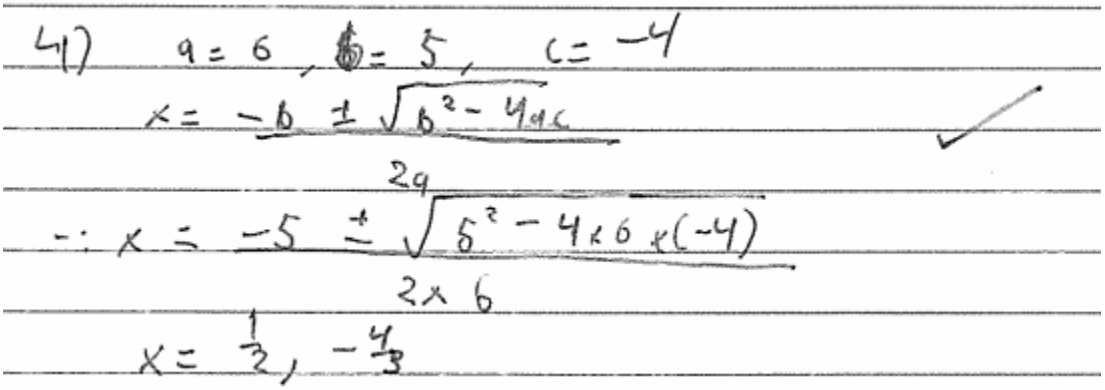
Criteria	Marks
Factorises quadratic and solves	2
Forms a quadratic expression	1



Generally completed well. Some students made errors when multiplying by x .

Question 4

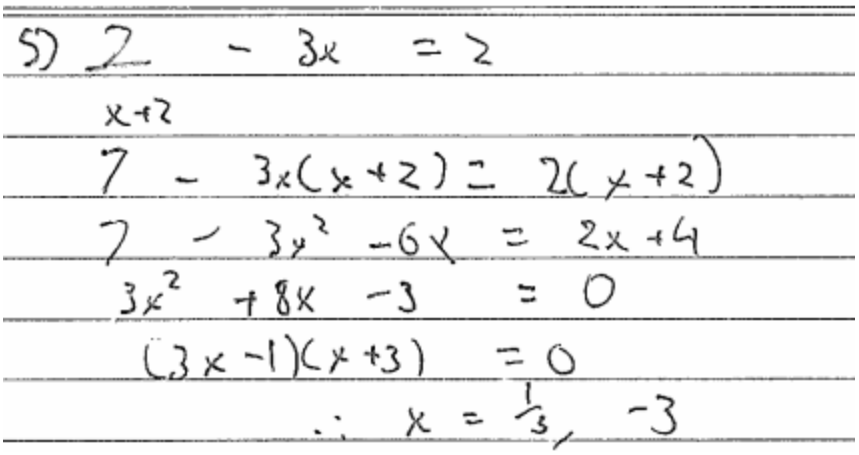
Criteria	**Marks**
Substitutes to solve	2
Correctly identifies quadratic formula and correct values for a, b and c	1



Many careless errors in the quadratic formula but mist students answered correctly.

Question 5

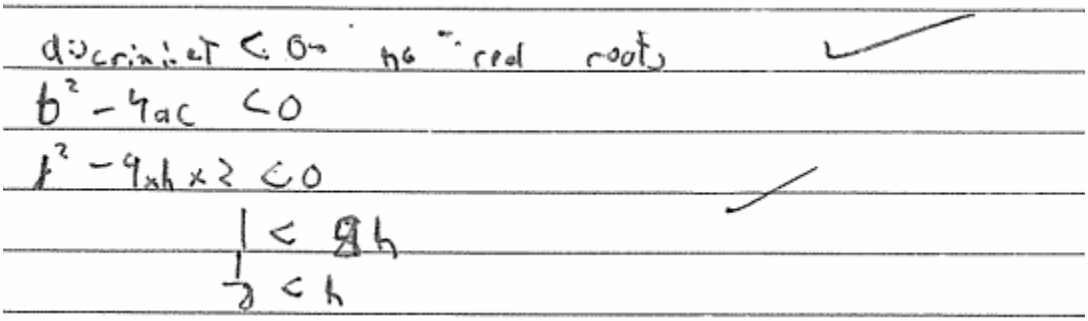
Criteria	**Marks**
Using quadratic formula or equivalent to solve for x	2
Forms a quadratic equation	1



A lot of errors when multiplying by , especially with the negative terms.

Question 6

Criteria	**Marks**
Solves inequality for h	2
Identifies that the discriminant needs to be smaller than 0	1



Students needed to state the discriminant needed to be negative and then solve the corresponding inequation for h.

Question 7

Criteria	**Marks**
Identifies the b in the form $y = (x - a)^2 + b$ as the maximum height.	3
Writes in correct completed square form	2
Takes steps to complete the square	1

$= -x^2 + 6x - 5$

$= -(x^2 - 6x + 5)$ ✓

$= -(x^2 - 6x + 9 - 9 + 5)$

$= -(x-3)^2 - (-9+5)$

$= -(x-3)^2 + 4$ ✓

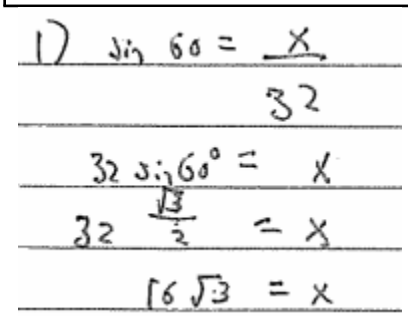
maximum height at 4 ✓

(vertex at (3, 4)

Part C

Question 1

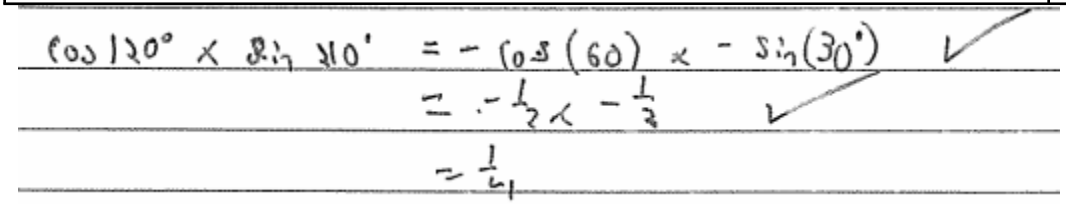
Criteria	Marks
Correct answer	1



Answered well. Students are reminded to show their working and give exact values unless told otherwise.

