

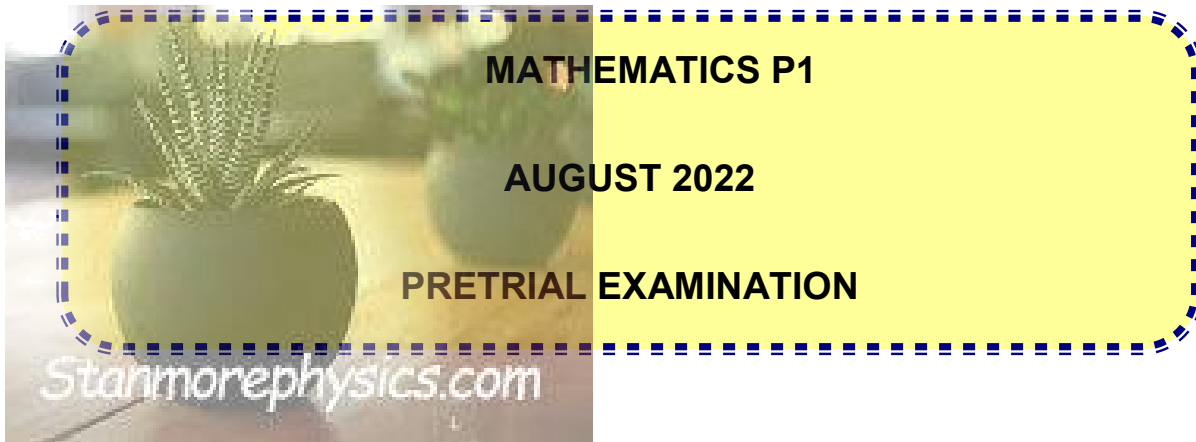


LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12



MATHEMATICS P1
AUGUST 2022
PRETRIAL EXAMINATION

Stanmorephysics.com

MARKS: 150

TIME: 3 HOUR

This question paper consists of 10 pages and 1 formula sheet.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 12 Questions.
2. Answer ALL the questions.
3. Clearly show ALL calculations, diagrams and graphs 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 your answers correctly according to the numbering system used in this question paper.
9. It is in your own interest to write legibly and to present your work neatly.

NSC

QUESTION 11.1 Solve for x

1.1.1 $(x - 2)(x - 7) = 0$ (2)

1.1.2 $4x + \frac{4}{x} + 11 = 0; x \neq 0$ (Correct to TWO decimal places.) (4)

1.1.3 $6x < 3x^2$ (3)

1.1.4 $\sqrt{x-1} = x-3$ (4)

1.2 Solve for x and y simultaneously:

$2x - y + 1 = 0$

and

$x^2 + xy + 2 = 3x + y$ (6)

1.3 Determine the sum of the digits of $5^{2009} 2^{2010}$. (4)**[23]****QUESTION 2**

2.1 The first four terms of a quadratic number pattern are 13; 20; 29; 40.

2.1.1 Write down the value of the 5th term. (1)

2.1.2 Determine the general term of the number pattern in the form

$T_n = an^2 + bn + c.$ (5)

2.1.3 Michael stated that one of the terms of the sequence is 4 493. Is

Michael's claim correct? Use calculations to motivate your verdict. (3)

2.2 Consider the finite arithmetic series 5; 8; 11; 173

2.2.1 Calculate the number of terms of the series. (3)

2.2.2 Determine the sum of the even terms of the series. (4)

[16]

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QUESTION 3

Consider the infinite geometric series 90; 30; 10; ...

