GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2022

10611

MATHEMATICS

PAPER 1

TIME: 3 hours

MARKS: 150

MATHEMATICS: Paper 1

10611E

10 pages + 1 information sheet

X10

P.T.O.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of 11 questions.
2. Answer ALL the questions.
3. Clearly show ALL calculations, diagrams, graphs, et cetera which you have used in determining the answers.
4. Answers only will NOT necessarily be awarded full marks.
5. You may use an approved scientific calculator (non-programmable and non-graphical) unless stated otherwise.
6. If necessary, answers should be rounded-off to TWO decimal places, unless stated otherwise.
7. Number the answers correctly according to the numbering system used in the question paper.
8. An INFORMATION SHEET is included at the end of the question paper.
9. Write neatly and legibly.

QUESTION 1

1.1 Solve for x:

1.1.1 $2x(x^2 - 1) = 0$ (2)

1.1.2 $x - 6 + \frac{2}{x} = 0 \; ; \; x \neq 0$ (correct to TWO decimal places) (4)

1.1.3 $(x-1)(x+4) \geq 6$ (3)

1.1.4 $\sqrt{x-2} + 3 = \frac{10}{\sqrt{x-2}}$ (5)

1.2 Solve for x and y:

$x - 2y = 1$ and $2x^2 - xy - 5y - 3y^2 - 2 = 0$ (4)

1.3 Given: $2^{x+1} + 2^x = 3^{y+2} - 3^y$, where x and y are integers.
Determine the value of x and y. (3)

1.4 The equations $x^2 + rx + m = 0$ and $x^2 + mx + r = 0$ have real and EQUAL roots.
Solve for the values of r and m if $r > 0$ and $m > 0$. (6)
[27]

QUESTION 2

2.1 Given the quadratic sequence:

20; 12; 10; 14; ...

2.1.1 Determine an expression for the n^{th} term of the pattern in the form $T_n = an^2 + bn + c$. (4)

2.1.2 The FIRST differences form an arithmetic sequence. Determine between which successive terms in the quadratic sequence, the FIRST difference will be 148. (3)

2.1.3 Determine the smallest value of n for which $S_n > 10140$ in the arithmetic sequence. (5)

2.2 If $\sum_{r=1}^{5}(r+b) = 10a$, determine b in terms of a. (3)

[15]

QUESTION 3

Given the following geometric sequence:

$$\frac{24}{x} + 12 + 6x + 3x^2 + \ldots$$

3.1 Calculate the sum to infinity of the series. (4)

3.2 Write down the values of x for which this sequence converges. (2)

3.3 For which values of x will the series increase? (2)

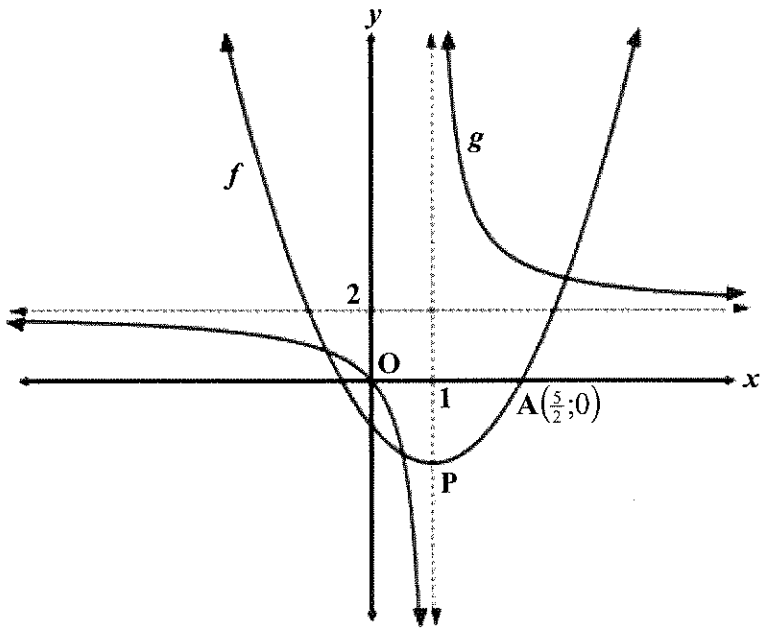
3.4 If $x = 4$, determine the sum of the sequence to 15 terms. (4)

[12]

QUESTION 4

The graphs of $f(x)=(x+p)^2+q$ and $g(x)=\frac{a}{x+b}+c$ are drawn in the sketch below and have the following properties:

- $A\left(\frac{5}{2};0\right)$ is a point on the graph of f.
- P is the turning point of f and lies on the vertical asymptote of g.
- The vertical asymptote passes through (1;0).
- The horizontal asymptote passes through (0;2).
- Graph g passes through the origin.



