KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

GRADE 11 INVESTIGATION 2025

NATURE OF ROOTS

THE AIM OF THE INVESTIGATION IS TO DISCOVER THE CHARACTERISTICS OF THE X - INTERCEPTS(ROOTS) OF A QUADRATIC EQUATION.

DATE	20 FEBRUARY 2025
TOTAL MARKS	50
TIME	1 HOUR

INSTRUCTIONS AND INFORMATION

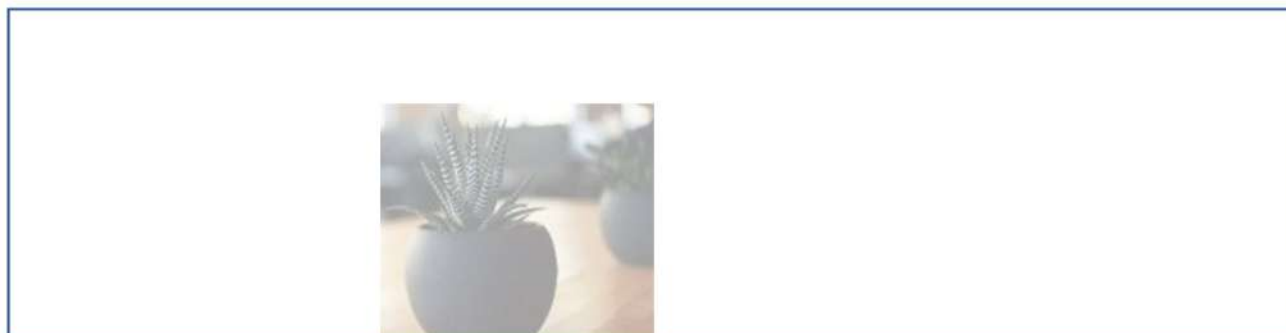Read the following instructions carefully before answering the questions:

1. This question paper consists of 4 questions. Answer ALL the questions.

2. Show clearly ALL calculations, diagrams, graphs etc. which you have used in determining the answers.

3. Answers only will not necessarily be awarded full marks.

4. An approved scientific calculator (non-programmable and non- graphical) may be used, unless stated otherwise.

5. If necessary, answers should be rounded off to TWO decimal places, unless stated otherwise.

6. It is in your own interest to write legibly and to present the work neatly.

7. The answers must be written on this question paper.

NAME OF LEARNER:_____ GRADE: 11 _____

FORMULA: $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Question 1

Use the quadratic formula to determine the roots of the quadratic equations below.
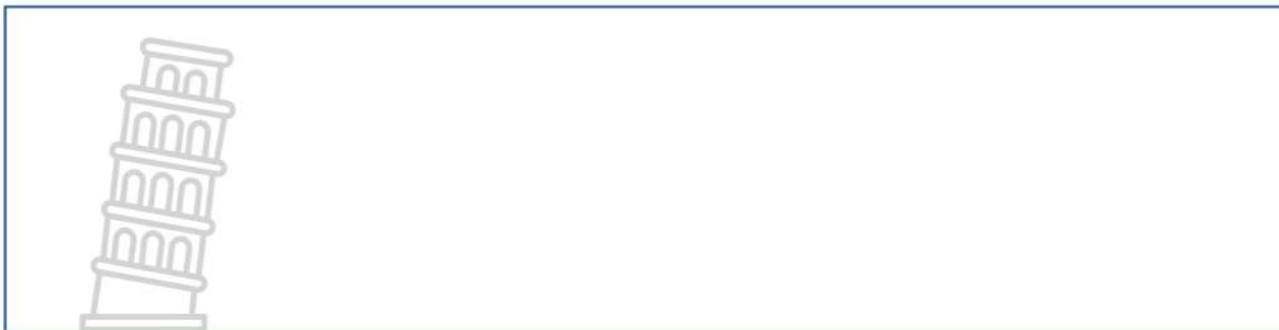
1.1. $x^2 - 6x + 9 = 0$

(3)

1.2. $x^2 - 4x + 3 = 0$

(3)

1.3. $x^2 - 4x - 3 = 0$ (leave the answer in surd form).