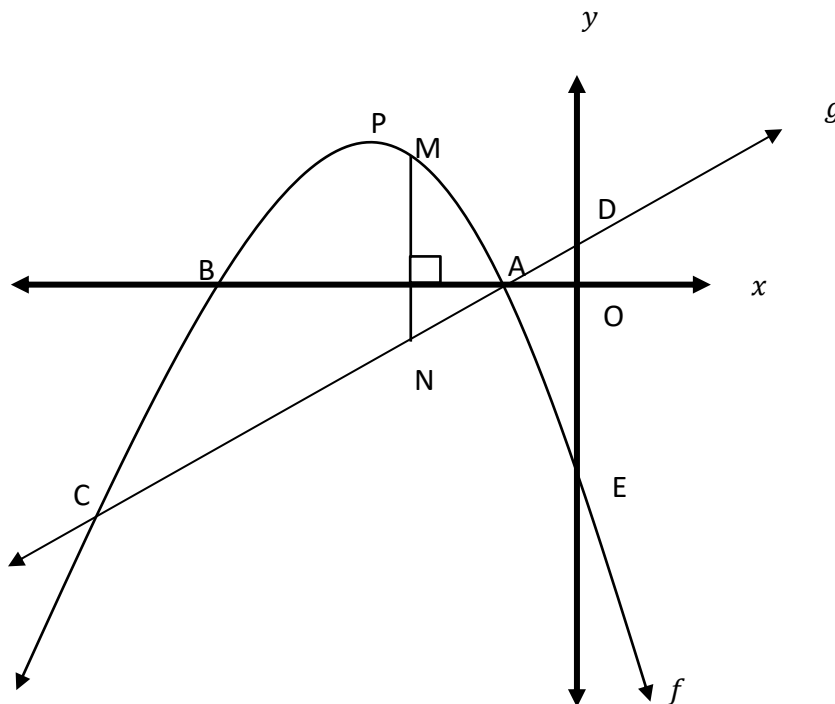
- 3.1 Write the series in sigma notation. (1)
- 3.2 Write down the 10th term of the series as a simple fraction. (1)
- 3.3 Explain why the series converges. (1)
- 3.4 Determine the largest value of n for which $S_{\infty} - S_n > 1$. (6)

[09]

QUESTION 4

The figure below shows the graphs of $f(x) = -(x + 7)^2 + 25$ and $g(x) = x + 2$

MN is parallel to the y -axis. A and B are the x -intercepts of $f(x)$. P is the turning point of f . Points A and C lie on both graphs. D and E are the y -intercepts of the graphs.



- 4.1 Determine:
 - 4.1.1 The coordinates of point P, the turning point of the parabola. (2)
 - 4.1.2 The length of DE. (2)

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- 4.1.3 The coordinates of C. (6)
- 4.2 The graph of g is shifted up to pass at B. Determine the equation of the shifted graph of g . (5)
- 4.3 The value of x for which the length of MN is at a maximum in the domain where $f > g$. (4)
- [19]

QUESTION 5

Given the function

$$f(x) = \frac{-2}{(x+3)}$$

- 5.1 Determine the value of k if the graph passes through the point $(k; -\frac{1}{4})$. (2)
- 5.2 Write down the equation(s) of the asymptote(s). (2)
- 5.3 Write down the equation of the line of symmetry that intersects the graph defined by the above function. (2)
- 5.4 Determine the range of h if $h(x) = f(x) + 2$ (2)

[08]**QUESTION 6**

Given $f(x) = \frac{1}{4}x^2, x \geq 0$

- 6.1 Sketch the graph of f^{-1} showing any intercepts with the axes and ONE other point on the graph. (3)
- 6.2 State the domain of f^{-1} . (2)
- 6.3 When the graph of f is shifted to $f(x+3)$, point A on f , shifted to point $(4; y)$ on $f(x+3)$. Determine the coordinates of the image of point A on f^{-1} . (3)

[08]

QUESTION 7

- 7.1 Exactly six years ago Lesego bought a new car which is worth one third of its original price now. If the car depreciates by a fixed annual rate according to the reducing-balance method, calculate the annual rate of depreciation. (4)
- 7.2 Bonang is granted a home loan of R 650 000 to be repaid over a period of 15 years. The bank charges interest at 11, 5% per annum compounded monthly. She repays her loan by equal monthly installments starting one month after the loan was granted.
- 7.2.1 Calculate Bonang's monthly installment. (4)
- 7.2.2 How long will it take her to finish the repayment of the loan, if she decides to increase her monthly installment to R 9 000 per month after 5 years? (5)
- 7.2.3 Calculate her final/last month installment (2)