Question 2

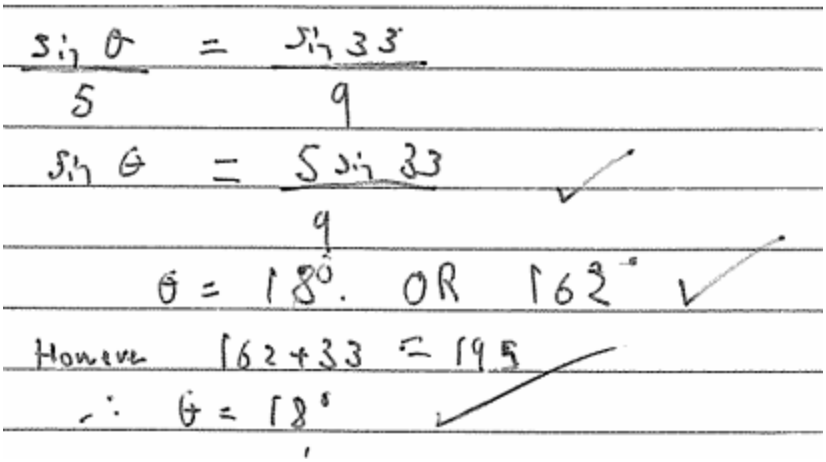
Criteria	Marks
Correct answer with working out	2
Identifies both cos120 and sin30 are negative	1



Many students struggled to demonstrate the connection to related angle in the first quadrant.

Question 3

Criteria	Marks
Identifies only 1 correct answer	3
Writes two answers for θ	2
Correctly writes the sin rule for the triangle	1

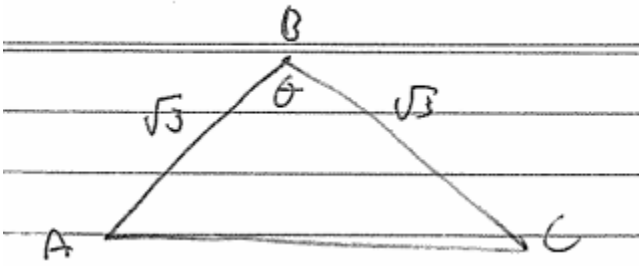


Most students achieved 2 marks out of 3 as they did not consider the ambiguous case and identify why the obtuse angle is not a possibility here.

Question 4

a)

Criteria	**Marks**
Correct answer	1



Answered well.

b)

Criteria	**Marks**
Substitute into cos formula to solve for side AC	3
Solves to find value of angle $\angle ABC$	2
Correctly write area formula and identifies correct values for a,b and C	1

b) $A = \frac{1}{2}ab\sin C$

$a = \sqrt{3}$, $b = \sqrt{3}$, $C = \theta$, $A = 1.25\ cm^2$ ✓

$\therefore 1.25 = \frac{1}{2}\sqrt{3} \times \sqrt{3} \sin C$

$C = \sin^{-1}\left(\frac{2.5}{3}\right)$

$C = 56.44$ ✓ OR $180 - 56.44$

find AC

$c^2 = a^2 + b^2 - 2ab\cos C$

$c = AC$ $a = \sqrt{3}$, $b = \sqrt{3}$, $C = 56.44$ OR 123.56

$c^2 = (\sqrt{3})^2 + (\sqrt{3})^2 - 2 \times \sqrt{3} \times \sqrt{3} \times \cos(56.44)$ ✓

$c = 3.83$

OR $c^2 = (\sqrt{3})^2 + (\sqrt{3})^2 - 2 \times \sqrt{3} \times \sqrt{3} \cos(123.56)$

$c = 3.05$

Most students achieved 2 marks out of 3 as they found angle ABC, but made errors when finding AC. Students should have considered the ambiguous case when applying the area of a tringle rule. This results in two possible answers. Students were not penalised for this error.