4.1 Show that the equation of g can be written as $y=\frac{2}{x-1}+2$. (3)

4.2 Calculate the coordinates of P. (3)

4.3 Write down the equation of the vertical asymptote of p if $p(x) = g(x-1)$. (1)

4.4 Determine the equation of the axis of symmetry of g in the form $y = mx + c$, if $m < 0$. (2)

4.5 Write down the equation of k, if k is the reflection of g about the x-axis. (2)

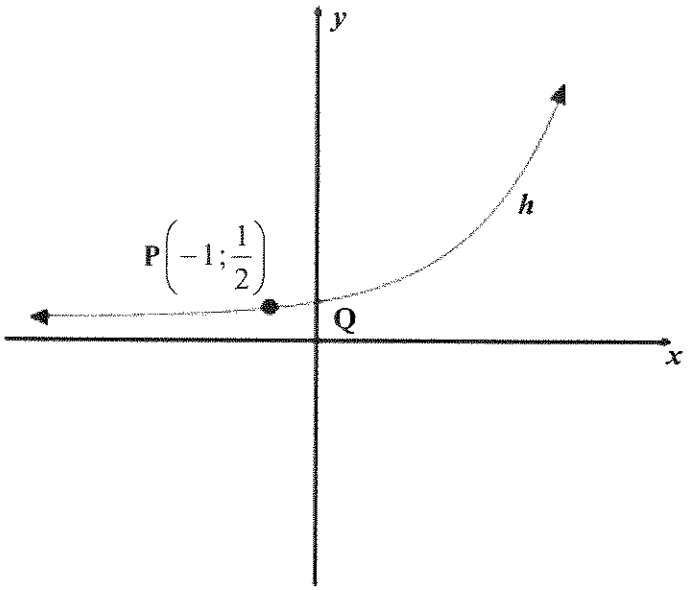
4.6 For which values of x is $f'(x).g(x) > 0$? (2)

4.7 For which values of k will the equation $g(x) = x + k$ have two real roots of opposite signs? (1)

[14]

QUESTION 5

The graph of $h(x) = a^x$, where $a > 0$, is sketched below. $P\left(-1 ; \frac{1}{2}\right)$ is a point on h.



5.1 Write down the coordinates of Q. (1)

5.2 Determine the value of a. (2)

5.3 Write down the equation for h^{-1} in the form $y = \ldots$ (2)

5.4 Sketch the graph of h^{-1} in your ANSWER BOOK. Clearly show all intercepts with the axes. (2)

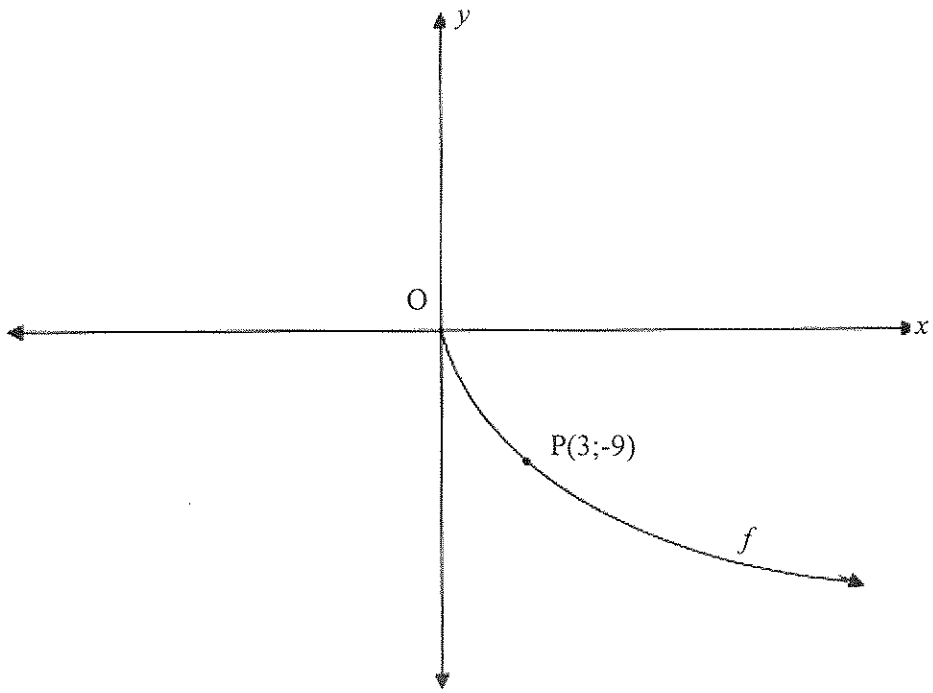
5.5 Write down the domain of h^{-1}. (1)

5.6 Hence or otherwise, determine the value(s) of x for which $\log_2 x > 1$. (1)

5.7 If $g(x) = (100).3^x$, calculate the value of x for which $h(x) = g(x)$. (3)
[12]

QUESTION 6

The graph of $f(x) = -\sqrt{27x}$ for $x \geq 0$ is sketched below. The point P(3 ; –9) lies on the graph of f.



6.1 Use the graph to determine the values of x for which $f(x) \geq -9$. (2)

6.2 Write down the equation of f^{-1} in the form $y = \ldots$
Indicate ALL restrictions. (4)

6.3 Sketch the graph of f^{-1} in your ANSWER BOOK. Indicate all intercept(s) with the axes and the coordinates of ONE other point on your sketch. (3)

6.4 Describe the transformation from f to g if $g(x) = \sqrt{27x}$ where $x \geq 0$. (1)
[10]

QUESTION 7

7.1 At what annual percentage interest rate, compounded quarterly, should a lump sum be invested in order for it to double in 6 years ? (5)

7.2 Simon buys furniture to the value of R10 000. He borrows the money on 1 February 2020 from a financial institution that charges interest at a rate of 9,5% p.a. compounded monthly. He agrees to pay monthly installments of R450. The agreement of the loan allows him to pay equal monthly installments from the 1 August 2020.