[15]**QUESTION 8**

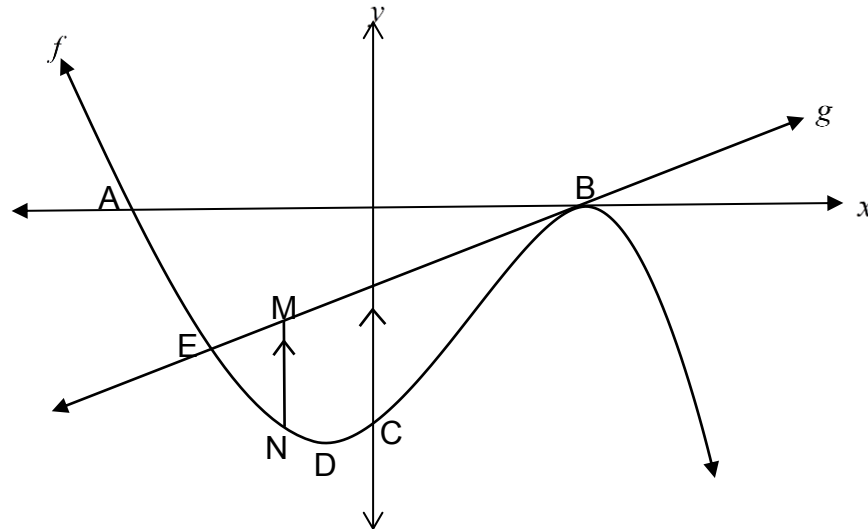
- 8.1 If $f(x) = 2x - x^2$, determine $f'(x)$ from FIRST PRINCIPLES. (5)
- 8.2 8.2.1 Determine $\frac{dy}{dx}$ if $xy = 3$. (2)
- 8.2.3 Determine $D_x \left[\frac{\sqrt[3]{x^2 - 2x + 1}}{x^2} \right]$ (4)

[11]

QUESTION 9

The graphs of $f(x) = -x^3 + 3x^2 + 9x - 27$ and $g(x) = tx + q$ are sketched below.

A and B are the x -intercepts and C, the y -intercept of f . The turning points of f are $D(-1; -32)$ and B. g and f intersect at E $(-2; -10)$ and B.



9.1 Show that the equation of g is $y = 2x - 6$ (4)

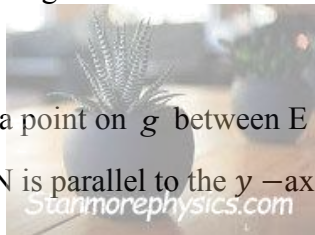
9.2 For what value(s) of x is

9.2.1 f increasing? (1)

9.2.2 the derivative of f decreasing? (2)

9.2.3 $x \cdot f'(x) < 0$? (2)

9.2.4 MN a maximum, if M is a point on g between E and B,
N is a point on f and MN is parallel to the y -axis. (5)



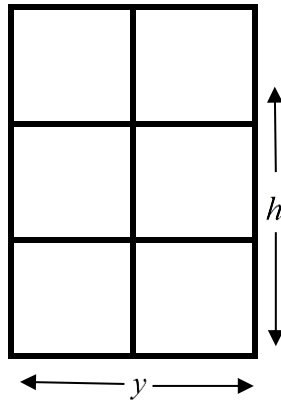
[14]

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QUESTION 10

A window frame with dimensions y by h is illustrated below.

The frame consists of six smaller frames.



10.1 If 12m of material is used to make the entire frame, show that

$$y = \frac{1}{4}(12 - 3h). \quad (2)$$

10.2 Show that the area of the window is given by $A = 3h - \frac{3}{4}h^2$. (3)

10.3 Find $\frac{dA}{dh}$ and hence the dimensions, h and y , of the frame so that the area of the window is a maximum. (5)

[10]

QUESTION 11

Consider the word “CALCULATOR”.

- 11.1 How many different word arrangements can be made from all the letters of the word CALCULATOR? (2)
- 11.2 What is the probability of making a word arrangement that will start and end with the letter L? (2)
- 11.3 In how many ways can all the letters be arranged if no similar letters should be close to each other? (3)
- [7]

QUESTION 12

- 12.1 Given $P(A) = 0,5$; $P(B) = x$ and $P(A \text{ or } B) = 0,88$.

Calculate the value(s) of x , if

- 1.1.1 Events A and B are mutually exclusive. (2)
- 1.1.2 Events A and B are independent. (3)
- 12.2 South African National Women Football Team known as “Banyana Banyana” are to play a friendly football match against their Nigerian counterparts known as “Super Falcons”. There should be a winner on the day of the match. Penalties would decide the winner in case the match is drawn after regulation time. On the day that the match takes place, there is a 30% chance that it could rain(R), 45%

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chance that it could be sunny(S) or it could be cloudy(C). Banyana Banyana has a 24% chance of winning on a rainy day, a 65% of winning on a sunny day or a 33% chance of winning on a cloudy day.

