education

Department:
Education
PROVINCE OF KWAZULU-NATAL

NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS P1

SEPTEMBER 2019

PREPARATORY EXAMINATIONS

MARKS: 150

TIME: 3 hours

N.B. This question paper consists of 10 pages and an information sheet.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 13 questions.
2. Answer **ALL** questions.
3. Clearly show **ALL** calculations, diagrams, graphs, et cetera that you have used in determining your answers.
4. Answers only will not necessarily be awarded full marks.
5. An approved scientific calculator (non-programmable and non-graphical) may be used, unless stated otherwise.
6. If necessary, answers should be rounded off to TWO decimal places, unless stated otherwise.
7. Diagrams are NOT necessarily drawn to scale.
8. Number the answers correctly according to the numbering system used in this question paper. Write neatly and legibly.

QUESTION 1

1.1 Solve for x:

1.1.1 $x(4-x)=0$ (2)

1.1.2 $2x^2+5x=1$ (rounded off to 2 decimal places) (4)

1.2 Given: $\sqrt{x-2}=2-x$

1.2.1 Solve for x. (4)

1.2.2 Hence, or otherwise, determine the value(s) of p if $\sqrt{p^2-p-2}=2+p-p^2$ (4)

1.3 Solve: $-2x^2+5x\leq 0$ (4)

1.4 If $2^{x+1}+2^x=3^{y+2}-3^y$, and x and y are integers, (6)
calculate the value of $x+y$.

[24]

QUESTION 2

The first four terms of a quadratic sequence are $8\,;15\,;\,24\,;\,35\,;...$

2.1 Write down the next TWO terms of the quadratic sequence. (1)

2.2 Determine the n^{th} term of the sequence. (4)

[5]

QUESTION 3

The first three terms of an arithmetic sequence are $2p - 3\ ;\ p + 5\ ;\ 2p + 7$.

3.1 Determine the value(s) of p. (3)

3.2 Calculate the sum of the first 120 terms. (3)

3.3 The following pattern is true for the arithmetic sequence above:

$T_1 + T_4 = T_2 + T_3$

$T_5 + T_8 = T_6 + T_7$

$T_9 + T_{12} = T_{10} + T_{11}$

$\therefore T_k + T_{k+3} = T_x + T_y$

3.3.1 Write down the values of x and y in terms of k. (2)

3.3.2 Hence, calculate the value of $T_x + T_y$ in terms of k in simplest form. (4)

[12]

QUESTION 4

4.1 Given: $\sum_{k=1}^{\infty} 5(3^{2-k})$

4.1.1 Write down the value of the first TWO terms of the infinite geometric series. (2)

4.1.2 Calculate the sum to infinity of the series. (2)

4.2 Consider the following geometric sequence:

$\sin 30°; \cos 30°; \frac{3}{2}; \ldots; \frac{81\sqrt{3}}{2}$

Determine the number of terms in the sequence. (5)

[9]

QUESTION 5

Given $f(x) = \frac{-4}{2-x} - 1$

5.1 Write down the equations of the vertical and horizontal asymptotes of f. (2)

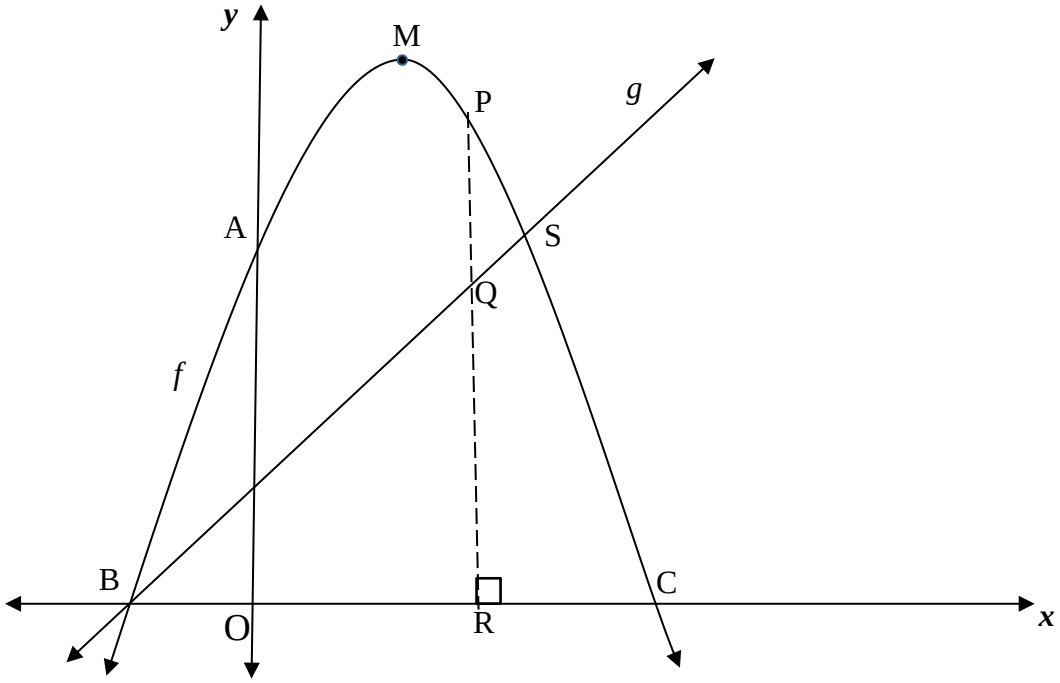
5.2 Determine the intercepts of the graph of f with the axes. (3)

5.3 Draw the graph of f. Show all intercepts with the axes as well as the asymptotes of the graph. (4)

[9]

QUESTION 6

In the diagram, the graphs of $f(x) = -x^2 + 5x + 6$ and $g(x) = x + 1$ are drawn below.
The graph of f intersects the x – axis at B and C and the y – axis at A.
The graph of g intersects the graph of f at B and S. PQR is perpendicular to the x – axis with points P and Q on f and g respectively. M is the turning point of f.