7.2.1 Calculate the total amount owing to the financial institution on 1 July 2020. (2)

7.2.2 How many months will it take Simon to repay the loan? (4)

7.2.3 What is the balance of the loan immediately after Simon has made the 25^{th} payment? (2)

[13]

QUESTION 8

8.1 Determine $f'(x)$ from first principles if $f(x)=3x^2+2x$. (4)

8.2 Determine: $\frac{dy}{dx}$ if $y = 4\sqrt{x} - \frac{8}{\sqrt{x}} + \pi x^3$. (4)

8.3 The graph of $g(x)=ax^2+\frac{b}{x}=96$ has a minimum value at $x=4$.

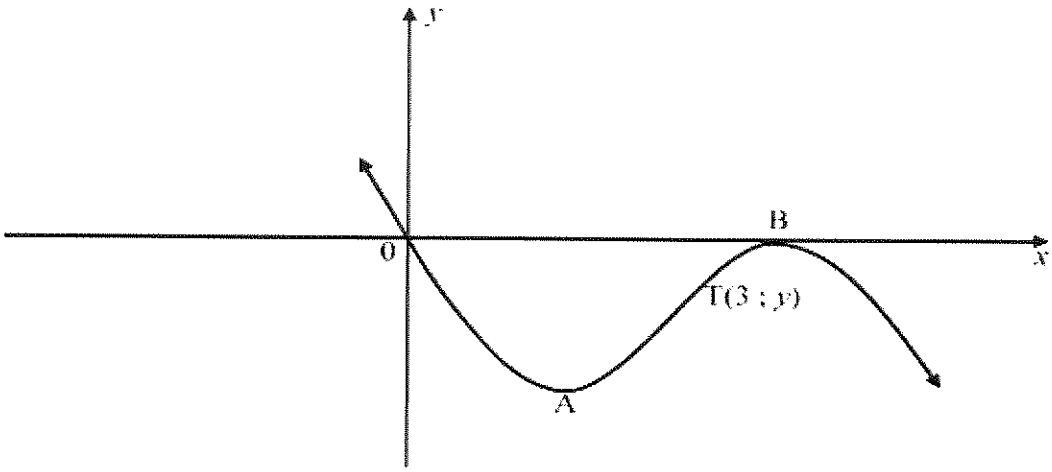
Calculate the values of a and b. (6)

[14]

QUESTION 9

The graph of $h(x) = -x^3 + ax^2 + bx + c$ is sketched below.

- A and B(6 ; 0) are the turning points of h.
- T(3 ; y) is a point on h.
- The graph of h passes through the origin.



9.1 Show that $a = 12$ and $b = -36$. (3)

9.2 Calculate the coordinates of A. (3)

9.3 Calculate the value of y. (1)

9.4 Is the graph of h concave up or concave down at point T?
Show ALL your calculations. (3)

9.5 Determine the coordinates of the point of inflection. (2)
[12]

QUESTION 10

A hotel has 72 rooms to let to clients. The daily rent per room is R500. If the rent is increased by R100 per day, 2 rooms can be left vacant daily.
The rent is Rx per room per day, where $x > 500$.

10.1 Show that the total daily income (I) is given by $I = 82x - \frac{x^2}{50}$. (5)

10.2 Calculate the maximum daily income per room. (2)
[7]

QUESTION 11

11.1 Events A and B are mutually exclusive.
It is given that:

- P(B) = 2P(A)
- P(A or B) = 0,57

Calculate P(B). (3)

11.2 A box of 40 calculators is sent to a store by a supplier. The owner of the store is not aware that 5 of the calculators are defective. Two calculators are selected at random from the box, the first one not being replaced before the second one is selected.

11.2.1 What is the probability that the first calculator chosen is NOT defective? (1)

11.2.2 What is the probability that if two calculators are selected, ONE calculator is defective and the other is not? (3)

11.2.3 What is the probability that if two calculators are selected, BOTH are defective? (3)

11.3 Four different Economics books and three different Life Sciences books are required to be placed on a shelf.

11.3.1 If you decide to place any book in any position, in how many different ways can you arrange the books on the shelf? (1)

11.3.2 If two particular books must be placed next to each other, in how many different ways can you arrange the books on the shelf? (1)

11.3.3 If all the Economics books must be placed next to one another and all the Life Sciences books must be placed next to one another, in how many different ways can you arrange the books on the shelf? (2)

[14]

TOTAL: 150

END

INFORMATION SHEET

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

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

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

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

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

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

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

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

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

In ΔABC:

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc.\cos A$$

$$\text{area } \Delta\text{ABC} = \frac{1}{2}ab.\sin C$$

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

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

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

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

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

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

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PREPARATORY EXAMINATION

2022

MARKING GUIDELINES

MATHEMATICS (PAPER 1) (10611)

23 pages

INSTRUCTIONS AND INFORMATION

A – Accuracy

C.A. – Consistent Accuracy

NOTE:

- If a candidate answered a question TWICE, mark only the FIRST attempt.
- If a candidate crossed out an answer and did not redo it, mark the crossed-out answer.
- Consistent accuracy applies to ALL aspects of the marking guidelines.
- It is unacceptable for candidates to use adopted values/answers in solving questions.