12.2.1 Draw a tree diagram to represent all outcomes of the above scenario. (3)

12.2.2 What is the probability of Banyana Banyana winning the match? (3)

[11]

TOTAL: 150

INFORMATION SHEET: MATHEMATICS

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

$$A = P(1 + ni)$$

$$A = P(1 - ni)$$

$$A = P(1 - i)^n$$

$$A = P(1 + i)^n$$

$$\sum_{i=1}^n 1 = n$$

$$\sum_{i=1}^n i = \frac{n(n+1)}{2}$$

$$T_n = a + (n-1)d$$

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

$$T_n = ar^{n-1}$$

$$S_n = \frac{a(r^n - 1)}{r - 1}; \quad r \neq 1$$

$$S_\infty = \frac{a}{1 - r}; \quad -1 < r < 1$$

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

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

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

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$M \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

$$y = mx + c$$

$$y - y_1 = m(x - x_1)$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \tan \theta$$

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

$$\text{In } \triangle ABC: \quad \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cdot \cos A \quad \text{area } \triangle ABC = \frac{1}{2} ab \cdot \sin C$$

$$\sin(\alpha + \beta) = \sin \alpha \cdot \cos \beta + \cos \alpha \cdot \sin \beta$$

$$\sin(\alpha - \beta) = \sin \alpha \cdot \cos \beta - \cos \alpha \cdot \sin \beta$$

$$\cos(\alpha + \beta) = \cos \alpha \cdot \cos \beta - \sin \alpha \cdot \sin \beta$$

$$\cos(\alpha - \beta) = \cos \alpha \cdot \cos \beta + \sin \alpha \cdot \sin \beta$$

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

$$\sin 2\alpha = 2 \sin \alpha \cdot \cos \alpha \quad \bar{x} = \frac{\sum fx}{n}$$

$$\sigma^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}$$

$$P(A) = \frac{n(A)}{n(S)}$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$



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MATHEMATICS P1

AUGUST 2022

PRETRIAL EXAMINATION

MARKS: 150

This memorandum consists of 16 pages.

In discussing this memorandum with learners, take note of required steps, mark allocation, indicate how solution are found than what solutions are. Explain between lines reasoning to make sense to these solutions.

QUESTION 1

1.1.1	$(x - 2)(x - 7) = 0$ $x = 2 \text{ or } x = 7$	$x = 7$ $x = 2$	(2)
1.1.2	$4x + \frac{4}{x} + 11 = 0; x \neq 0$ $4x^2 + 11x + 4 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $x = \frac{-11 \pm \sqrt{(11)^2 - 4(4)4}}{8}$ $x = -0.43 \text{ or } -2,32$	✓ Standard form ✓ Substitution ✓ -0.43 ✓ -2.32	(4)
1.1.3	$3x^2 - 6x > 0$ $3x(x - 2) > 0$ $0 < x < 2 \text{ or } x \in (0; 2)$	✓ Standard form ✓ Factors ✓ Correct solution ✓	(4)
1.1.4	$\sqrt{x-1} = x-3$ $x-1 = x^2 - 6x + 9$ $x^2 - 6x + 9 - x + 1 = 0$ $x^2 - 7x + 10 = 0$ $(x-5)(x-2) = 0$ $x = 5 \text{ or } x = 2 (N/A)$	✓ Squaring ✓ Standard form ✓ Factors ✓ Solution with rejection	(4)



1.2	$y = 2x + 1$ $x^2 + x(2x + 1) - 3x - (2x + 1) + 2 = 0$ $3x^2 - 4x + 1 = 0$ $(3x - 1)(x - 1) = 0$ $x = \frac{1}{3} \quad \text{or} \quad x = 1$ $y = \frac{5}{3} \quad \text{or} \quad y = 3$	✓ subject of formula ✓ Substitution ✓ standard form ✓ factors ✓ values of x ✓ values of y	(6)
1.3	$5^{2009} 2^{2010} .24 = .2^{2009} .2.$ $= 10^{2009} .48$ $= 48\,000\,000 \dots (2009 \text{ zeros})$ \therefore The sum of the digits is $4+8=12$	✓ $2^{2009} .2.$ ✓ 10^{2009} ✓ 48 ✓ 12	(4)
			[23]

QUESTION 2

2.1.1	53		(1)
2.1.2	$13 \quad 20 \quad 29 \quad 40$ $7 \quad 9 \quad 11$ $2 \quad 2$ $a = 1$ $3a + b = 7$ $b = 4$ $a + b + c = 13$ $c = 8$ $T_n = n^2 + 4n + 8$	✓ Value of a ✓ Value of b ✓ Value of c ✓ T_n	(4)