(3)

2

1.4. $x^2 - 4x + 7 = 0$

(3)

1.5 Using the words given below, classify each of the roots in 1.1 -1.4. (write down the root(s) and then describe them)

Rational	Irrational	Equal	Unequal
Real	Non-real		

	Root (s)	Description	
1.1			(2)
1.2			(2)
1.3			(2)
1.4			(1)

3

Did you notice that the value under the square root sign determines the description you gave?

This is called the discriminant (Δ)

$$\Delta = b^2 - 4ac$$

Study the two tables above and then complete the following sentences.

If Δ is < 0 then the roots are _____

If $\Delta = 0$ then the roots are _____, _____ and

_____

If $\Delta > 0$ and a perfect square then the roots are _____,

_____ and _____

If $\Delta > 0$ and not a perfect square then roots are _____,

_____ and _____

(7)

Question 2

Application

Without solving for x discuss the nature of the roots of the following equations.
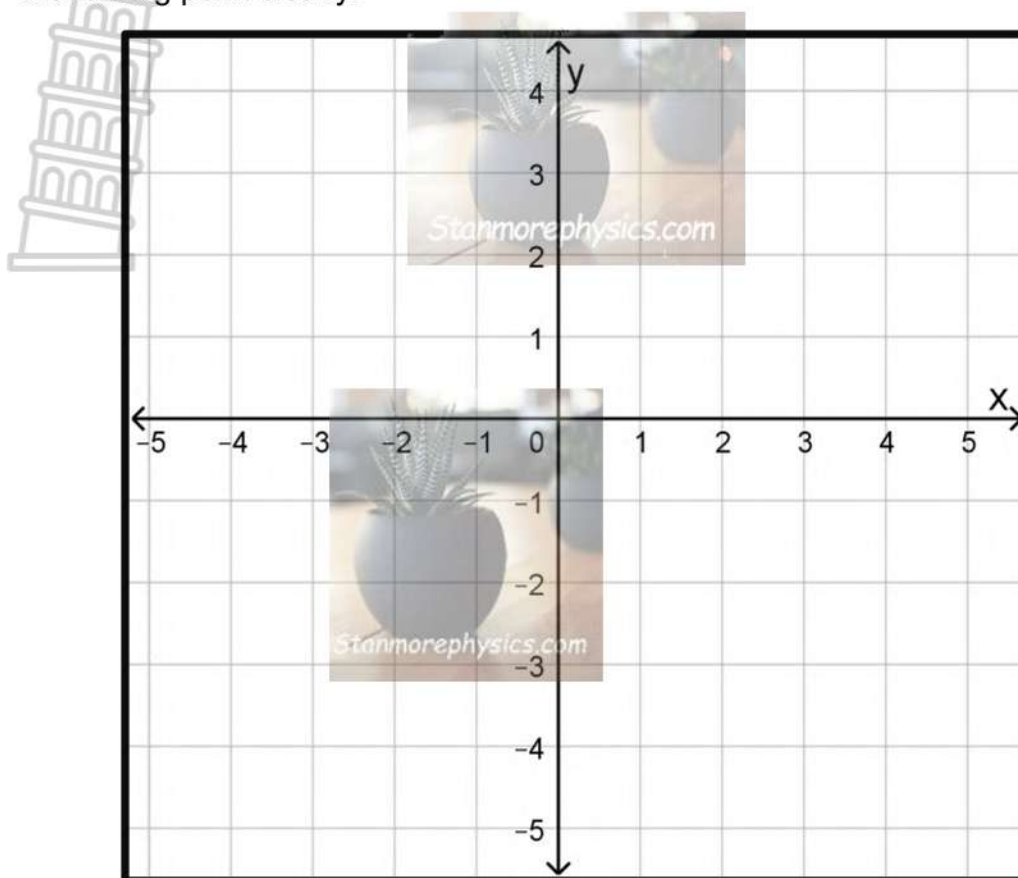
2.1. $2x^2 + 5x - 3 = 0$

(3)

2.2. $2x^2 - 7x = -8$

(3)

4

3.1.1. Sketch the graph of $f(x) = x^2 - 4$ using point by point plotting. Show all intercepts and the turning point clearly.