QUESTION 1

1.1	1.1.1	$2x(x^2-1)=0$ $2x(x-1)(x+1)=0$ $x=0$ or $x=1$ or $x=-1$ **NOTE: Any other valid method**	✓ factors ✓ answers	(2)
	1.1.2	$x-6+\frac{2}{x}=0$ $x^2-6x+2=0$ $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ $x=\frac{-(-6)\pm\sqrt{(-6)^2-4(1)(2)}}{2(1)}$ $x=\frac{6\pm\sqrt{28}}{2}$ $\therefore x=5{,}65\ldots or\ldots x=0{,}35$ **NOTE: Penalise for rounding-off in this question ONLY.** **Any other valid method**	✓ standard form ✓ substitution into correct formula ✓✓ answers	(4)
	1.1.3	$(x-1)(x+4)\geq 6$ $\therefore x^2+3x-4\geq 6$ $\therefore x^2+3x-10\geq 0$ $\therefore (x+5)(x-2)\geq 0$ $\therefore x\leq -5$ **OR** $x\geq 2$ –5 2	✓ standard form ✓ factors ✓ answers	(3)

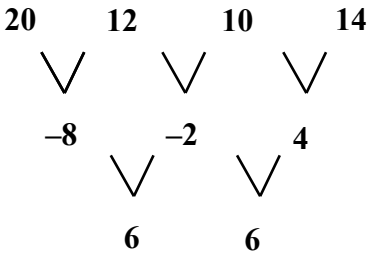
1.1.4	$\sqrt{x-2}+3=\dfrac{10}{\sqrt{x-2}}$		
	Let $k=\sqrt{x-2}$		
	$k+3=\dfrac{10}{k}$		
	$k^2+3k-10=0$	✓ standard form	
	$(k+5)(k-2)=0$	✓ factors	
	$k=-5$ **or** $k=2$	✓ both answers for k	
	$\sqrt{x-2}\neq -5$ **or** $\sqrt{x-2}=2$	✓ selection	
	$\left(\sqrt{x-2}\right)^2=(2)^2$		
	$\therefore x=6$	✓ answer	
	OR		
	$\sqrt{x-2}+3=\dfrac{10}{\sqrt{x-2}}$		
	$\left(\sqrt{x-2}\right)\left(\sqrt{x-2}\right)+3\sqrt{x-2}=10$		
	$x-2+3\sqrt{x-2}=10$		
	$3\sqrt{x-2}=12-x$	✓ simplified both sides	
	$\left(3\sqrt{x-2}\right)^2=(12-x)^2$	✓ squaring both sides	
	$9x-18=144-24x+x^2$		
	$x^2-33x+162=0$	✓ standard form	
	$(x-6)(x-27)=0$	✓ factors	
	$x=6$ **or** $x\neq 27$	✓ selection	(5)

1.2	$x-2y=1$ and $2x^2-xy-5y-3y^2-2=0$ $x=2y+1 \quad \cdots(1)$ $2x^2-xy-5y-3y^2-2=0 \quad \cdots.(2)$ Substitute (1) into (2): $2(2y+1)^2-(2y+1)y-5y-3y^2-2=0$ $3y^2+2y=0$ $y(3y+2)=0$ $y=0$ **or** $y=-\frac{2}{3}$ $x=1$ **or** $x=-\frac{1}{3}$ **NOTE: Any other valid method**	✓ equation for x ✓ standard form ✓ y-values ✓ x-values	(4)
1.3	$2^{x+1}+2^x=3^{y+2}-3^y$ $2^x(2^1+1)=3^y(3^2-1)$ $2^x(3)=3^y(8)$ $\therefore \frac{2^x}{8}=\frac{3^y}{3}$ $\therefore \frac{2^x}{2^3}=\frac{3^y}{3}$ $\therefore 2^{x-3}=3^{y-1}$ $\therefore x-3=0$ and $y-1=0$ $\therefore x=3$ and $y=1$ **OR** $2^{x+1}+2^x=3^{y+2}-3^y$ $2^x(2^1+1)=3^y(3^2-1)$ $2^x(3)=3^y(8)$ $2^x(3)=3^y(2^3)$ $\therefore x=3$ and $y=1$	✓ factorise ✓ simplified equated bases ✓ answers ✓ factorise ✓ simplified equated bases ✓ answers	(3)

1.4	$x^2+rx+m=0$ and $x^2+mx+r=0$ $x^2+rx+m=0$ For real and equal roots, $\Delta=0$ $b^2-4ac=0$ $(r)^2-4(1)(m)=0$ $r^2-4m=0$ $r^2=4m$ $m=\frac{r^2}{4}$ ... (1) $x^2+mx+r=0$ $b^2-4ac=0$ $m^2-4(1)(r)=0$ $m^2-4r=0$ ... (2) Substitute (1) in (2) $\left(\frac{r^2}{4}\right)^2-4r=0$ $\frac{r^4}{16}-4r=0$ $r^4-64r=0$ $r(r^3-64)=0$ $r(r-4)(r^2+4r+16)=0$ $\therefore r=4$ $m=\frac{r^2}{4}$ $m=\frac{4^2}{4}$ $\therefore m=4$ **OR**	✓ substitute into $\Delta=0$ ✓ equation for m ✓ equation 2 ✓ substitute for m ✓ value of r ✓ value of m **OR**	