2.1.3	$n^2 + 4n + 8 = 4493$ $n^2 + 4n - 4485 = 0$ $(n + 69)(n - 65) = 0$ $n = 65$ Michael is right. It is term 65	✓ Subst. of 4493 ✓ Standard form ✓ 65 and rejection of -69 ✓ Conclusion.	(4)
2.2.1	$173 = 5 + (n - 1)3$ $3n = 171$ $n = 57$	✓ Subst. of a and d ✓ Subst. of 173 ✓ answer	(3)
2.2.2	Even terms 8; 14; 20; ...; 170 There are 28 even and 29 odd terms $S_{28} = \frac{28}{2}(8 + 170)$ or $\frac{28}{2}[(8 + 170)]$ $= 3492$	✓ 28 ✓ Subst. ✓ answer	(3)
			[15]

QUESTION 3

3.1	$\sum_{n=1}^{\infty} 90\left(\frac{1}{3}\right)^{n-1}$	✓ Correct answer	(1)
3.2	$90\left(\frac{1}{3}\right)^9 = \frac{10}{2187}$	✓ Answer as simple fraction	(1)
3.3	$r = \frac{1}{3}$ $-1 < r < 1$	✓ $r = \frac{1}{3}$ $-1 < r < 1$	(1)
3.4	$S_{\infty} = \frac{90}{1 - \frac{1}{3}} = 135$ $=$	✓ Subst. in S_{∞} Formula ✓ Value of S_{∞}	

	$S_n = \frac{90(1 - \frac{1^n}{3})}{\frac{2}{3}}$ $= 135(1 - \frac{1^n}{3})$ $S_\infty - S_n = 135 - 135(1 - \frac{1^n}{3}) = 1$ $135(1 - \frac{1^n}{3}) = 134$ $(1 - \frac{1^n}{3}) = \frac{134}{135}$ $(\frac{1^n}{3}) = \frac{1}{135}$ $n = \log_{\frac{1}{3}} \frac{1}{135}$ $= 4.4649735$ <p>The largest value of n is 4</p> <p>OR</p> $S_\infty = \frac{90}{1 - \frac{1}{3}} = 135$ $S_\infty - S_1 = 135 - 90 = 45$ $S_\infty - S_2 = 135 - (90 + 30) = 15$ $S_\infty - S_3 = 135 - (90 + 30 + 10) = 5$ $S_\infty - S_4 = 135 - (90 + 30 + 10 + \frac{10}{3}) = \frac{5}{3}$ $S_\infty - S_5 = 135 - (90 + 30 + 10 + \frac{10}{3} + \frac{10}{9}) = \frac{5}{9}$ <p>So largest value of n is 4</p>	<ul style="list-style-type: none"> ✓ Subst. in formula ✓ Value of the sum ✓ Subst in S_∞-sum ✓ Use of log ✓ Answer <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> ✓ Subst. in S_∞ Formula ✓ Value of S_∞ ✓ 45 and 15 ✓ 5 and $\frac{5}{3}$ ✓ $\frac{5}{9}$ ✓ answer 	(6)
			[09]

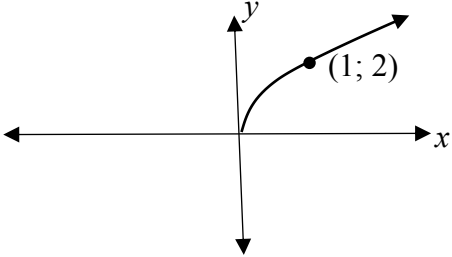
QUESTION 4

4.1.1	P(-7; 25)	<ul style="list-style-type: none"> ✓ . ✓ answer 	(2)
4.1.2	At D: $y=2$ At E: $y = -49+25= -24$ DE=26 units	<ul style="list-style-type: none"> ✓ y-value at E ✓ answer 	(2)
4.1.3	At C $f = g$ $x + 2 = -(x + 7)^2 + 25$ $x - 23 + x^2 + 14x + 49 = 0$ $x^2 + 15x + 26 = 0$ $(x + 13)(x + 2) = 0$ $x = -13$ at C or $x = -2$ at A C (-13: -11)	<ul style="list-style-type: none"> ✓ equating ✓ simplification ✓ standard form ✓ factors ✓ values of x at C ✓ value of y at C 	(6)
4.2	At B $0 = -(x + 7)^2 + 25$ $(x + 7) = \pm 5$ $x = -12$ at B or $x = -2$ at A $\therefore 0 = 1(-12) + c$ $c = 1$ $y = x + 12$	<ul style="list-style-type: none"> ✓ equating to 0 ✓ standard form or $(x + 7) = \pm 5$ ✓ value of x at B ✓ subst. B in line formula ✓ answer 	(5)
4.3	$f - g = -(x + 7)^2 + 25 - (x + 7)$ $= -x^2 - 14x - 49 - x - 7$ $D_x(f - g) = -2x - 14 - 1$ $D_x(f - g) = 0$ $-2x - 15 = 0$ $x = -\frac{15}{2}$ or $7\frac{1}{2}$ so MN is maximum when $x = -\frac{15}{2}$ or $7\frac{1}{2}$	<ul style="list-style-type: none"> ✓ equating ✓ $-x^2 - 14x - 49 - x - 7$ ✓ Derivative ✓ answer 	(4)
			[19]