(3)

3.1.2. Study the graph and then write down the value(s) of the roots of $f(x)$.
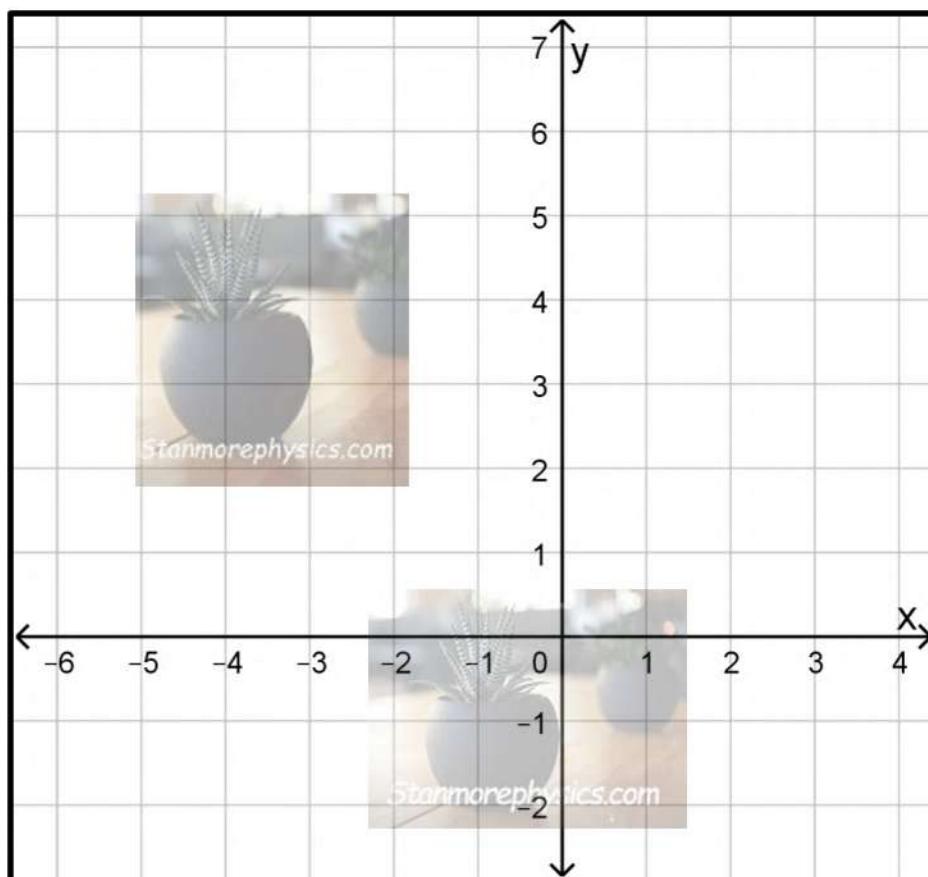Discuss the nature of these roots

(2)

3.2.1. Sketch the graph of $g(x) = x^2 - 4x + 4$

Hint: Complete the table below and then plot the values in the table on the set of axis given.

x	-1	0	1	2	4
$g(x)$					

(3)

3.2.2. Use the graph to determine the roots of $g(x)$. Discuss the nature of these roots

(2)

3.2.3. Sketch the graph of $h(x) = x^2 - 4x + 3$.

Hint: Complete the table below and then plot the values in the table on the set of axis given.

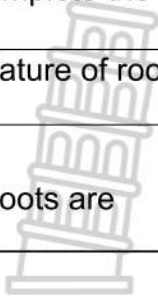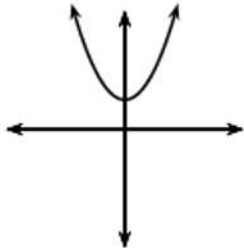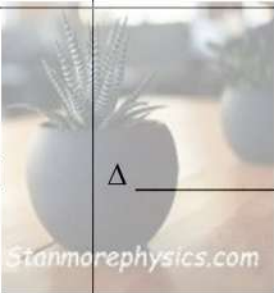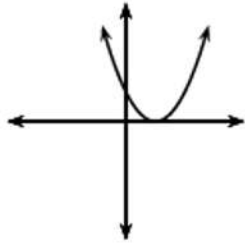| x	−1	0	1	2	4	5
$h(x)$						

(3)

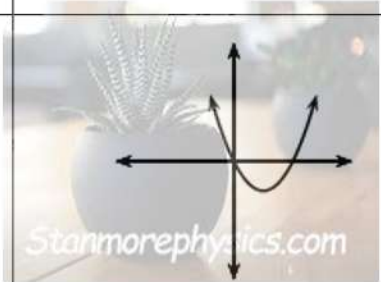3.2.4.   Does $h(x)$ have real roots? Explain your answer.