	$x^2+rx+m=0$ and $x^2+mx+r=0$ For real and equal roots quadratic must be a perfect square. $x^2+rx+m=0$ $\left(x+\sqrt{m}\right)^2=0$ $x^2+2\sqrt{m}x+m=0$ $r=2\sqrt{m}$ $r^2=4m$ $\frac{r^2}{4}=m$ ... (1) $x^2+mx+r=0$ $\left(x+\sqrt{r}\right)^2=0$ $x^2+2\sqrt{r}+r=0$ $m=2\sqrt{r}$ $m^2=4r$ ⋯.(2) Substitute (1) in (2) $\left(\frac{r^2}{4}\right)^2-4r=0$ $\frac{r^4}{16}-4r=0$ $r^4-64r=0$ $r(r^3-64)=0$ $r(r-4)(r^2+4r+16)=0$ $\therefore r=4$ $m=\frac{r^2}{4}$ $m=\frac{4^2}{4}$ $\therefore m=4$	✓ $\left(x+\sqrt{m}\right)^2=0$ ✓ equation for m ✓ equation 2 ✓ substitute for m ✓ value of r ✓ value of m	(6)
			[27]

QUESTION 2

2.1	2.1.1	 $2a = 6$ $\quad 3a + b = -8 \quad a + b + c = 20$ $a = 3 \quad 3(3) + b = -8 \quad 3 - 17 + c = 20$ $b = -17 \quad c = 34$ $T_n = 3n^2 - 17n + 34$	✓ 2nd diff. ✓ $a = 3$ ✓ $b = -17$ ✓ $c = 34$	(4)
	2.1.2	$T_n = a + (n-1)d$ $148 = -8 + (n-1)(6)$ $148 = 6n - 14$ $n = 27$ Between 27^{th} and 28^{th} terms.	✓ substitution into correct formula ✓ value for n ✓ conclusion	(3)
	2.1.3	$S_n = \frac{n}{2}[2a + (n-1)d]$ $\frac{n}{2}[2(-8) + (n-1)6] > 10140$ $3n^2 - 11n > 10140$ $3n^2 - 11n - 10140 > 0$ $(3n + 169)(n - 60) > 0$ $\therefore n > 60$ $n = 61$	✓ substitution ✓ standard form ✓ factors ✓ selection, $n > 60$ ✓ answer	(5)
2.2		$\sum_{r=1}^{5}(r+b) = (1+b) + (2+b) + (3+b) + (4+b) + (5+b)$ $\sum_{r=1}^{5}(r+b) = 15 + 5b$ $\therefore \sum_{r=1}^{5}(r+b) = 10a$ $\therefore 15 + 5b = 10a$ $\therefore 5b = 10a - 15$ $\therefore b = 2a - 3$	✓ expansion ✓ equating ✓ answer	(3)
				[15]

QUESTION 3

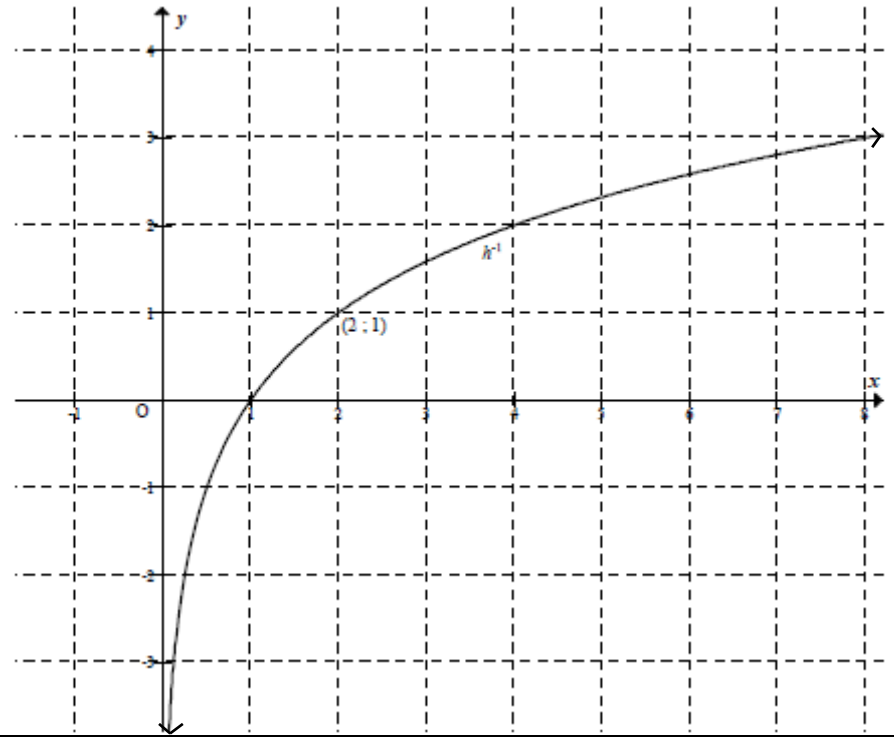
3.1	$a = \frac{24}{x}$ $r = \frac{6x}{12}$ **or** $\frac{3x^2}{6x}$ **or** $\frac{x}{2}$ $S_\infty = \frac{a}{1-r}$ $S_\infty = \frac{\frac{24}{x}}{1-\frac{x}{2}}$ $S_\infty = \frac{48}{2x-x^2}$	✓ value of r ✓ substitution in correct formula ✓ correct numerator ✓ correct denominator	(4)
3.2	It exists when: $-1 < \frac{x}{2} < 1$ i.e.: $-1 < r < 1$ $\therefore\ -2 < x < 2$ **ANSWER ONLY: Award full marks.**	✓ $-1 < r < 1$ ✓ answer	(2)
3.3	$r > 1$ $\therefore \frac{x}{2} > 1$ $\therefore\ x > 2$ **ANSWER ONLY: Award full marks.**	✓ $r > 1$ ✓ answer	(2)
3.4	$a = \frac{24}{4}$ $\therefore a = 6$ $r = \frac{x}{2} = 2$ $n = 15$ $\therefore S_n = \frac{a(r^n - 1)}{r-1}$ $\therefore S_{15} = \frac{6(2^{15} - 1)}{2-1}$ $\therefore S_{15} = 196\ 602$	✓ value of a ✓ value of r ✓ substitution into correct formula ✓ answer	(4)
			[12]