QUESTION 5

5.1	$-\frac{1}{4} = \frac{-2}{k+3}$ $k+3 = 8$ $k = 5$	✓ subst. ✓ answer	(2)
5.2	$y = 0$ $x = 0$	✓ vertical asymptote ✓ Horizontal asymptote.	(2)
5.3	$m = -1$ $-\frac{1}{4} = -(5) + c$ $c = -5\frac{1}{4} \text{ or } -\frac{21}{4}$ $y = -x - \frac{21}{4}$	✓ Value of m ✓ answer	
5.4	$y \neq 2$	✓ answer	(2)

QUESTION 6

6.1		✓ shape ✓ point ✓ intercepts	(3)
6.2	$x \geq 0$	✓ ✓ answer	(2)

6.3	$x + 3 = 4$ $x = 1$ $y = \frac{1}{4}(1)^2$ $= \frac{1}{4}$ $\therefore A\left(1; \frac{1}{4}\right)$ <p>coordinates of the image are $\left(\frac{1}{4}; 1\right)$</p>	<ul style="list-style-type: none"> ✓ $x=1$ ✓ y coordinate at A ✓ coordinates of the image 	(3)
			[8]

QUESTION 7

7.1	$\frac{1}{3}P - P\left(1 - \frac{i}{12}\right)^{72}$ $\sqrt[72]{\frac{1}{3}} = 1 - \frac{i}{12}$ $\frac{i}{12} = 1 - \sqrt[72]{\frac{1}{3}}$ $\frac{i}{12} = 0.01514268287$ $i = 18,2\%$	<ul style="list-style-type: none"> ✓ 72 ✓ $\frac{1}{3}$ ✓ Correct radical sign ✓ Answer as % 	(4)
7.2	$Pv = \frac{x[1 - (1 + i)^{-n}]}{i}$ $650000 = \frac{x\left[1 - \left(1 + \frac{11.5\%}{12}\right)^{-15 \times 12}\right]}{\frac{11.5\%}{12}}$ $x = \frac{650000 \times \frac{11.5\%}{12}}{\left[1 - \left(1 + \frac{11.5\%}{12}\right)^{-15 \times 12}\right]}$ $= 7593.23$	<ul style="list-style-type: none"> ✓ Subst, in Pv formula ✓ Correct value of i ✓ 180 ✓ answer 	

7.2.2	<p>Balance after 5 years</p> $Pv = \frac{x[1 - (1+i)^{-n}]}{i}$ $= \frac{7593.23 \left[1 - \left(1 + \frac{11.5\%}{12} \right)^{-10 \times 12} \right]}{\frac{11.5\%}{12}}$ $= R487061$ $Pv = \frac{x[1 - (1+i)^{-n}]}{i}$ $487061 = \frac{9000 \left[1 - \left(1 + \frac{11.5\%}{12} \right)^{-n} \right]}{i}$ $\frac{487061}{9000} \times \frac{11.5\%}{12} = \left[1 - \left(1 + \frac{11.5\%}{12} \right)^{-n} \right]$ $\left(1 + \frac{11.5\%}{12} \right)^{-n} = 1 - \frac{487061}{9000} \times \frac{11.5\%}{12}$ $\left(\frac{2423}{2400} \right)^{-n} = 0,4813702315$ $n = \frac{\log(0,4813702315)}{\log\left(\frac{2423}{2400}\right)}$ $-n = -76,65561398$ $n = 77 \text{ months}$	<p>✓ balance after 5 years</p> <p>✓ subst. of 9000 and balance in Pv formula</p> <p>✓ correct use of logs.</p> <p>✓ 76.65561398</p> <p>✓ 77 months</p>	(5)
	<p>Last instalment.</p> $A = Pv(1+i)$ <p>where $Pv = \frac{x[1 - (1+i)^{-n}]}{i}$</p> $A = \frac{9000 \left[1 - \left(1 + \frac{11.5}{1200} \right)^{-0.65561398} \right]}{\frac{11.5}{1200}} \left(1 + \frac{11.5}{1200} \right)$ $= R5910,21$	<p>✓ All correct substitutions</p> <p>✓ answer</p>	(2)
			[15]