6.1 Write down the co-ordinates of A. (1)

6.2 S is the reflection of A about the axis of symmetry of f. Calculate the coordinates of S. (2)

6.3 Calculate the coordinates of B and C. (3)

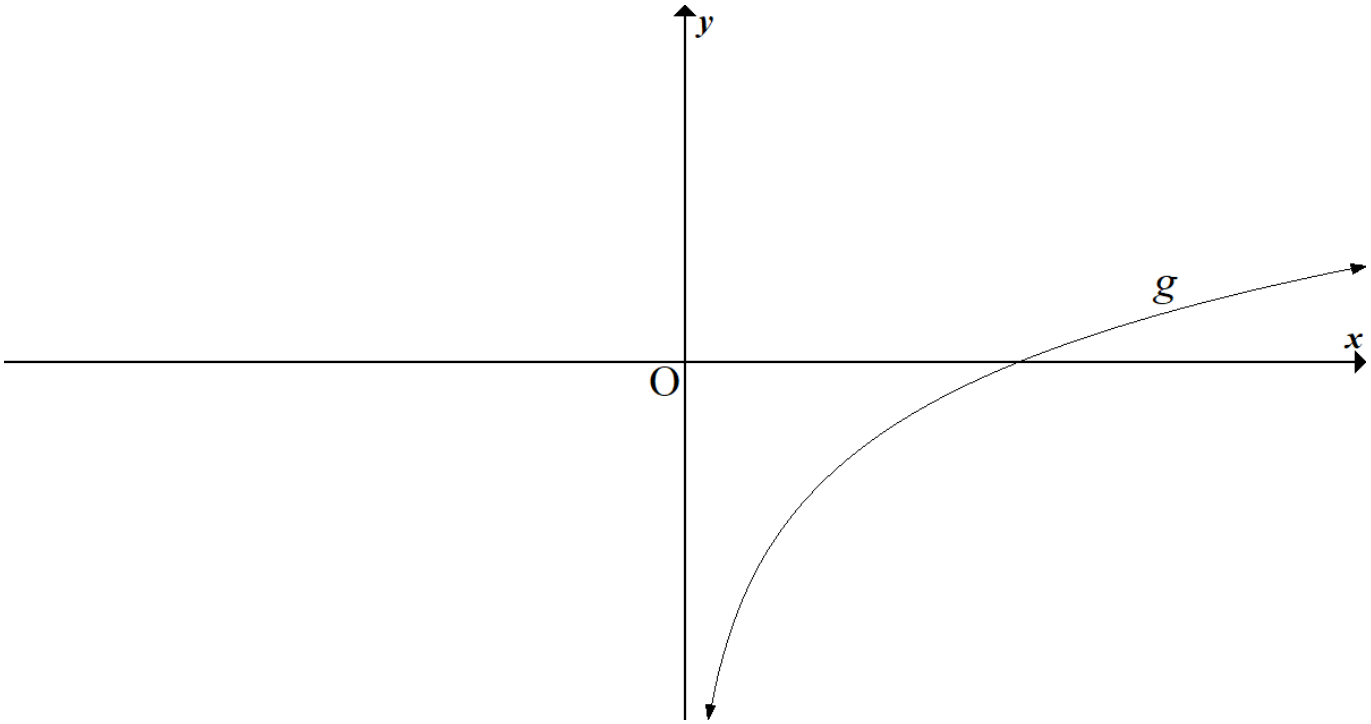
6.4 If PQ = 5 units, calculate the length of OR. (4)

6.5 Calculate the:
6.5.1 Coordinates of M. (4)
6.5.2 Maximum length of PQ between B and S. (4)

[18]

QUESTION 7

In the diagram, the graph of $g(x) = \log_5 x$ is drawn.



7.1 Write down the equation of g^{-1}, the inverse of g, in the form $y = \ldots$ (2)

7.2 Write down the range of g^{-1}. (1)

7.3 Calculate the value(s) of x for which $g(x) \leq -4$. (4)

[7]

QUESTION 8

8.1 A car depreciated at the rate of 13,5 % p.a. to R250 000 over 5 years according to the reducing balance method. Determine the original price of the car, to the nearest rand. (3)

8.2 Melissa takes a loan of R950 000 to buy a house. The interest is 14,25 % p.a. compounded monthly. His first instalment will commence one month after taking out the loan.