QUESTION 4

4.1	$y=\frac{a}{x-1}+2$ $0=\frac{a}{0-1}+2$ $0=-a+2$ $a=2$ $y=\frac{2}{x-1}+2$	✓ substitute b and c ✓ substitute point (0 ; 0) ✓ value for a	(3)
4.2	$f(x)=(x+p)^2+q$ $0=(\frac{5}{2}-1)^2+q$ $q=-\frac{9}{4}$ Turning Point : $\left(1;-\frac{9}{4}\right)$ **OR** $y=a(x+\frac{1}{2})(x-\frac{5}{2})$ $y=1(x+\frac{1}{2})(x-\frac{5}{2})$ $y=x^2-2x-\frac{5}{4}$ $x=\frac{-(-2)}{2(1)}$ $x=1$ $y=-\frac{9}{4}$ **NOTE: Answer does not have to be in coordinate form.**	✓ substitute p and point A ✓ $q=-\frac{9}{4}$ ✓ correct x-value of turning point ✓ substitute a and both roots ✓ value for x ✓ value for y	(3)
4.3	$x=2$ **NOTE: Answer only, award FULL marks**	✓ answer	(1)
4.4	$y-y_1=m(x-x_1)$ $y-2=-1(x-1)$ $y=-x+3$ **NOTE: Answer only, award FULL marks**	✓ substitute $m=-1$ and pt. (1;2) ✓ answer	(2)

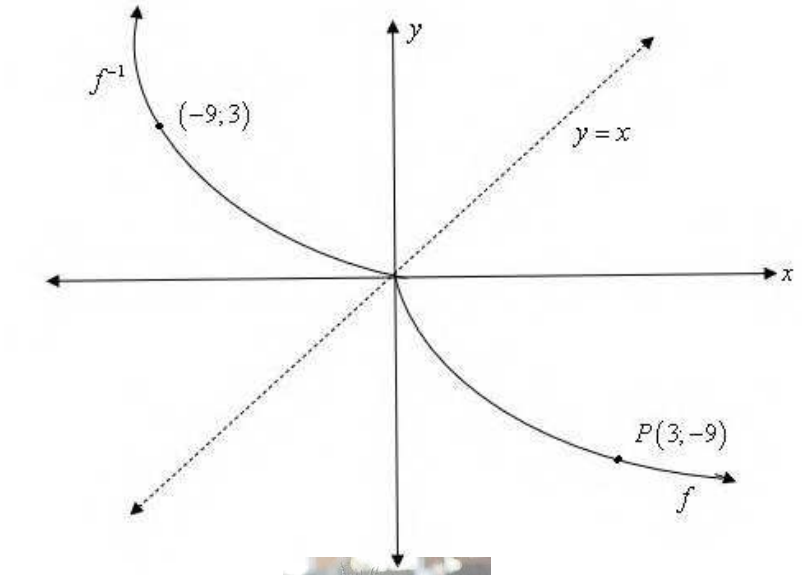
4.5	$k(x) = -g(x)$ $\therefore k(x) = -(\frac{2}{x-1} + 2)$ $\therefore k(x) = \frac{-2}{x-1} - 2$	✓ $k(x) = -g(x)$ ✓ answer	(2)
4.6	$x > 1$ or $0 < x < 1$ **OR** $x \in (1;\infty)$ or $(0<x<1)$ **OR** $x > 0$; $x \neq 1$ **OR** $x \in (0;\infty)$; $x \neq 1$	✓ answer ✓ answer ✓ answer ✓ answer ✓ answer ✓ answer ✓ answer ✓ answer	(2)
4.7	$k > 0$	✓ answer	(1)
			[14]

QUESTION 5

5.1	(0;1) **NOTE: Answer MUST be in coordinate form.**	✓ answer	(1)
5.2	$a^{-1} = \frac{1}{2}$ $\frac{1}{a} = \frac{1}{2}$ $a = 2$	✓ substitute point ✓ answer	(2)
5.3	$2^y = x$ $y = \log_2 x$ **NOTE: Answer only, award FULL marks**	✓ interchange x and y ✓ answer	(2)
5.4		✓ shape ✓ x-intercept	(2)
5.5	$x > 0$	✓ answer	(1)
5.6	$x > 2$	✓ answer	(1)