(2)

7

Question 4

Complete the following table summarising the results from question 3

Nature of roots	Discriminant	Function ($a > 0$)
Roots are _____	$\Delta < 0$	
Roots are real and equal	Δ _____	
Roots are _____ and_____	$\Delta > 0$ Δ is a rational number	

(3)

TOTAL MARKS: 50

KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

MATHEMATICS – GRADE 11
INVESTIGATION 2025- MEMO

MARKS: 50   DURATION: 1 hour

AIMS OF THE INVESTIGATION: To investigate nature of roots (x-intercepts) of a quadratic equation

FORMULA: $\dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Question 1

Use the quadratic formula to determine the roots of the quadratic equations below.

1.1. $x^2 - 6x + 9 = 0$

$x = \dfrac{-(-6) \pm \sqrt{(-6)^2 - 4(1)(9)}}{2(1)}$ ✓a substitution

$x = \dfrac{6 \pm \sqrt{0}}{2}$ ✓

$x = 3$ ✓ca

(3)

1.2. $x^2 - 4x + 3 = 0$

$x = \dfrac{-(-4) \pm \sqrt{(-4)^2 - 4(1)(3)}}{2(1)}$ ✓a substitution

$x = \dfrac{4 \pm \sqrt{4}}{2}$ ✓

$x = 3 \; or \; x = 1$ ✓ca

(3)

1

1.3. $x^2 - 4x - 3 = 0$

$$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(1)(-3)}}{2(1)} \checkmark \text{a substitution}$$

$$x = 2 \pm \sqrt{7} \checkmark \text{ca} \checkmark \text{ca}$$

(3)

1.4. $x^2 - 4x + 7 = 0$

$$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(1)(7)}}{2(1)} \checkmark \text{a substitution}$$

$$x = \frac{4 \pm \sqrt{-12}}{2} \qquad \checkmark$$

No real solution $\qquad \checkmark$

(3)

1.5 Using the words given below, classify each of the roots in 1.1 -1.4.

(write down the root(s) and then classify)

Rational	Irrational	Equal	Unequal
Real	Non-real		

	Root (s)	Description
1.1	$x = 3$	Real, Rational, Equal $\checkmark\checkmark$ (2)
1.2	$x = 3 \text{ or } x = 1$	Real, rational, unequal $\checkmark$ $\checkmark$ (2)
1.3	$x = 2 \pm \sqrt{7}$	Real, Irrational, unequal$\checkmark\checkmark$ (2)
1.4	$x = \frac{4 \pm \sqrt{-12}}{2}$	Non-real $\checkmark$ (1)

2

Did you notice that the value under the square root sign determines the description you gave?

This is called the discriminant (Δ)

$$\Delta = b^2 - 4ac$$

Study the two tables above and the complete the following sentences.

If Δ is < 0 then the roots are   <u>Non-real</u>

If Δ = 0 then the roots are <u>Real, Rational and equal.</u>

If Δ > 0 and a perfect square then the roots are <u>Real, rational and unequal.</u>

If Δ > 0 and not a perfect square then roots are <u>Real, irrational and unequal.</u>

(7)

Question 2

Application

Calculate the value for Δ and then discuss the nature of the roots of the following equations.

Use the descriptive words in the table in 1.5.