8.2.1 Calculate the monthly repayments over a period of 20 years. (4)

8.2.2 Determine the balance on the loan after the 100th instalment. (4)

8.2.3 If Melissa failed to pay the 101st, 102nd, 103rd and 104th instalments, calculate the value of the new instalment that will settle the loan in the same time period. (4)

[15]

QUESTION 9

9.1 Determine $f'(x)$ from first principles given $f(x) = x^2 - \frac{1}{2}x$. (5)

9.2 Determine:

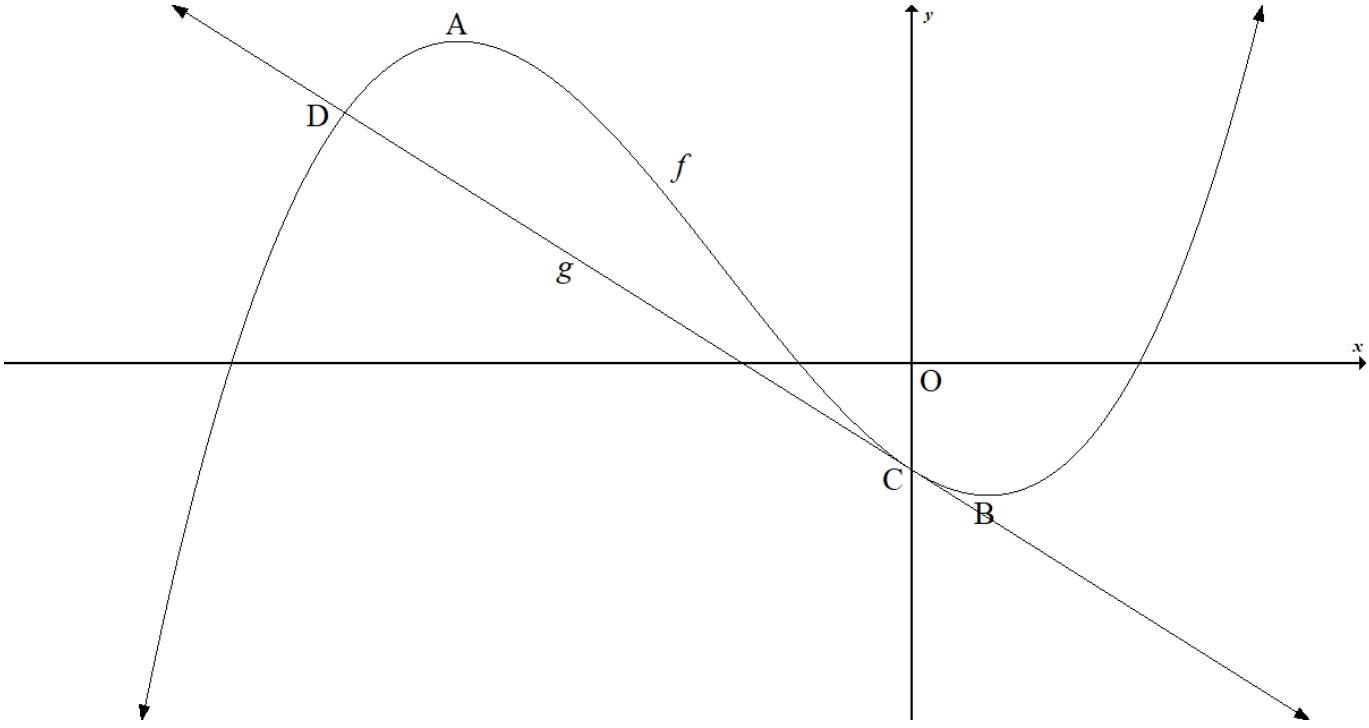
9.2.1 $\frac{d}{dx}\left[3x^4 + \sqrt[5]{x} + a^2\right]$ (3)

9.2.2 $\frac{dy}{dx}$, if $xy = x + x^2 - 1$. (4)

[12]

QUESTION 10

In the diagram, the graph of $f(x) = x^3 + 5x^2 - 8x - 12$ is drawn. A and B are the turning points and C the y - intercept of f. $g(x) = mx + c$ is a tangent to the graph of f at C. D is the intersection of f and g.



10.1 Calculate the:

10.1.1 co-ordinates of the x-intercepts of f. (6)
10.1.2 co-ordinates of B. (4)
10.1.3 x – coordinate of the point of inflection of f. (2)

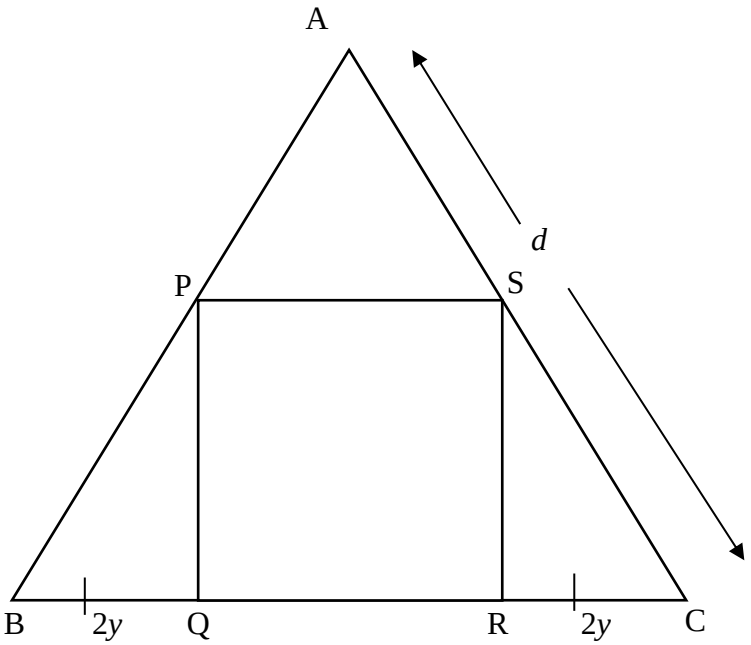
10.2 Determine the:

10.2.1 equation of the g. (2)
10.2.2 values of x for which $f'(x) \cdot g'(x) > 0$. (3)

[17]

QUESTION 11

In the diagram below, ΔABC is an equilateral triangle with sides *d* units long. P and S are points on sides AB and AC respectively. Q and R are points on BC such that PQRS is a rectangle. BQ = RC = 2*y* units.