5.7	$g(x)=100.3^x \ldots\ldots h(x)=2^x$ $if \ldots g(x)=h(x)$ $\therefore 100.3^x=2^x$ $\therefore 100=\frac{2^x}{3^x}$ $\therefore 100=(\frac{2}{3})^x$ $\therefore x=\log_{\frac{2}{3}}100$ $\therefore x=-11,36$ **OR** $2+x\log 3=x.\log 2$ $\therefore 2=x.\log 2-x\log 3$ $\therefore 2=x.\log\frac{2}{3}$ $\therefore x=\frac{2}{\log\frac{2}{3}}$ $\therefore x=-11,36$	✓ simplification ✓ x as subject ✓ answer **OR** ✓ equating simplified sides ✓ x as subject ✓ answer	(3)
			[12]

QUESTION 6

6.1	$0 \le x \le 3$ **NOTE: The answer may be written as separate inequalities.** **OR** $x \in [0;3]$	✓ critical values ✓ notation ✓ critical values ✓ notation	(2)
6.2	Equation of f: $y = -\sqrt{27x}$ for $x \ge 0$ Equation of f^{-1}: $x = -\sqrt{27y}$ for $y \ge 0$ $\therefore y = \frac{x^2}{27}$ for $x \le 0$	✓ interchange x and y ✓ constraint of f^{-1} ✓ equation of y ✓ constraint of y	(4)
6.3	 	✓ shape ✓ x-intercept ✓ point (–9 ; 3)	(3)
6.4	Reflection in the x-axis	✓ answer	(1)
			[10]

QUESTION 7

NOTE: Incorrect formula, STOP marking, unless independent marks are being awarded.

7.1	$A = P(1+i)^n$ $2x = x(1+\frac{i}{4})^{24}$ $\therefore (1+\frac{i}{4})^{24} = 2$ $\therefore 1+\frac{i}{4} = \sqrt[24]{2}$ $\therefore \frac{i}{4} = 0{,}0293$ $\therefore i = 0{,}1172$ The annual interest rate $\cong 11{,}72\%$ **NOTE: If a candidate substitutes in their own values for A and P, award 4/5 marks.**		✓ $n = 24$ ✓ substitution ✓ simplified sides ✓ value of i ✓ answer	(5)
	7.2.1	$F_v = P_v(1+i)^n$ $F_v = 10\,000(1+\frac{\frac{9{,}5}{12}}{100})^5$ $F_v = 10\,402{,}15$ **NOTE: Any other valid method**	✓ substitution ✓ answer	(2)
	7.2.2	$P_v = \frac{x[1-(1+i)^{-n}]}{i}$ $\therefore 10\,402{,}15 = \frac{450[1-(1{,}0079)^{-n}]}{0.0079}$ $\therefore [1-(1{,}0079)^{-n}] = 0{,}183$ $\therefore 1-0{,}183 = (1{,}0079)^{-n}$ $\therefore 0{,}8169 = (1{,}0079)^{-n}$ $\therefore -n = \log_{1{,}0079} 0{,}8169$ $\therefore -n = -25{,}7008$ $\therefore n = 26$ months **NOTE: Answer mark is for 26 months.**	✓ substitution into the correct formula ✓ simplified sides ✓ correct use of logs ✓ answer	(4)

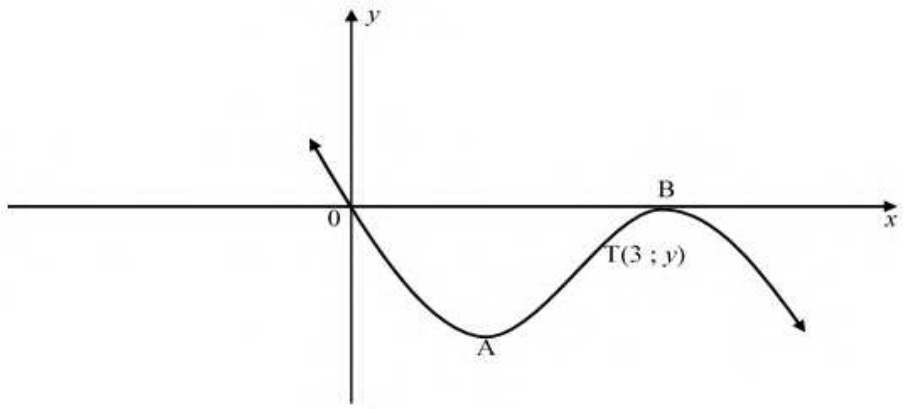
	7.2.3	Balance of loan after 25^{th} payment = value of loan – value of annuity at that time $= 10\,402{,}15(1{,}0079\ldots)^{25} - \dfrac{450\,[(1{,}0079\ldots)^{25}-1]}{0{,}0079}$ = 12 668,89 – 12 386,53 = R282,36 **OR** After the 25^{th} payment, the remaining number of payments = 25,63 – 25 = 0,63 $\therefore balance = \dfrac{450\,[1-(1+\frac{0{,}095}{12})^{-0{,}70}]}{\frac{0{,}095}{12}}$ $\therefore balance$ = R282,36	✓ substitution ✓ answer ✓ substitution ✓ answer	(2)
				[13]