2.1. $2x^2 + 5x - 3 = 0$

> $\Delta = b^2 - 4ac$
>
> $\Delta = (5)^2 - 4(2)(-3)$✔
>
> $\Delta = 49$ ✔
>
> *The roots are real, rational and unequal.*✔
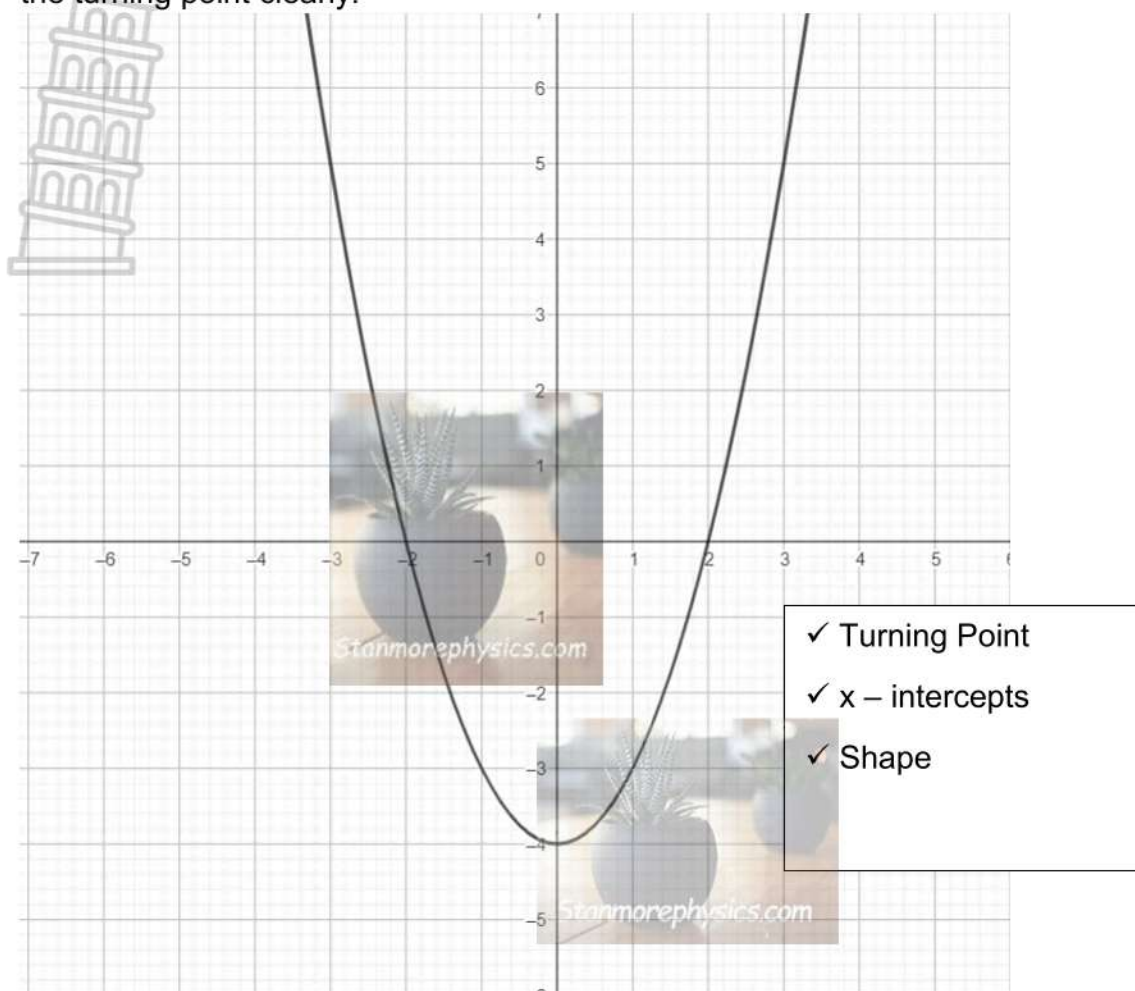
(3)

2.2. $2x^2 - 7x = -8$

> $\Delta = (-7)^2 - 4(2)(8)$
>
> $\Delta = -15$
>
> The roots are non-real.

(3)

Question 3

3.1.1. Sketch the graph of $f(x) = x^2 - 4$ using point by point plotting. Show all intercepts and the turning point clearly.

✓ Turning Point

✓ x – intercepts

✓ Shape

(3)