11.1 Show that the area of the rectangle PQRS is given by $A = 2\sqrt{3}y(d - 4y)$. (4)

11.2 Determine the maximum area of the rectangle in terms of *d*. (6)
[10]

QUESTION 12

A bag contains 12 blue balls, 10 red balls and 18 green balls. 2 balls are chosen at random without replacement.

Determine the probability:

12.1 if the two balls chosen at random are green. (3)

12.2 if the two balls chosen at random are blue and red. (3)
[6]

QUESTION 13

The digits 1, 2, 3, 4, 5, 6, 7, 8, 9 are used to form 3 - digit codes, eg. 567, 218, etc.

Determine the number of different codes that can be formed:

13.1 if repetition is allowed. (2)

13.2 such that the code is greater than 500 and repetition is NOT allowed. (2)

13.3 such that the middle digit is 5 and repetition is allowed. (2)
[6]

TOTAL: 150

INFORMATION SHEET: MATHEMATICS

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$A = P(1+ni) \qquad A = P(1-ni) \qquad A = P(1-i)^n \qquad A = P(1+i)^n$$

$$T_n = a + (n-1)d \qquad S_n = \frac{n}{2}\left(2a + (n-1)d\right)$$

$$T_n = ar^{n-1} \qquad S_n = \frac{a\left(r^n - 1\right)}{r-1} \; ; \quad r \neq 1 \qquad S_\infty = \frac{a}{1-r} \; ; \; -1 < r < 1$$

$$F = \frac{x\left[(1+i)^n - 1\right]}{i} \qquad P = \frac{x[1-(1+i)^{-n}]}{i}$$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \qquad \mathrm{M}\left(\frac{x_1 + x_2}{2}; \frac{y_1 + y_2}{2}\right)$$

$$y = mx + c \qquad y - y_1 = m(x - x_1) \qquad m = \frac{y_2 - y_1}{x_2 - x_1} \qquad m = \tan\theta$$

$$(x-a)^2 + (y-b)^2 = r^2$$

In ΔABC: $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$ $\qquad a^2 = b^2 + c^2 - 2bc.\cos A$ $\qquad area\,\Delta ABC = \dfrac{1}{2}ab.\sin C$

$$\sin(\alpha + \beta) = \sin\alpha.\cos\beta + \cos\alpha.\sin\beta \qquad \sin(\alpha - \beta) = \sin\alpha.\cos\beta - \cos\alpha.\sin\beta$$

$$\cos(\alpha + \beta) = \cos\alpha.\cos\beta - \sin\alpha.\sin\beta \qquad \cos(\alpha - \beta) = \cos\alpha.\cos\beta + \sin\alpha.\sin\beta$$

$$\cos 2\alpha = \begin{cases} \cos^2\alpha - \sin^2\alpha \\ 1 - 2\sin^2\alpha \\ 2\cos^2\alpha - 1 \end{cases} \qquad \sin 2\alpha = 2\sin\alpha.\cos\alpha$$

$$\bar{x} = \frac{\sum f.x}{n} \qquad \sigma^2 = \frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}{n}$$

$$\mathrm{P}(A) = \frac{n(\mathrm{A})}{n(\mathrm{S})} \qquad \mathrm{P(A\ or\ B) = P(A) + P(B) - P(A\ and\ B)}$$

$$\hat{y} = a + bx \qquad b = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sum(x - \bar{x})^2}$$

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MARKING GUIDELINE

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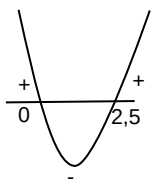
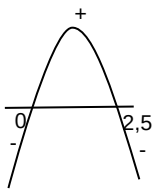
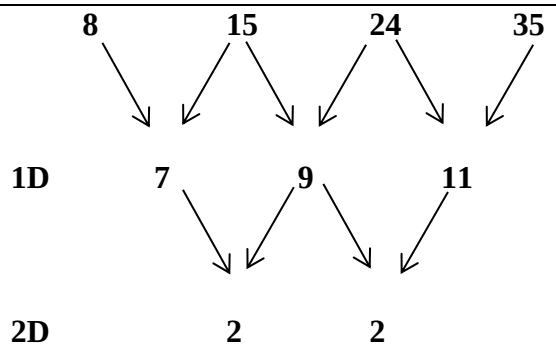
This marking guideline consists of 13 pages.