QUESTION 8

8.1	$f(x) = 2x - x^2$ $f(x+h) = 2(x+h) - (x+h)^2$ $= 2x + 2h - (x^2 + 2xh + h^2)$ $= 2x + 2h - x^2 - 2xh - h^2$ $f(x+h) - f(x) = 2x + 2h - x^2 - 2xh - h^2 - (2x - x^2)$ $= 2x + 2h - x^2 - 2xh - h^2 - 2x + x^2$ $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \rightarrow 0} \frac{2x + 2h - x^2 - 2xh - h^2 - 2x + x^2}{h}$ $= \lim_{h \rightarrow 0} \frac{2h - 2xh - h^2}{h}$ $= \lim_{h \rightarrow 0} \frac{h(2 - 2x - h)}{h}$ $= \lim_{h \rightarrow 0} 2 - 2x - h$ $= 2 - 2x$ <p>OR</p> $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \rightarrow 0} \frac{(2(x+h) - (x+h)^2) - (2x - x^2)}{h}$ $= \lim_{h \rightarrow 0} \frac{2x + 2h - x^2 - 2xh - h^2 - (2x - x^2)}{h}$ $= \lim_{h \rightarrow 0} \frac{2h - 2xh - h^2}{h}$ $= \lim_{h \rightarrow 0} \frac{h(2 - 2x - h)}{h}$ $= \lim_{h \rightarrow 0} 2 - 2x - h$ $= 2 - 2x$	<ul style="list-style-type: none"> ✓ simplified $f(x+h)$ ✓ substitution of $f(x+h) - f(x)$ ✓ simplification of $f(x+h) - f(x)$ ✓ common factor ✓ answer 	(5)
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8.2.1	$xy = 3$ $y = \frac{3}{x}$ $y = 3x^{-1}$ $\frac{dy}{dx} = -3x^{-2}$	✓ y subject of formula. ✓ Exponential rules ✓ answer	(3)
8.2.2	$D_x \left[\frac{\sqrt[3]{x^2 - 2x + 1}}{x^2} \right] = D_x \left[\frac{x^{\frac{2}{3}} - 2x + 1}{x^2} \right]$ $= D_x \left(x^{\frac{2}{3}-2} - 2x^{1-2} + x^{-2} \right)$ $= D_x \left(x^{-\frac{4}{3}} - 2x^{-1} + x^{-2} \right)$ $= \frac{-4}{3} x^{-\frac{7}{3}} + 2x^{-2} - 2x^{-3}$	✓ $x^{\frac{2}{3}}$ ✓ $\left(x^{-\frac{4}{3}} - 2x^{-1} + x^{-2} \right)$ ✓ $\frac{-4}{3} x^{-\frac{7}{3}}$ ✓ $+2x^{-2} - 2x^{-3}$	(4)
			[11]

QUESTION 9

9.1	B is turning point So $f(3) = -27 + 27 + 27 - 27 = 0$ $(x - 3)$ is a factor $f(x) = -(x - 3)^2(x + 3)$ $x = 3$ B(3;0) OR 	✓ Factor theorem ✓ Coordinates of B OR ✓ Derivative equated to 0 ✓ Coordinates of B	(4)
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	$f'(x) = -3x^2 + 6x + 9$ $0 = -3x^2 + 6x + 9$ $0 = x^2 - 2x - 3$ $(x-3)(x+1) = 0$ $x = 3 \text{ or } x = -1$ <p>at B; $x = 3$</p> <p>so</p> $y - 0 = \frac{-10 - 0}{-2 - 3}(x - 3)$ $y = 2(x - 3)$ $y = 2x - 6$	✓ Subst. of E and B in line formula ✓ Answer	
9.2.1	F increase between E and B $-32 < x < 3$	✓ answer	(1)
9.2.2	$x = \frac{3-1}{2}$ $= 1$ <p>OR</p> $f'(x) = -3x^2 + 6x + 9$ $f''(x) = -6x + 6$ $-6x + 6 = 0$ $x = 1$ <p>∴ derivative function decreases when $x > 1$</p>	✓ method to get $x=1$ ✓ answer	(2)
9.2.3	$x.f'(x) < 0$ $\Rightarrow x > 0 \text{ and } f'(x) < 0$ <p>OR $x < 0 \text{ and } f'(x) > 0$</p> <p>So</p> $-1 < x < 0 \text{ or } x > 3$ <p>OR</p> $-1 < x < 3; x \neq 0$	✓ ✓ Correct intervals	(2)