3.1.2. Use the graph to determine the roots of $f(x)$. Discuss the nature of these roots
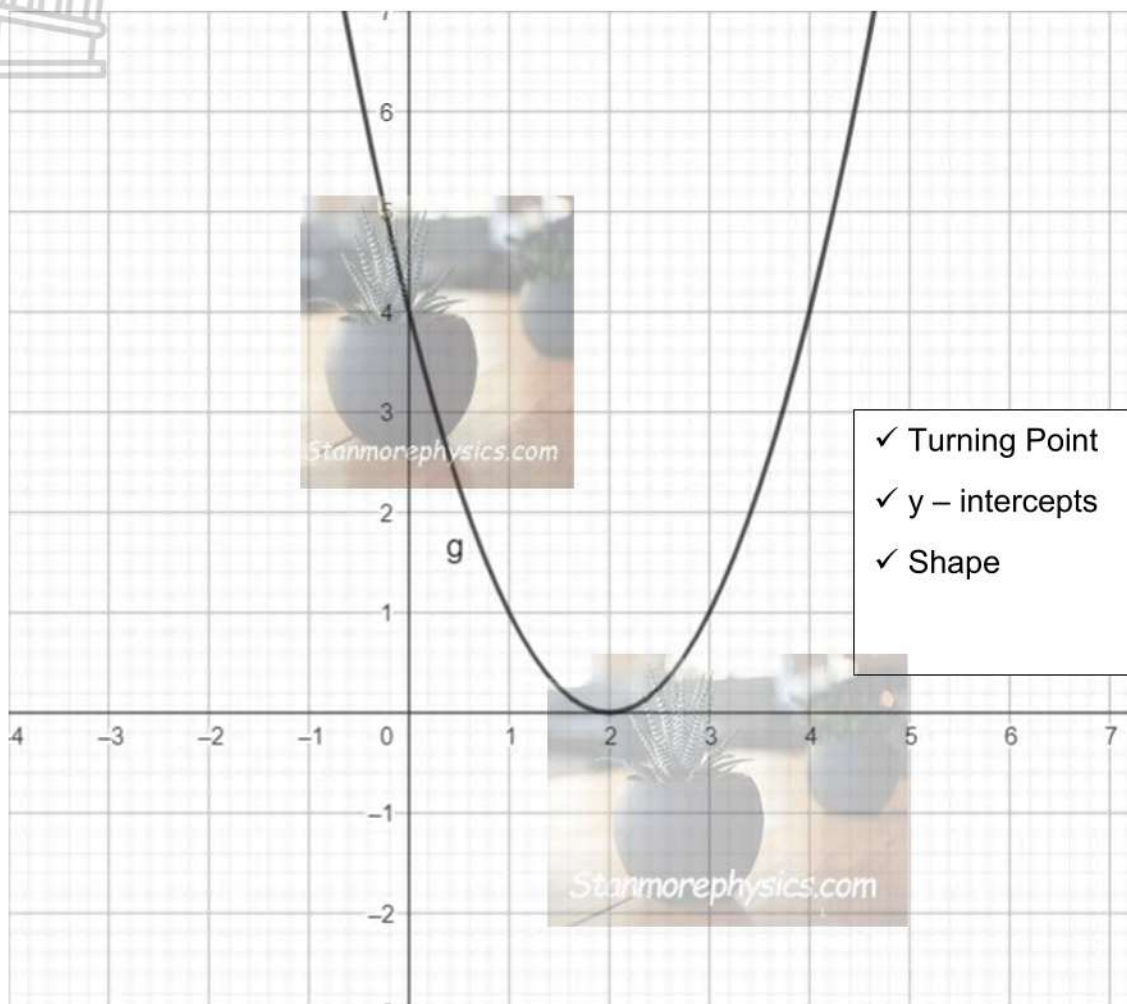
$x = -2 \; or \; x = 2$ ✓ca

Real, rational and unequal.   ✓

(2)

4

3.2.1. Sketch the graph of $g(x) = x^2 - 4x + 4$

Hint: Complete the table below and then plot the values in the table on the set of axis given.

x	-1	0	1	2	4
$g(x)$	9	4	1	0	4

✓ Turning Point

✓ y – intercepts

✓ Shape

(3)