QUESTION 1

1.1.1	$x = 0 \text{ or } x = 4$	A✓ 0 A✓ 4	(2)
1.1.2	$2x^2 + 5x - 1 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{-(5) \pm \sqrt{(5)^2 - 4(2)(-1)}}{2(2)}$ $= 0{,}19 \quad or \quad -2{,}69$	A✓standard form CA✓substitution in correct formula CA✓CA✓answers (penalize 1 mark if rounding off is incorrect-once here for entire paper)	(4)
1.2.1	$\sqrt{x-2} = 2 - x$ $(\sqrt{x-2})^2 = (2-x)^2$ $x - 2 = 4 - 4x + x^2$ $x^2 - 5x + 6 = 0$ $(x-2)(x-3) = 0$ $x = 2 \text{ or } x = 3$ *n/a* **OR** $\sqrt{x-2} = 2 - x$ $x - 2 \geq 0 \text{ and } 2 - x \geq 0$ $x \geq 2 \text{ and } x \leq 2$ $x = 2$	A✓ squaring both sides CA✓standard form CA✓factors CA✓answers and rejecting **OR** A✓ A✓each inequality A✓both inequalities CA✓answer **Answer only FULL MARKS**	(4) (4)
1.2.2	$p^2 - p = x$ $\therefore p^2 - p = 2$ $p^2 - p - 2 = 0$ $(p+1)(p-2) = 0$ $p = -1 \text{ or } p = 2$	letting $p^2 - p = x$ CA✓$p^2 - p = 2$ CA✓standard form CA✓factors CA✓answers **MAX 3marks if four solutions arrived at**	(4)
1.3	$-2x^2 + 5x \leq 0$ $2x\left(x - \frac{5}{2}\right) \geq 0$ $x \leq 0 \quad \text{or} \quad x \geq \frac{5}{2}$ OR  OR  	AA✓✓ factors CA✓ $x \leq 0$ CA✓ $x \geq \frac{5}{2}$ **OR** If graphical Solution is used: AA 2 marks for graph CACA 2 marks for answer	(4) (4)

1.4	$2^{x+1} + 2^x = 3^{y+2} - 3^y$ $2^x(2+1) = 3^y(9-1)$ $2^x(3) = 3^y(8)$ $2^{x-3} = 3^{y-1}$ $x - 3 = 0 \quad and \quad y - 1 = 0$ $x = 3 \quad and \quad y = 1$ $x + y = 4$	A✓factorising CA✓simplifying CA✓exponential form CA✓each exponent and equal to 0 CA✓x and y value CA✓answer If $x - 3 = 0 \quad and \quad y - 1 = 0$ is missing then maximum 5/6 marks	(6)
			[24]

QUESTION 2

2.1	48 ; 63	A✓answers	(1)
2.2	 $2a = 2 \qquad a = 1$ $3a + b = 7 \qquad b = 4$ $a + b + c = 8 \qquad c = 3$ $T_n = n^2 + 4n + 3$ **OR** $2a = 2 \qquad a = 1$ $T_1 + d_2 - d_1 = c$ $8 + 2 - 7 = c$ $3 = c$ $T_n = n^2 + bn + 3$ $8 = 1 + b + 3$ $b = 4$ $T_n = n^2 + 4n + 3$	A✓a value CA✓b value CA✓c value CA✓answer **OR** A✓a value CA✓c value CA✓b value CA✓answer	(4) (4)

	OR $T_n = T_1 + (n-1)d_1 + \frac{(n-1(n-2)}{2}d_2$ $= 8 + (n-1)(7) + \frac{(n-1(n-2)}{2}(2)$ $= 8 + 7n - 7 + n^2 - 3n + 2$ $= n^2 + 4n + 3$	**OR** A✓formula A✓substitution into correct formula CA✓simplifying CA✓answer	(4)
	OR $T_n = \frac{n-1}{2}[2a + (n-2)d] + T_1$ $= \frac{n-1}{2}[2(7) + (n-2)(2)] + 8$ $= \frac{n-1}{2}[14 + 2n - 4] + 8$ $= \frac{n-1}{2}[2n + 10] + 8$ $= (n-1)(n+5) + 8$ $= n^2 + 4n - 5 + 8$ $= n^2 + 4n + 3$	**OR** A✓formula A✓substitution into correct formula CA✓simplifying CA✓answer	(4)
			[5]

QUESTION 3

3.1	$T_2 - T_1 = T_3 - T_2$ $p + 5 - 2p + 3 = 2p + 7 - p - 5$ $-p + 8 = p + 2$ $p = 3$	A✓ equating differences CA✓simplifying CA✓answer	(3)
3.2	Pattern is 3 ; 8 ; 13 ; …. $S_n = \frac{n}{2}[2a + (n-1)d]$ $S_{120} = \frac{120}{2}[2(3) + 119(5)]$ $= 36060$	CA✓a = 3 and d = 5 CA✓substitution into formula CA✓answer	(3)
3.3.1	$x = k + 1$ and $y = k + 2$	A✓x – value A✓y – value	(2)

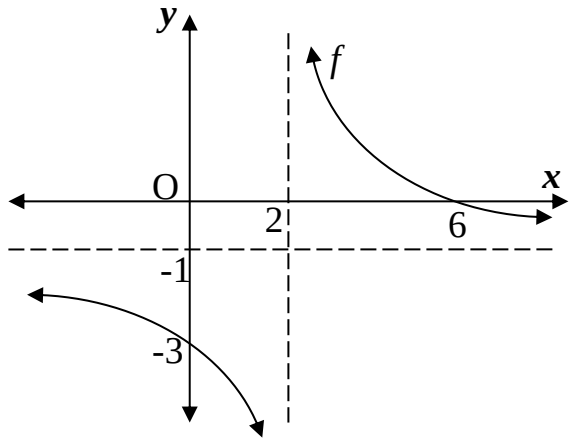
3.3.2	$T_x = a + (x-1)d = 3 + 5k$ $T_y = a + (k+1)d$ $= 3 + (k+1)(5)$ $= 8 + 5k$ $T_x + T_y = 11 + 10k$	CA✓substitution into n^{th} term CA✓$3 + 5k$ CA✓$8+5k$ CA✓answer	(4)
			[12]

