GRADE 11

MATHEMATICS INVESTIGATION

DATE_____

MARKS: 55

TIME: 1 Hour 15 minutes

INSTRUCTIONS AND INFORMATION

10. Read the following instructions carefully before answering the questions.
11. This task consists of 4 parts
12. Answer ALL sections.
13. Clearly show ALL calculations, diagrams, graphs, et cetera which you have used in determining your answers.
14. Answers only will not necessarily be awarded full marks.
15. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
16. If necessary, answers should be rounded off to TWO decimal places, unless stated otherwise.
17. Diagrams are NOT necessarily drawn to scale.
18. Write neatly and legibly.

SECTION A

Part 1

Solve the following equations by using the Quadratic formula and answer the subsequent questions:

1 $12x^2 + 5x - 2 = 0$ (3)

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a. Are the roots equal or unequal? (1)

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b. Are the roots rational or irrational? (1)

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c. Are the roots real or non-real? (1)

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2. $3x^2 + 6x + 1 = 0$ (3)

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a. Are the roots equal or unequal? (1)

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b. Are the roots rational or irrational? (1)

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c. Are the roots real or non-real? (1)

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3. $x^2 - 6x + 9 = 0$ (3)

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a. Are the roots equal or unequal? (1)

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b. Are the roots rational or irrational? (1)

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c. Are the roots real or non-real? (1)

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4. $2x^2 + 4x + 10 = 0$ (3)

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a. Are the roots equal or unequal? (1)

……

b. Are the roots rational or irrational? (1)

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c. Are the roots real or non-real? (1)

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Part 2

1. Now that you have done the four examples you must determine the value of $b^2 - 4ac$ which is called the discriminant (Δ).

	Equation	$\Delta = b^2 - 4ac$	
a.	$12x^2 + 5x - 2 = 0$		(1)
b.	$3x^2 + 6x + 1 = 0$		(1)
c.	$x^2 - 6x + 9 = 0$		(1)
d.	$2x^2 + 4x + 10 = 0$		(1)

2. Hence, determine the connection between the discriminant and the nature of the roots of each equation in the table below:

	Discriminant	Roots are: Equal/unequal	Roots are: Rational/Irrational	Roots are: Real/Non-Real
$\Delta > 0$ and a perfect square				
$\Delta > 0$ and is not a perfect square				
$\Delta = 0$				
$\Delta < 0$				

(1 x 4 = 4)

Part 3

1. **Draw rough sketches to represent the following functions:**
2.

Function	**Nature of the roots (from part 2 above)**	**Rough sketch**	
$y = 12x^2 + 5x - 2$			(2)
$y = 3x^2 + 6x + 1$			(2)
$y = x^2 - 6x + 9$			(2)
$y = 2x^2 + 4x + 10$			(2)

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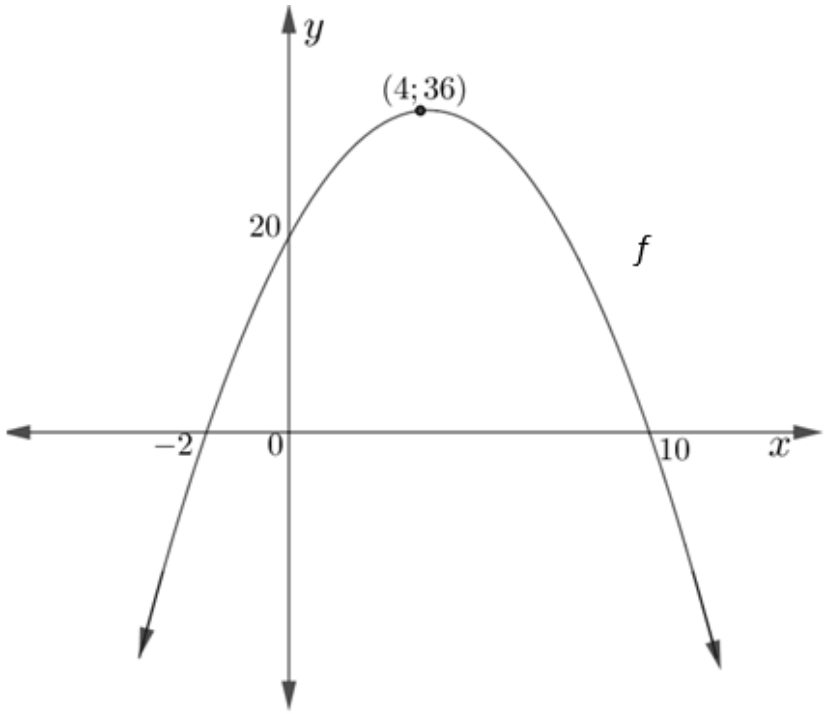
SECTION B

Application of your knowledge on the nature of roots:		
1.	Prove that the roots of $x^2 + (1-k)x + k - 3 = 0$ are real for all real values of k.	(6)

2.	The graph of $f(x) = -x^2 + 8x + 20$ is sketched below. The graph intersects the $x-$axis at $(-2;0)$ and $(10;0)$, and the $y-$axis at $(0;20)$. The point $(4;36)$ is the turning point of f.		
			
2.1	Determine the value of k if $g(x) = 4x + k$ is a tangent to $f(x) = -x^2 + 8x + 20$.		
2.2	Use the graph $f(x) = -x^2 + 8x + 20$ to determine the values of :		
	2.2.1	p for which $-x^2 + 8x + p = 0$ will have equal roots.	(1)

	2.2.2	b for which $-x^2+8x+20=b$ will have no real roots.	(1)
	2.2.3	m for which $-x^2+8x+m=0$ will have two positive roots.	(1)
			[9]