Part D

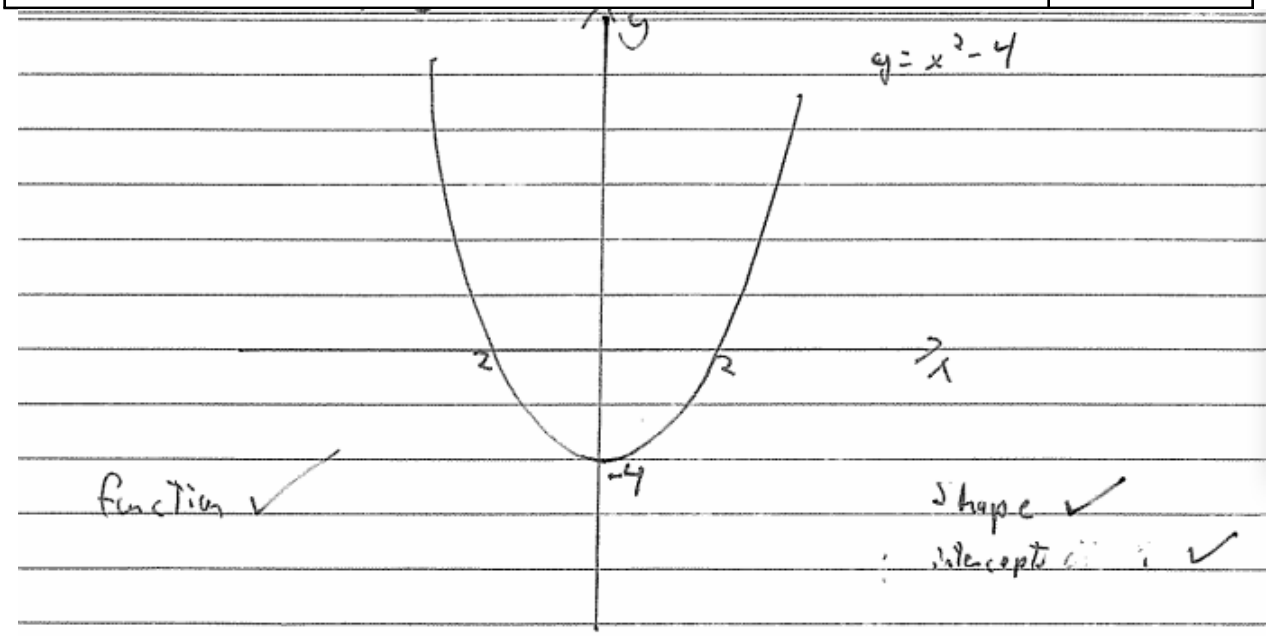
Question 1

a) i)

Criteria	**Marks**
Correct shape	2
Label y intercept correctly	1

ii)

Criteria	**Marks**
Correct answer	1



Many graphs sketched poorly.

Full marks not awarded for graphs that did not have necessary points, intercepts / main features labelled clearly or if unacceptable size (curve needs to be at least the size of the number plane, which should be a third of the writing paper in size).

Many sketches did not have ruled or labelled axes or curves.

Many graphs did not use one smooth line, some very messy, lazy, rushed or careless work.

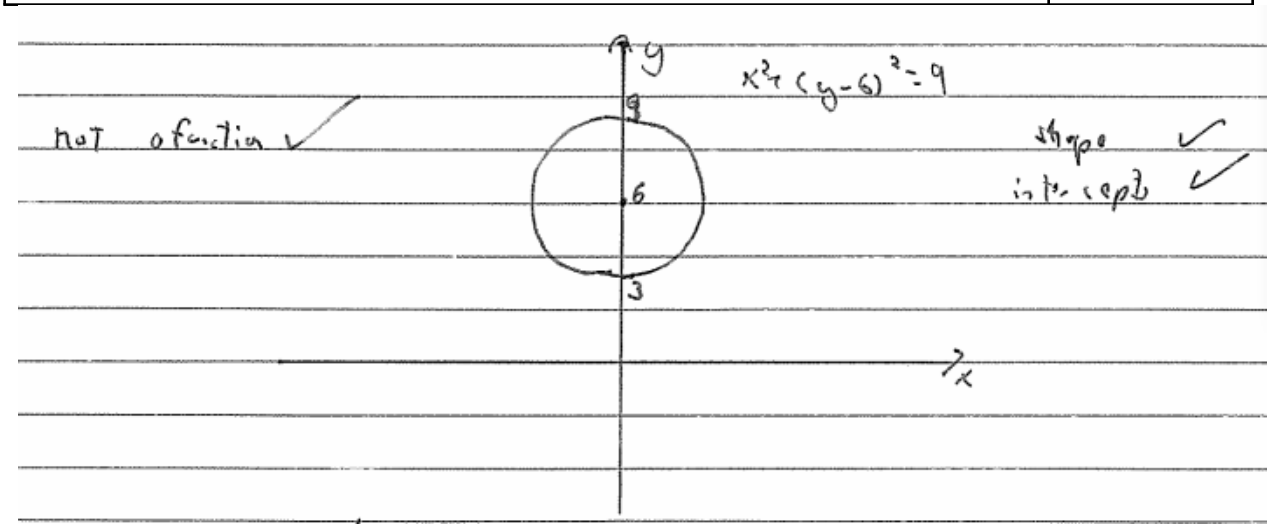
No marks for saying a graph was a relation (needed to say if it was a function or not a function.)

b) i)

Criteria	**Marks**
Correct shape	2
Label centre correctly	1

ii)

Criteria	**Marks**
Correct answer	1



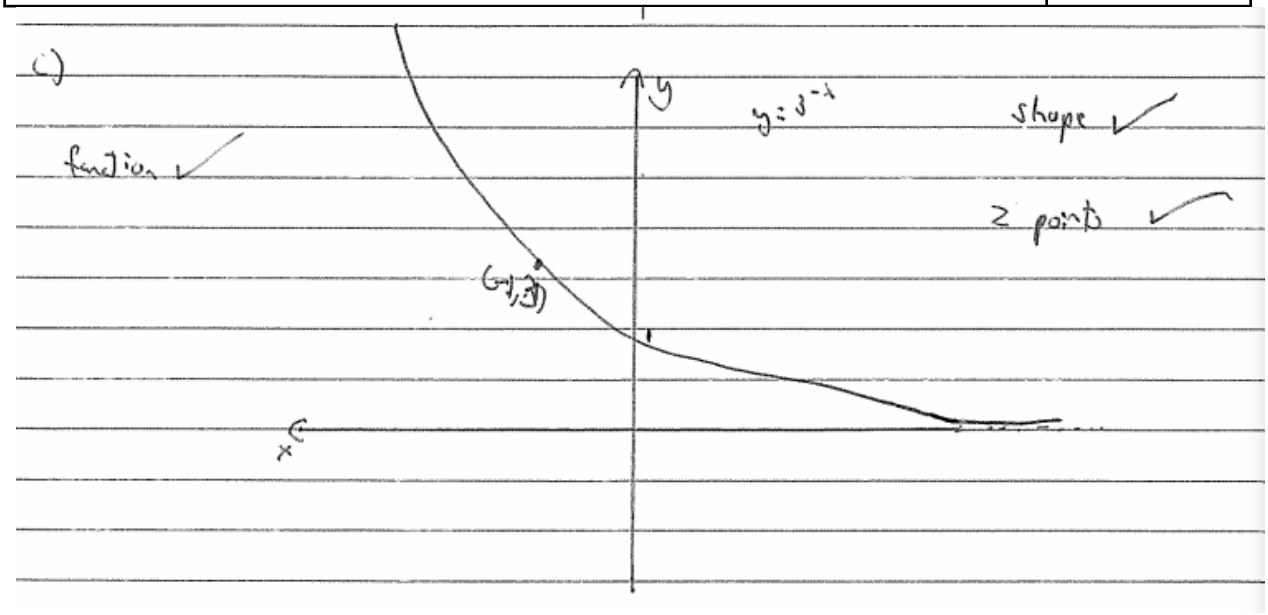
Students who clearly showed the radius was correct received 1 mark for the sketch.