QUESTION 4

4.1.1	15 ; 5	AA✓✓both terms	(2)
4.1.2	$S_\infty = \frac{a}{1-r}$ $= \frac{15}{1-\frac{1}{3}}$ $= \frac{45}{2} = 22{,}5$	CA✓substitution of common ratio CA✓answer	(2)
4.2	$sin\,30°\ ;\ cos\,30°\ ;\ \frac{3}{2}$ $\frac{1}{2}\ ;\ \frac{\sqrt{3}}{2}\ ;\ \frac{3}{2}$ $a = \frac{1}{2}\ ;\ r = \sqrt{3}$ $ar^{n-1} = 40{,}5\sqrt{3}$ $\frac{1}{2}(\sqrt{3})^{n-1} = \frac{81}{2}\sqrt{3}$ $3^{\frac{n-1}{2}} = 3^4.3^{\frac{1}{2}}$ $\frac{n-1}{2} = 4\frac{1}{2} = \frac{9}{2}$ $n - 1 = 9$ $n = 10$ **OR**	A✓listing terms CA✓$\frac{1}{2}(\sqrt{3})^{n-1} = \frac{81}{2}\sqrt{3}$ CA✓$3^{\frac{n-1}{2}} = 3^4.3^{\frac{1}{2}}$ CA✓ $\frac{n-1}{2} = 4\frac{1}{2} = \frac{9}{2}$ CA✓answer **OR**	(5)

	$sin\,30°\ ;\ cos\,30°\ ;\ \frac{3}{2}$ $\frac{1}{2}\ ;\ \frac{\sqrt{3}}{2}\ ;\ \frac{3}{2}$ $a=\frac{1}{2}\ ;\ r=\sqrt{3}$ $ar^{n-1}=\frac{81}{2}\sqrt{3}$ $\frac{1}{2}\left(\sqrt{3}\right)^{n-1}=\frac{81}{2}\sqrt{3}$ $\frac{\left(\sqrt{3}\right)^{n}}{\sqrt{3}}=81\sqrt{3}$ $243=\left(\sqrt{3}\right)^{n}$ $3^5=3^{\frac{1}{2}n}$ $n = 10$	A✓listing terms CA✓$\frac{1}{2}\left(\sqrt{3}\right)^{n-1}=\frac{81}{2}\sqrt{3}$ CA✓$243=\left(\sqrt{3}\right)^{n}$ CA✓ $3^5=3^{\frac{1}{2}n}$ CA✓answer	(5)
			[9]

QUESTION 5

5.1	$x=2\ and\ y=-1$	AA✓$x=2$ ✓$y=-1$	(2)
5.2	$y-\text{intercept}:(0\ ;-3)$ $x-\text{intercept: }\frac{-4}{2-x}-1=0$ $\frac{-4}{2-x}=\frac{1}{1}$ $-4=2-x$ $x=6$ $(6\ ;\ 0)$	A✓y – intercept A✓$\frac{-4}{2-x}-1=0$ A✓x – intercept (co-ordinate form not needed)	(3)
5.3		CA✓x -intercepts CA✓y - intercept CA✓both asymptotes A✓shape	(4)
			[9]

QUESTION 6

6.1	$A(0;6)$	A✓answer (Must be in coordinate form)	(1)
6.2	$x = -\frac{b}{2a} = 2{,}5$ S(5 ; 6) **OR** $y = x + 1 = 6$ $x = 5$ $S(5\ ;\ 6)$ **OR** $y = -x^2 + 5x + 6 = 6$ $x^2 - 5x = 0$ $x(x-5) = 0$ $x = 0\ or\ x = 5$ n/a $S(5\ ;\ 6)$ **OR** $-x^2 + 5x + 6 = x + 1$ ……..	Using axis of symmetry A✓x – value A✓y – value **OR** A✓equating equation to 6 A✓x – value **OR** A✓equating equation to 6 A✓x – values and rejection	(2) (2) (2)
6.3	$-x^2 + 5x + 6 = 0$ $x^2 - 5x - 6 = 0$ $(x+1)(x-6) = 0$ $x = -1\ or\ x = 6$ $B(-1;0), C(6;0)$	A✓factors CACA✓✓x – values	(3)
6.4	$(-x^2 + 5x + 6) - (x + 1) = 5$ $-x^2 + 5x + 6 - x - 1 = 5$ $x^2 - 4x = 0$ $x(x-4) = 0$ $x = 0\ or\ 4$ OR = 4units	A✓subtraction of both graphs A✓equating to 5 CA✓factors CA✓OR value	(4)
6.5.1	$x = \frac{-1+6}{2} = \frac{5}{2}$ $y = -\left(\frac{5}{2}\right)^2 + 5\left(\frac{5}{2}\right) + 6 = \frac{49}{4} = 12{,}25$ $\left(\frac{5}{2}; 12{,}25\right)$ **OR**	A✓midpoint formula CA✓Axis of symmetry value CA✓substitution CA✓answer **OR**	(4)