9.2.4	<p>Distance is given by</p> $2x - 6 - (-x^3 + 3x^2 + 9x - 27)$ $= 2x - 6 + x^3 - 3x^2 - 9x + 27$ $= x^3 - 3x^2 + 7x + 21$ <p>Distance is maximum if</p> $3x^2 - 6x - 7 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{6 \pm \sqrt{(-6)^2 + 4(3)(7)}}{2(3)}$ $x = 2.83 \text{ or } x = -0.83$	<ul style="list-style-type: none"> ✓ Subtracting ✓ Derivative ✓ Derivative = 0 ✓ Subst in formula ✓ Values of c 	(5)
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QUESTION 10

10.1	<p>There are four horizontal bars and three vertical bars.</p> $\Rightarrow 4y + 3h = 12$ $4y = 12 - 3h$ $y = \frac{1}{4}(12 - 3h)$	<ul style="list-style-type: none"> ✓ $4y + 3h$ ✓ $4y + 3h = 12$ 	(2)
10.2	$\text{Area} = lb$ $= yh$ $= \frac{1}{4}(12 - 3h)h$ $= 3h - \frac{3}{4}h^2$	<ul style="list-style-type: none"> ✓ $A = yh$ ✓ Subst of y ✓ simplification 	(3)

<p>10.3</p> $Area = 3h - \frac{3}{4}h^2$ $\frac{dA}{dh} = 3 - \frac{3}{2}h$ $\frac{dA}{dh} = 0$ $3 - \frac{3}{2}h = 0$ $h = 2$ $y = \frac{1}{4}(12 - 3(2))$ $= \frac{3}{2}$		<p>✓ derivative</p> <p>✓ equating to 0</p> <p>✓ $h = 2$</p> <p>✓ subst of h</p> <p>✓ value of y</p>	<p>(5)</p>

QUESTION 11

<p>11.1</p> $\frac{10!}{2.2.2} = 453600$ <p>=</p>		<p>✓</p> <p>✓ answer</p>	<p>(2)</p>
<p>11.2</p> $\frac{8!}{4} = 10080$		<p>✓ answer</p> <p>✓</p>	<p>(2)</p>
<p>11.3</p> <p>Same letters are together in $2.2.2.7!$ ways =</p> $Probability = \frac{8.7!}{10!} = \frac{4}{45}$ <p>So required probability is $\frac{41}{45}$</p> <p>OR</p> <p>Same letters not together is 41380 ways</p> $Probability \text{ required is } \frac{41}{45}$		<p>✓ Same letters together</p> <p>✓ Probability of same letters together</p> <p>✓ Answer</p> <p>OR</p> <p>✓ Same letters together</p> <p>✓ Same letters not together</p> <p>✓ answer</p> 	<p>(3)</p>

			[7]

QUESTION 12

12.1. 1	$P(A \text{ or } B) = P(A) + P(B)$ $0.88 = 0.5 + x$ $x = 0.38$	✓ subst into correct formula ✓ answer	(2)
12.1. 2	$P(A \text{ or } B) = P(A) + P(B) - P(A).P(B)$ $0.88 = 0.5 + x - 0.5x$ $0.38 = 0.5x$ $x = 0,76$	✓ subst into correct formula ✓ $0.5x$ ✓ answer	(3)
		✓ 25% for C ✓ Correct outcomes to represent win/lose ✓ Correct diagram	
12.2. 2	Probability of winning $P(W) = P(R \text{ and } W) \text{ or } P(S \text{ and } L) \text{ or } P(C \text{ and } W)$ $= 30\% \times 24\% + 45\% \times 65\% + 25\% \times 67\%$	✓ $30\% \times 24\% + 45\% \times 65\% + 25\% \times 67\%$ ✓ . ✓ answer	(3)

	$= 0.9445 \text{ OR } \frac{1889}{2000}$		