c) i)

Criteria	**Marks**
Correct shape	2
Correct reflection with two points given	1

ii)

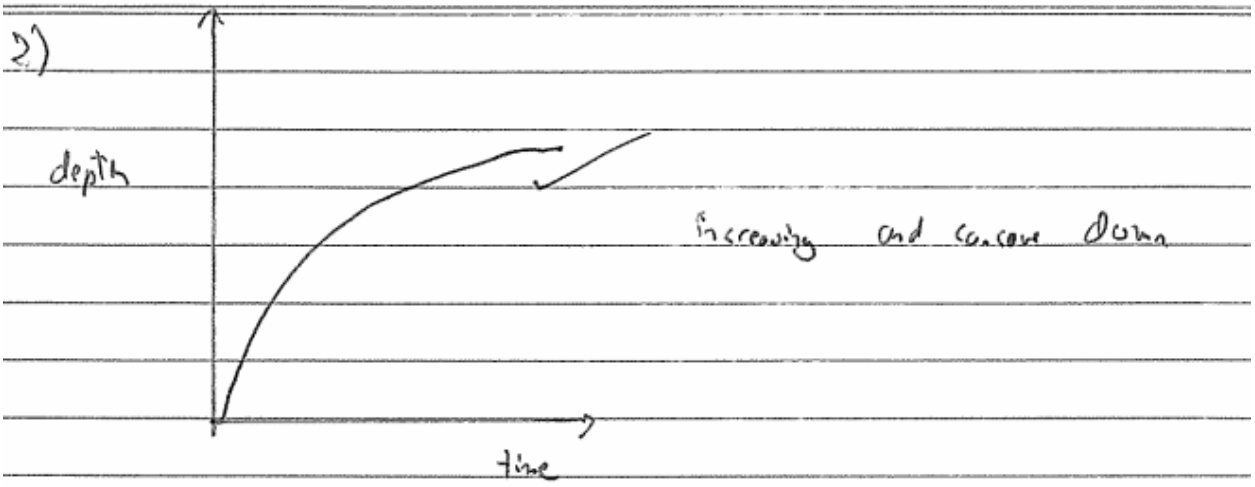
Criteria	Marks
Correct answer	1



Question 2

a)

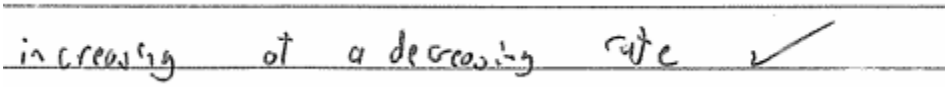
Criteria	Marks
Correct answer	1



Answered well

b)

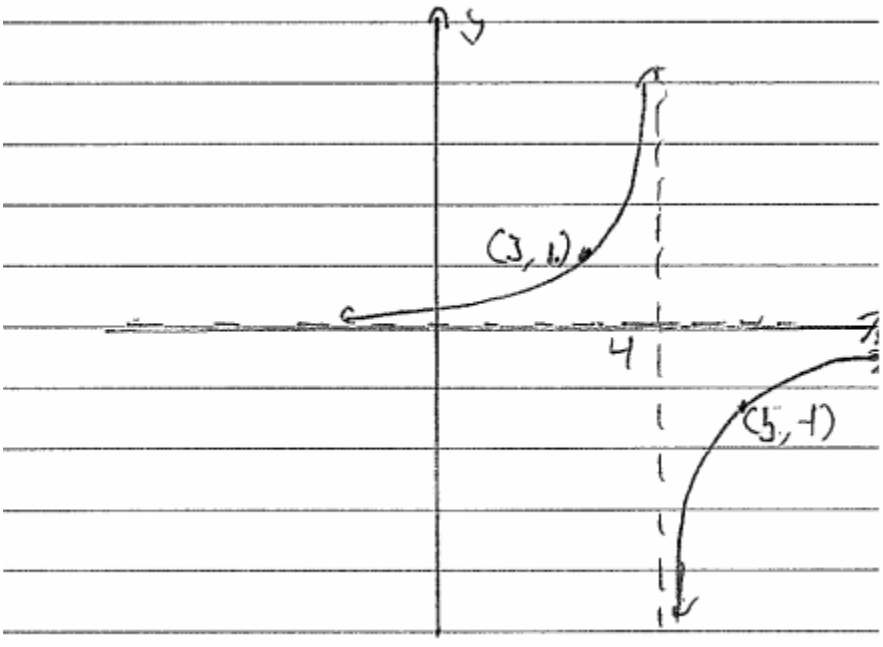
Criteria	Marks
Correct answer	1



Most answers gave a description of the rate of change. Some answers just mentioned a fast change or increasing without the rate at which it was increasing.

Question 3
a)

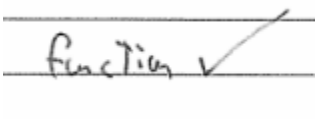
Criteria	Marks
Correct shape	3
Correct asymptotes	2
Correct reflection	1



Mostly answered well. Some errors in sketching the hyperbola due to incorrect asymptote (x=-4 instead of x=4). Needed to include the y- intercept.

b)

Criteria	Marks
Correct answer	1



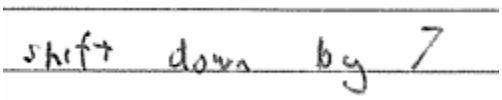
When explaining why it is a function:

Accepted vertical line test or VLT (although answers should not use abbreviations). Did not accept ‘straight line test’.

A better answer would be to explain how the vertical line test works.