	$x = -\frac{b}{2a} = -\frac{5}{2(-1)} = \frac{5}{2}$ $y = -\left(\frac{5}{2}\right)^2 + 5\left(\frac{5}{2}\right) + 6 = \frac{49}{4} = 12{,}25$ $\left(\frac{5}{2}; 12{,}25\right)$ **OR** $f'(x) = -2x + 5 = 0 \quad \therefore x = \frac{5}{2}$ $y = -\left(\frac{5}{2}\right)^2 + 5\left(\frac{5}{2}\right) + 6 = \frac{49}{4} = 12{,}25$ $\left(\frac{5}{2}; 12{,}25\right)$	A✓formula CA✓Axis of symmetry value CA✓substitution CA✓answer **OR** A✓derivative and equal to 0 CA✓Axis of symmetry value CA✓substitution CA✓answer	(4) (4)
6.5.2	PQ $= -x^2 + 4x + 5$ $x = -\frac{b}{2a} = -\frac{4}{2(-1)} = 2$ Max. PQ $= -(2)^2 + 4(2) + 5 = 9$units **OR** PQ $= -x^2 + 4x + 5$ PQ$' = -2x + 4 = 0 \quad \therefore x = 2$ Max. PQ $= -(2)^2 + 4(2) + 5 = 9$units	A✓ PQ in terms of *x* CA✓ substitution CA✓*x* – value CA✓answer **OR** A✓PQ in terms of *x* CA✓derivative and equal to 0 CA✓*x* – value CA✓answer	(4) (4)
			[18]

QUESTION 7

7.1	$y = 5^x$	AA✓✓ answer	(2)
7.2	$y > 0$ or $y \in (0\,;\,\infty)$	A✓answer	(1)
7.3	$log_5 x = -4$ $x = 5^{-4} = \frac{1}{625}$ $0 < x \leq \frac{1}{625}$	A✓Equating log graph to −4 A✓writing in exponential form CA✓end points A✓ interval **Can be solved by log inequalities**.	(4)
			[7]

QUESTION 8

8.1	$A = P(1-i)^n$ $250000 = P(1-13{,}5\%)^5$ $P = \frac{250000}{(1-13{,}5\%)^5}$ $= R516249$	A✓substitution into the correct formula CA✓making P the subject CA✓answer	(3)
8.2.1	$P = \frac{x[1-(1+i)^{-n}]}{i}$ $950000 = \frac{x\left[1-\left(1+\frac{14{,}25\%}{12}\right)^{-240}\right]}{\frac{14{,}25\%}{12}}$ $x = R11986{,}33$	A✓value of *n* A✓value of *i* CA✓substitution into correct formula CA✓answer	(4)
8.2.2	$P = \frac{x[1-(1+i)^{-n}]}{i}$ $= \frac{11986{,}33\left[1-\left(1+\frac{14{,}25\%}{12}\right)^{-140}\right]}{\frac{14{,}25\%}{12}}$ $= R816048{,}67$ **OR** $A = P(1+i)^n$ $A = 950\,000\left(1+\frac{14{,}25\%}{12}\right)^{100}$ =R3093215,766 $F = \frac{x[(1+i)^n-1]}{i}$ $F = \frac{11986{,}33\left[\left(1+\frac{14{,}25\%}{12}\right)^{100}-1\right]}{\frac{14{,}25\%}{12}}$ =R2277167,107 Balance on Loan = R3093215,766 −R2277167,107 = R816048,67	A✓Present value formula A✓value of *n* CA✓substitution into correct formula CA✓answer **OR** A✓Substitution into Compound Interest Formula CA✓substitution into Future Value Formula CA✓*A -F* CA✓answer	(4) (4)

8.2.3	$A = P(1+i)^n$ $= 816\ 048{,}67\left(1+\frac{14{,}25\%}{12}\right)^4$ $= R855\ 506{,}92$ $855\ 506{,}92 = \frac{x[1-(1+i)^{-n}]}{i}$ $= \frac{x\left[1-\left(1+\frac{14{,}25\%}{12}\right)^{-136}\right]}{\frac{14{,}25\%}{12}}$ $x = R12711{,}51$	CA✓substitution CA✓substitution of P and *i* A✓value of *n* CA✓answer	(4)
			[15]

QUESTION 9(penalize 1 mark once for incorrect notation in this question)

9.1	$f'(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $= \lim_{h\to 0}\frac{(x+h)^2-\frac{1}{2}(x+h)-\left(x^2-\frac{1}{2}x\right)}{h}$ $= \lim_{h\to 0}\frac{x^2+2xh+h^2-\frac{1}{2}x-\frac{1}{2}h-x^2+\frac{1}{2}x}{h}$ $= \lim_{h\to 0}\frac{h\left(2x+h-\frac{1}{2}\right)}{h}$ $= 2x-\frac{1}{2}$ **OR** $f(x+h) = (x+h)^2-\frac{1}{2}(x+h)$ $f(x+h) = x^2+2xh+h^2-\frac{1}{2}x-\frac{1}{2}h$ $f(x+h)-f(x) = 2xh+h^2-\frac{1}{2}h$ $\frac{f(x+h)-f(x)}{h} = \frac{2xh+h^2-\frac{1}{2}h}{h}$ $\frac{f(x+h)-f(x)}{h} = \frac{h(2x+h-\frac{1}{2})}{h}$ $f'(x) = \lim_{h\to 0}\left(2x+h-\frac{1}{2}\right)$ $f'(x) = 2x-\frac{1}{2}$	A✓formula A✓substitution CA✓ simplification of numerator CA✓factorization CA✓answer **OR** A✓value of *f(x+h)* CA✓ simplification CA✓factorization A✓formula CA✓answer	(5) (5)

9.2.1	$\frac{d}{dx}[3x^4 + \sqrt[5]{x} + a^2]$ $\frac{d}{dx}\left[3x^4 + x^{\frac{1}{5}} + a^2\right]$ $= 12x^3 + \frac{1}{5}x^{-\frac{4}{5}}$	A✓rewriting in exponential form A✓CA✓derivatives Penalize 1 mark if *a* is included in answer	(3)
9.2.2	$xy = x + x^2 - 1$ $y = 1 + x - x^{-1}$ $\frac{dy}{dx} = 1 + x^{-2}$	A✓ dividing by x ($x \neq 0$) A✓ $1 + x - x^{-1}$ CACA✓✓each derivative	(4)
			[12]