3.2.2. Use the graph to determine the roots of $g(x)$. Discuss the nature of these roots

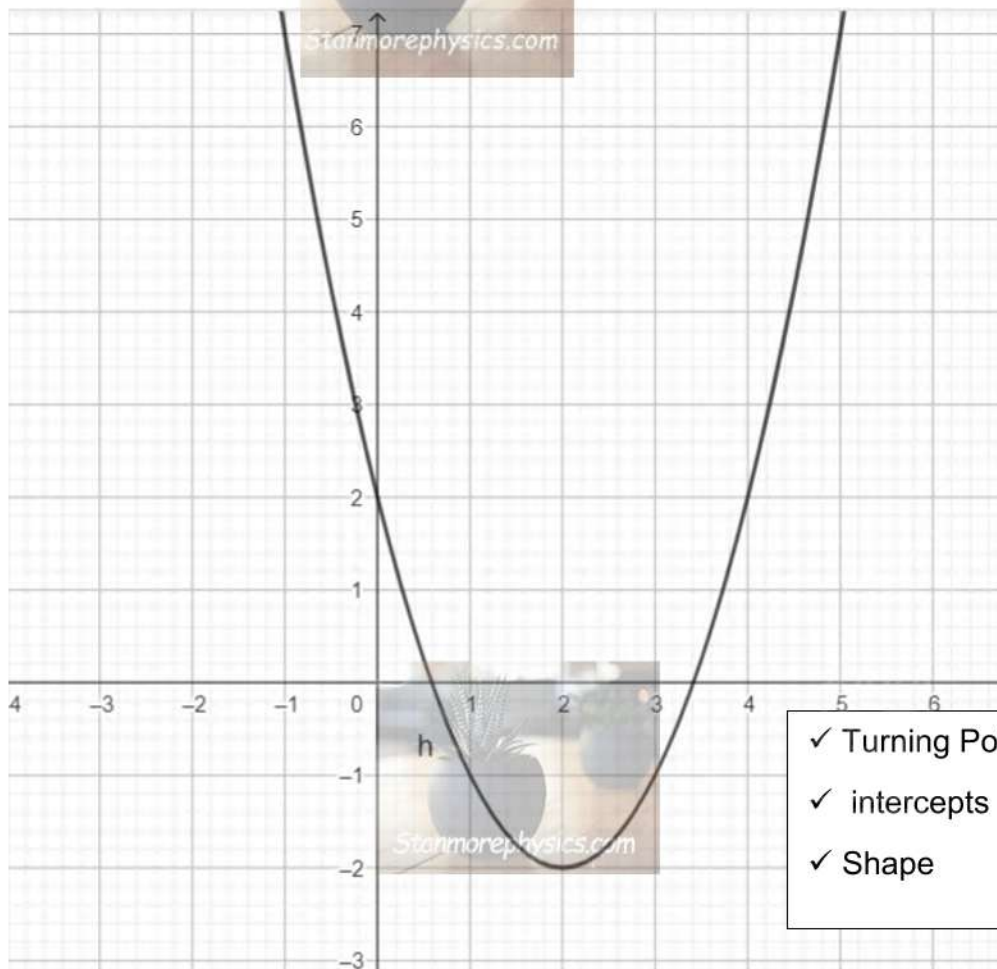|	
$x = 2$	✓ca
Roots are real, rational and equal.	✓ca

(2)

3.2.3. Sketch the graph of $h(x) = x^2 - 4x + 2$.
Hint: Complete the table below and then plot the values in the table on the set of axis given.

x	-1	0	1	2	4	5
$h(x)$	7	2	-1	-2	2	7

✓ Turning Point

✓ intercepts

✓ Shape

(3)

3.2.4. Does $h(x)$ have real roots? Explain your answer.

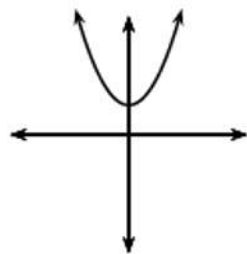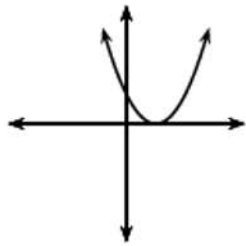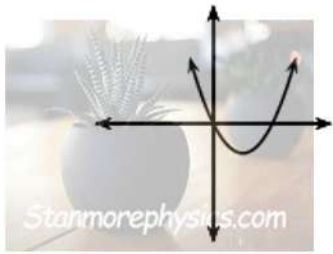|	
Yes.	✓a
The graph cuts the x – axis.	✓

(2)

Question 4

Complete the following table summarising the results from question 3

Nature of roots	Discriminant	Function ($a > 0$)
Roots are <u>non – real</u> ✓a	$\Delta < 0$	
Roots are real and equal	<u>$\Delta = 0$</u> ✓a	
Roots are <u>Real and unequal</u> ✓a	$\Delta > 0$ Δ is a rational number	

(3)

TOTAL MARKS: 50