Question 4

Criteria	**Marks**
Correct answer	1

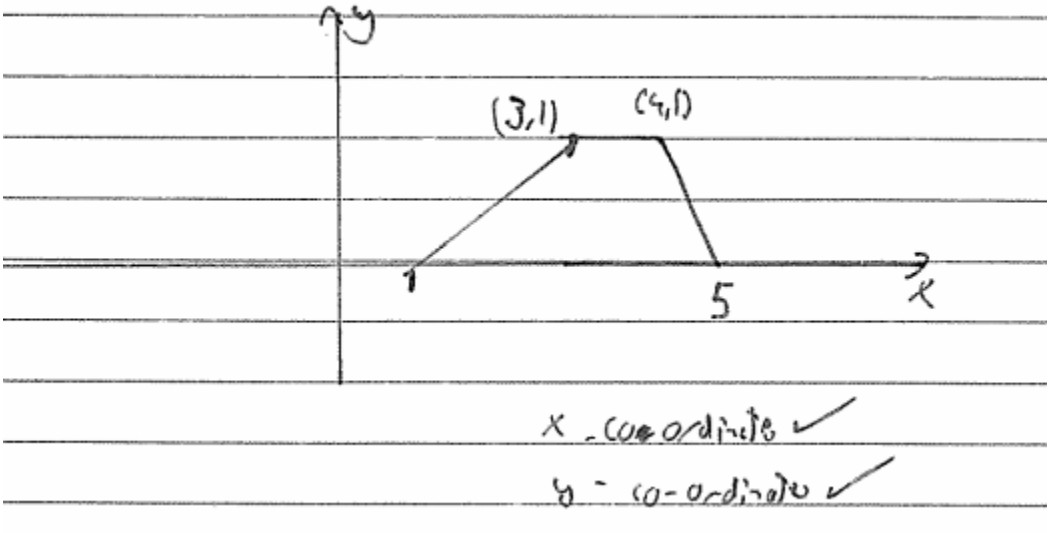


Comments:
Mostly answered well (some silly arithmetic errors). Describe means to write a sentence. Negative seven or -7 was not accepted as this does not describe the transformation, direction, completely i.e. shift left or down

Part E

Question 1

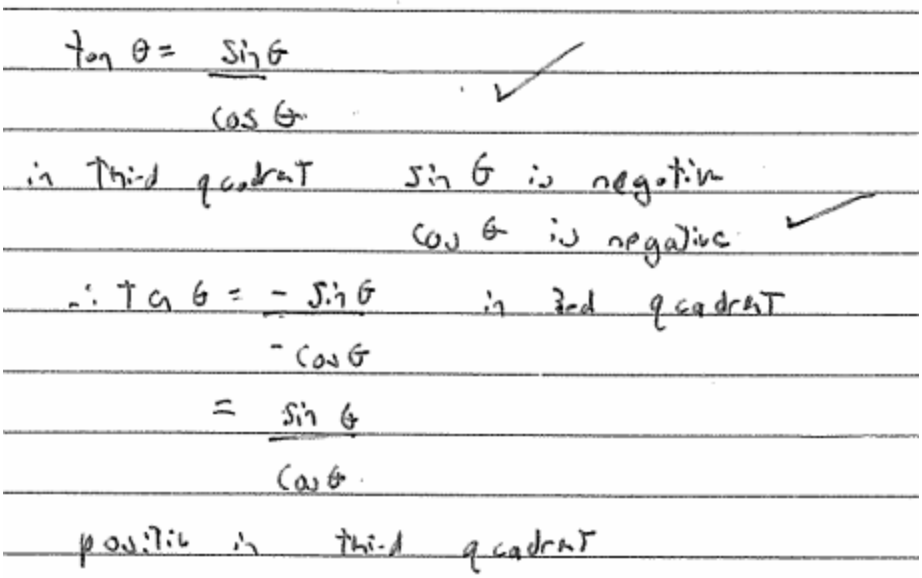
Criteria	**Marks**
Correct y values	2
Correct x values	1



The trapezium was moved left by mistake.

Question 2

Criteria	**Marks**
Identifies $sin\theta$ and $cos\theta$ as negative in third quadrant	2
Identifies $\tan theta = \frac{sin\theta}{cos\theta}$	1



Students needed to EXPLAIN this, not just show the ASTC diagram or unit circle alone.

Question 3

Criteria	**Marks**
Correct sketch of $xy = 6$	4
Corect sketch of $x - y = 5$	3
Finds both points of intersection	2
Sets up simultaneous equations to solve for points of inersection	1

$xy = 6$ (1)

$x - y = 5$

$x = 5 + y$ (2)

(2) → (1)