QUESTION 10

10.1.1	$x^3 + 5x^2 - 8x - 12 = 0$ $(x + 1)$ is a factor $f(-1) = 0$ $(x + 1)(x^2 - 4x - 12) = 0$ $(x + 6)(x + 1)(x - 2) = 0$ $x = -6 \ \ or \ \ x = -1 \ \ or \ \ x = 2$	A ✓$f(-1) = 0$ A ✓$(x + 1)(x^2 - 4x - 12) = 0$ A✓ all three factors CACACA✓✓✓each value Answer only 3/6 Marks	(6)
10.1.2	$f(x) = x^3 + 5x^2 - 8x - 12$ $f'(x) = 3x^2 + 10x - 8 = 0$ $(3x - 2)(x + 4) = 0$ $x = \frac{2}{3} \ or \ x = -4$ $f\left(\frac{2}{3}\right) = \left(\frac{2}{3}\right)^3 + 5\left(\frac{2}{3}\right)^2 - 8\left(\frac{2}{3}\right) - 12 = -\frac{400}{27}$ $= -14{,}81$ $B\left(\frac{2}{3}; -14{,}81\right)$	A✓derivative and equal to 0 CA✓factors CA✓x – values CA✓y – value	(4)
10.1.3	$f''(x) = 6x + 10 = 0$ $x = -\frac{5}{3}$ **OR** $x = \frac{\frac{2}{3} + (-4)}{2} = -\frac{5}{3}$ **OR** $x = -\frac{b}{3a} = -\frac{5}{3}$	CA✓second derivative and equal to 0 CA✓answer **OR** CA✓subst. into midpoint formula CA✓answer **OR** A✓formula CA✓answer	(2) (2) (2)

10.2.1	$f'(0) = -8$ $y = -8x - 12$	CA✓gradient CA✓answer	(2)
10.2.2	$f'(x).g'(x) > 0$ Since $g'(x) < 0$ for all $x \in R$ $(3x^2 + 10x - 8) < 0$ $(3x - 2)(x + 4) < 0$ $-4 < x < \frac{2}{3}$ **OR** $-4 < x < \frac{2}{3}$	 A✓$g'(x) < 0$ CA✓factors CA✓answer **OR** CACA ✓✓end points A✓interval	 (3) (3)
			[14]

QUESTION 11

11.1	ΔPQB: $\frac{PQ}{2y} = tan\,60°$ $\therefore PQ = 2\sqrt{3}y$ $QR = d - 4y$ $A = 2\sqrt{3}y(d - 4y)$ **OR** ΔAPS is equilateral $AP = PS = AS = d - 4y$ $SC = 4y$ $SR^2 = (4y)^2 - (2y)^2 = 12y^2$ $SR = 2\sqrt{3}y$ $A = 2\sqrt{3}y(d - 4y)$	 A✓ $tan\,60°$ A✓setting up ratio A✓value of PQ A✓value of QR **OR** A✓value of PS A✓value of SC A✓use of theorem of Pythagoras A✓value of SR	(4) (4)
11.2	$A = 2\sqrt{3}y(d - 4y).$ $= 2\sqrt{3}yd - 8\sqrt{3}y^2$ $A' = 2\sqrt{3}d - 16\sqrt{3}y = 0$ $d - 8y = 0$ $y = \frac{d}{8}$	 A✓expression for Area CA✓derivative and equal to 0 CA✓y – value	

	$Max\ A = 2\sqrt{3}.\frac{d}{8}\left(d - 4\left(\frac{d}{8}\right)\right)$ $= \frac{\sqrt{3}d}{4}\left(d - \frac{d}{2}\right)$ $= \frac{\sqrt{3}d}{4}\left(\frac{d}{2}\right) = \frac{\sqrt{3}d^2}{8}$	CA✓substitution into original equation CA✓simplifying CA✓answer	(6)
			[10]

QUESTION 12

12.1	$P(GG) = \frac{18}{40} \cdot \frac{17}{39}$ $= \frac{51}{260}$ *or* 0.1962 *or* 19.62%	A✓$\frac{18}{40}$ A ✓$\frac{17}{39}$ A✓answer in any form	(3)
12.2	$P(\text{B and R}) = \frac{12}{40} \cdot \frac{10}{39} + \frac{10}{40} \cdot \frac{12}{39}$ $P(\text{B and R}) = \frac{2}{13}$ *or* 0,1538 *or* 15,38 %	A✓$\frac{12}{40} \cdot \frac{10}{39}$ A✓$\frac{10}{40} \cdot \frac{12}{39}$ A✓answer in any form	(3)
			[6]

QUESTION 13

13.1	9 x 9 x 9 = 729	A✓9 x 9 x 9 A✓729	(2)
13.2	5 x 8 x 7 = 280 **OR** 5 | 8 digits | 7 digits | 56 ways 6 | 8 digits | 7 digits | 56 ways 7 | 8 digits | 7 digits | 56 ways 8 | 8 digits | 7 digits | 56 ways 9 | 8 digits | 7 digits | 56 ways | | **Total** | **280 ways**	A✓5 x 8 x 7 A✓280 **OR** A✓table A✓answer	(2) (2)
13.3	9 x 1 x 9 = 81	A✓9 x 1 x 9 A✓81	(2)
			[6]

Total : 150