$(5+y)y = 6$

$y^2 + 5y - 6 = 0$

$(y+6)(y-1) = 0$

$y = 1, -6$ ✓

when $y = 1$

$x(1) = 6$

$x = 6$

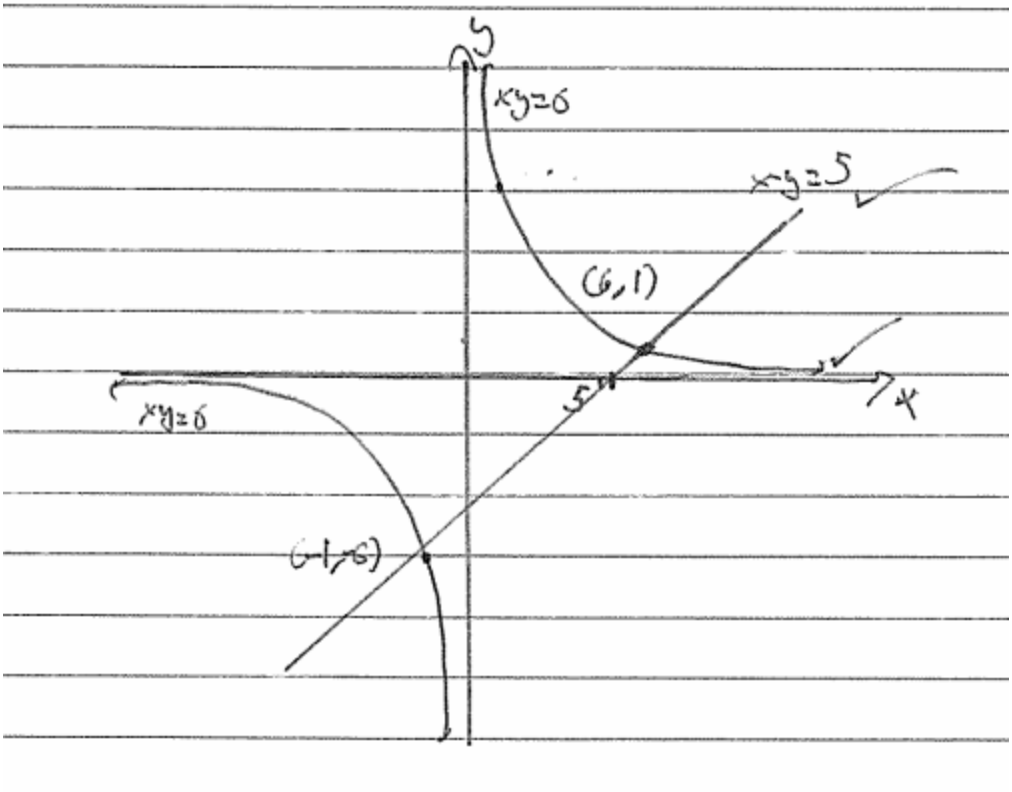
point of intersection at $(6, 1)$

when $y = -6$

$x(-6) = 6$

$x = -1$

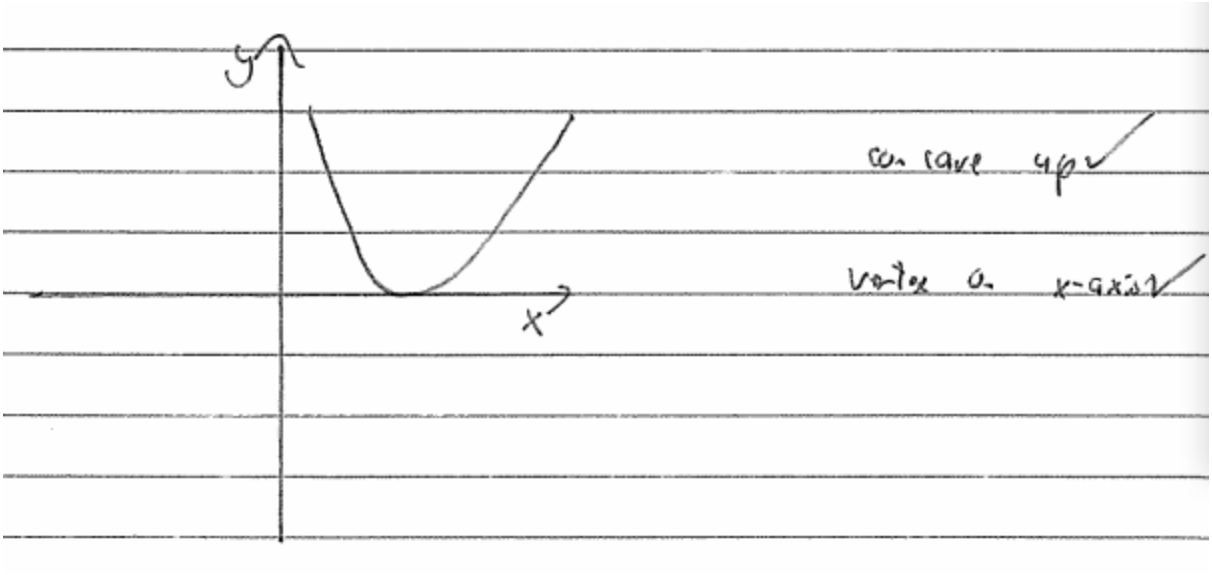
point of intersection at $(-1, -6)$ ✓



Some students did not follow the question...." FIRST find any point(s) of intersection". Many graphs were drawn inaccurately or messy, without any visible scales or labelled points/intercepts. People need to use more space and work down the page next time.

Question 4

Criteria	**Marks**
Concave up	2
Vertex on x-axis	1



Simple question done well. Some did excessive working needlessly.

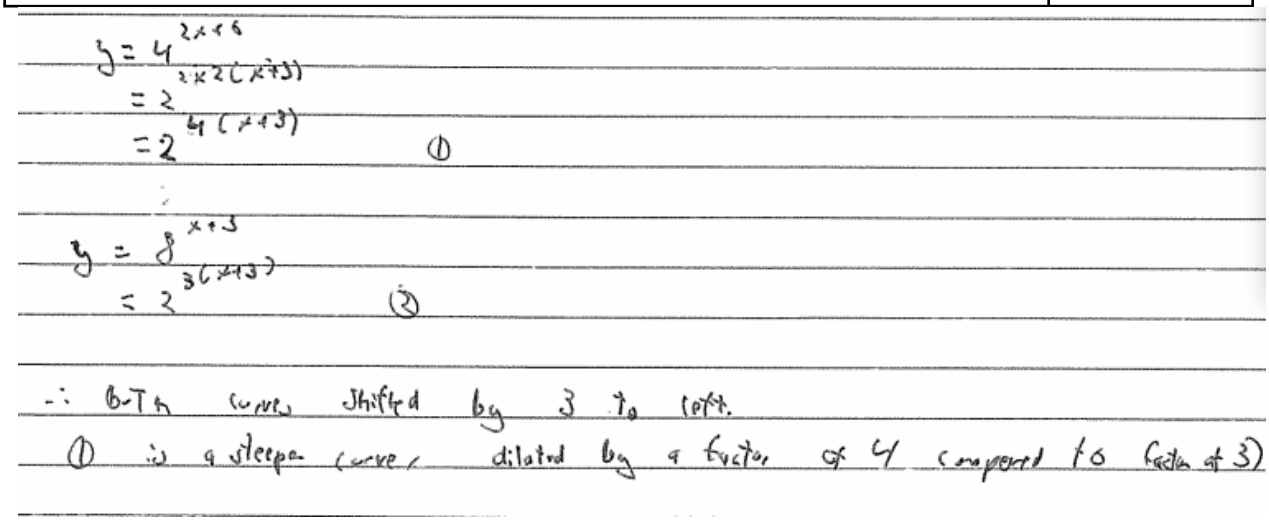
Question 5

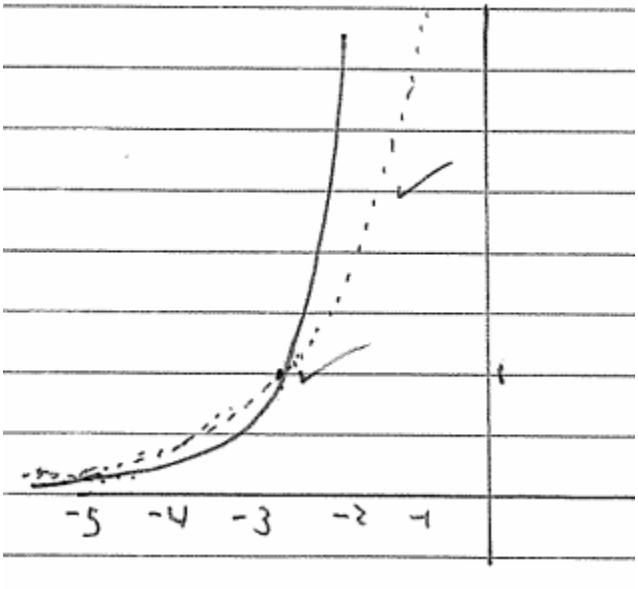
Negative in front lead to many problems completing the square. Some people found the vertex easily but could not interpret the y-ordinate as the maximum height.

Part F

Question 1

Criteria	Marks
Clearly shows sketch is exponential is less steep	2
Clearly shows point of intersection at x= -3	1

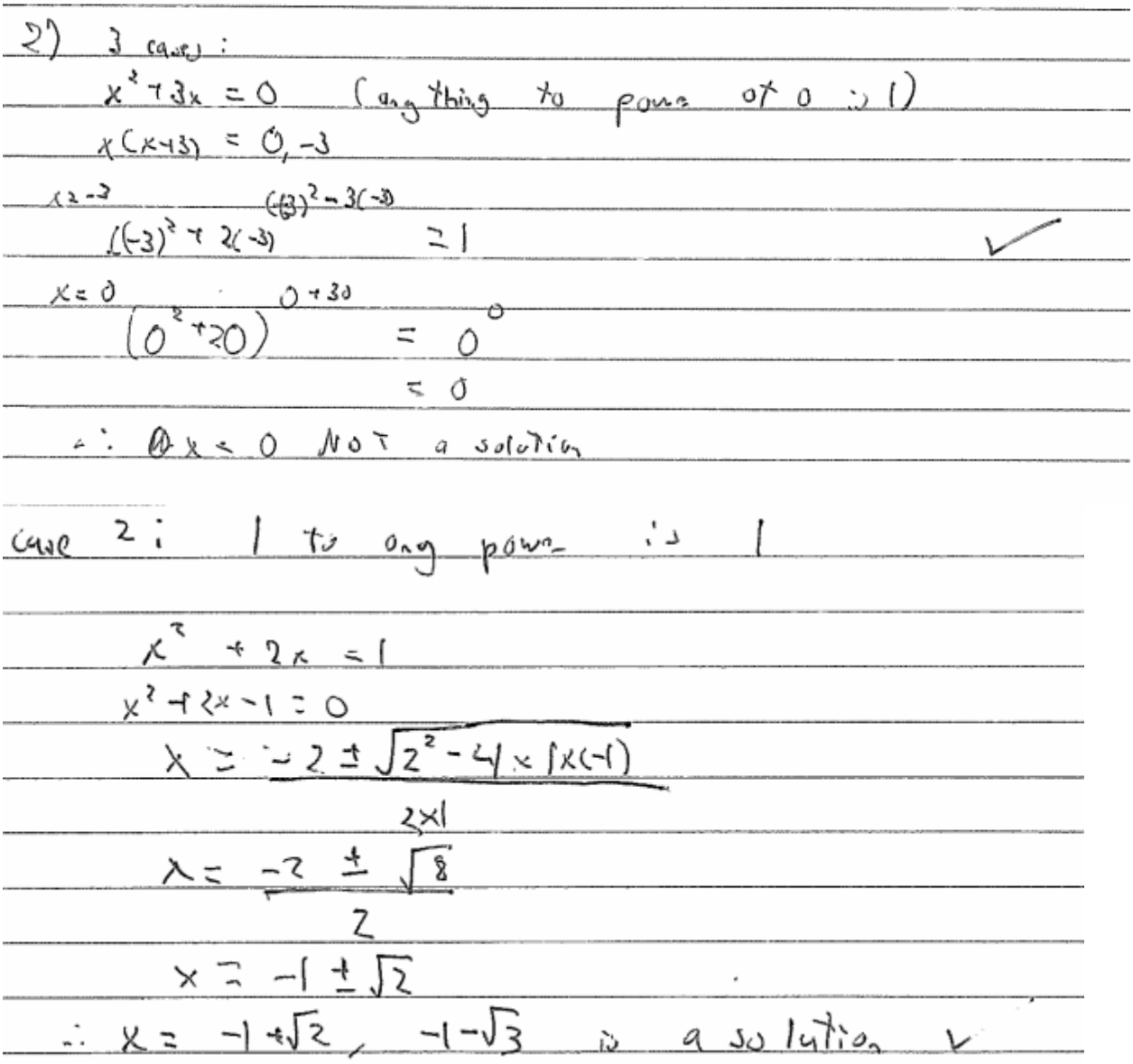


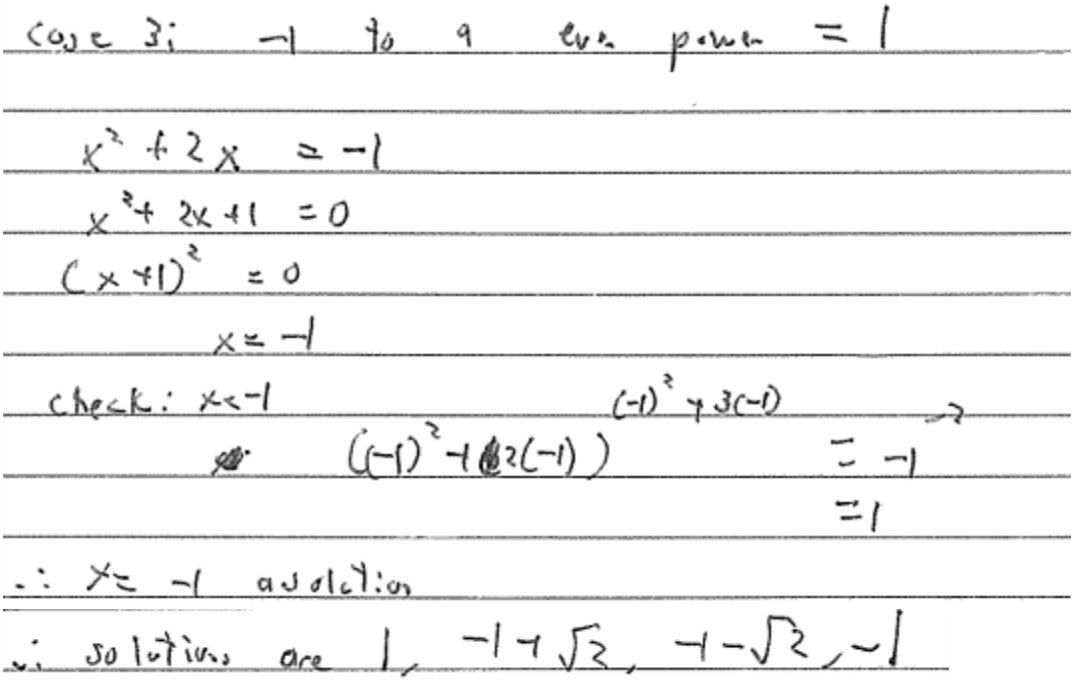


Most of the student got the point of intersection by table of values or algebraic method. Some students lost one mark because they did not provide the coordinate of point of intersection.

Question 2

Criteria	Marks
Correctly identifies -1 as a solution	4
Correctly identifies that $-1+\sqrt{3}$ and $-1-\sqrt{3}$ are solutions	3
Correctly identifies that 0 is NOT a solution	2
Correctly identifies -3 as a solution	1

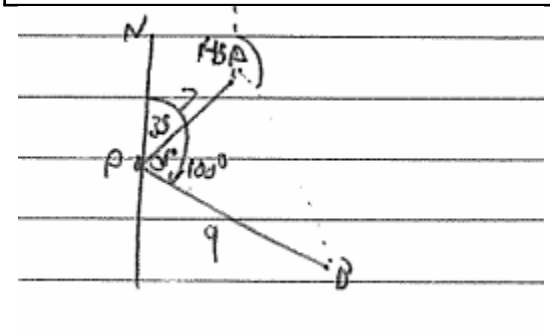




Poorly done. Most students achieved 2 marks out of 4.
Most of the students are able to find the three solutions $x = -3$, $x = -1 + \sqrt{2}$ and $x = -1 - \sqrt{2}$ (Note: $x = -1 + \sqrt{2}$ and $x = -1 - \sqrt{2}$ are counted as one mark)
Only a handful of students discussed the result $x = 0$ is not valid.
Almost no students got the answer $x = -1$

Question 3
a)

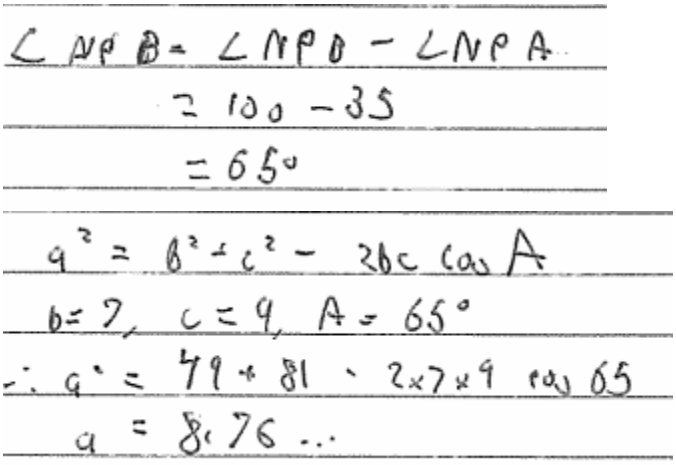
Criteria	**Marks**
Correct answer	1



Generally well done. A couple of students miscalculated the $\angle APB$ to be $55°$ or did not label the two sides.

b)

Criteria	**Marks**
Finds the correct bearing	4
Correctly finds angle $\angle PAB$	3
Correctly finds length AB	2
Attempts to find either side AB or angle PAB	1

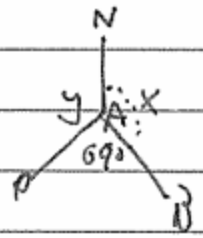


Most students achieved 2 or 3 marks out of 4 for this part.
Most students can apply cosine rule to find the length of AB, but made mistakes when attempting to use sine rule to find $\angle PAB$.
Some students discussed the ambiguous case for this part, but the ambiguous case is not supported here according to the given context and diagram.
A few students found the bearing of A from B instead of the required bearing of B from A.

$\frac{\sin(PAB)}{q} = \frac{\sin(65)}{8.76}$

$\sin(PAB) = \frac{q \sin(65)}{8.76}$

$\angle PAB = 68.61\ldots$ ✓



$y = 180 - 35$

$= 145$

$\therefore x = 360 - 145 - 69$

$= 146°$

∴ The bearing is 146° ✓