QUESTION 8

8.1	$f(x)=3x^2+2x$ $f(x+h)=3(x+h)^2+2(x+h)$ $f(x+h)=3x^2+6xh+3h^2+2x+2h$ $f(x+h)-f(x)=3x^2+6xh+3h^2+2x+2h-3x^2-2x$ $=6xh+3h^2+2h$ $f'(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{h\,(6x+3h+2)}{h}$ $=\lim\limits_{h\to 0}\ (6x+3h+2)$ $=6x+2$ **NOTE: Penalise 1 mark for notation error in this question.**	✓ $f(x+h)$ ✓ $f(x+h)-f(x)$ ✓ factorise ✓ answer	(4)

8.2	$y = 4\sqrt{x} - \frac{8}{\sqrt{x}} + \pi x^3$ $y = 4x^{\frac{1}{2}} - 8x^{-\frac{1}{2}} + \pi x^3$ $\frac{dy}{dx} = 2x^{-\frac{1}{2}} + 4x^{-\frac{3}{2}} + 3\pi x^2$ **NOTE:** Accept $\frac{2}{x^{\frac{1}{2}}} + \frac{4}{x^{\frac{3}{2}}} + 3\pi x^2$ **OR** $\frac{2}{\sqrt{x}} + \frac{4}{\sqrt{x^3}} + 3\pi x^2$	✓ change surds to rational exponents ✓✓✓ answers	(4)
8.3	**This question has been removed from the question paper.** **Do not mark this question.**		**(0)**
			[8]

QUESTION 9



9.1	$h(x) = -[x(x-6)^2]$ $h(x) = -[x^3 - 12x^2 + 36x]$ $h(x) = -x^3 + 12x^2 - 36x$ $\therefore a = 12$ $\therefore b = -36$	✓ substitute roots ✓ simplification ✓ simplification	(3)
9.2	$h(x) = -x^3 + 12x^2 - 36x$ $h'(x) = -3x^2 + 24x - 36$ $-3x^2 + 24x - 36 = 0$ $-3(x-6)(x-2) = 0$ $\therefore x = 6$ **or** $x = 2$ $\therefore x = 2$ at point A $\therefore h(2) = -32$ $\therefore$ A$(2; -32)$ **NOTE: Answer does NOT have to be in coordinate form. Equating to zero must NOT be implied.**	✓ derivative = 0 ✓ choice of x-value ✓ y-value	(3)
9.3	$h(3) = -(3)^3 + 12(3)^2 - 36(3)$ $y = -27$ **Answer only, FULL marks**	✓ answer	(1)

9.4	$h(x) = -x^3 + 12x^2 - 36x$ $h'(x) = -3x^2 + 24x - 36$ $h''(x) = -6x + 24$ $h''(3) = -6(3) + 24$ $h''(3) = 6$ $\therefore h''(3) > 0$ $\therefore h$ is concave UP at point T. **OR** $h''(x) = 0$ $-6x + 24 = 0$ $x = 4$ Point of Inflection is at $x = 4$ at Point T, the graph is CONCAVE UP **NOTE:** **Candidate must have a valid CALCULATION to reach a conclusion for full marks.** **If only the conclusion is given, award 1 mark.**	✓ $h''(x)$ ✓ value of $h''(3)$ ✓ conclusion ✓ $h''(x)$ ✓ point of inflection at $x = 4$ ✓ conclusion	(3)
9.5	$h''(x) = -6x + 24$ $\therefore 0 = -6x + 24$ $\therefore 6x = 24$ $\therefore x = 4$ $\therefore h(4) = -16$ Point of inflection is: (4 ; –16) **NOTE: Answer does not have to be in coordinate form.**	✓ value of x ✓ value of y	(2)
			[12]

QUESTION 10

10.1	Rent / Occupation (Rented) / Income R500 / 72 / R36 000 R600 / 72 – 2 Number of increases: $\frac{x-500}{100}$ Occupation (Rented): $72-2(\frac{x-500}{100})$ Income(I) = $x[72-\frac{2x}{100}+\frac{1\,000}{100}]$ $=x[\frac{7\,200-2x+1\,000}{100}]$ $=x\left[\frac{8\,200-2x}{100}\right]$ $=82x-\frac{x^2}{50}$	✓ $\frac{x-500}{100}$ ✓ $72-2(\frac{x-500}{100})$ ✓ substitution ✓ $x[\frac{7\,200-2x+1\,000}{100}]$ ✓ $=x\left[\frac{8\,200-2x}{100}\right]$	(5)
10.2	$I=82x-\frac{x^2}{50}$ $I'=82-\frac{2x}{50}$ $82-\frac{2x}{50}=0$ $82=\frac{2x}{50}$ x = R2 050 **NOTE: Equating to zero MAY be implied.**	✓ derivative = 0 ✓ answer	(2)
			[7]

QUESTION 11

11.1	$P(A \text{ or } B) = P(A) + P(B)$ $0,57 = P(A) + 2P(A)$ $\therefore\ 3P(A) = 0,57$ $\therefore\ P(A) = 0,19$ $\therefore\ P(B) = 2P(A)$ $= 2(0,19)$ $P(B) = 0,38$		✓ substitution ✓ value of P(A) ✓ answer	(3)
11.2	11.2.1	Not Defective (ND) $\therefore P(ND) = \frac{35}{40}$ ***or*** $\frac{7}{8}$ ***or*** 0,88	✓ answer	(1)
	11.2.2	Not Defective (ND)/Defective (D) P(ND and D) + P(D and ND) $= (\frac{35}{40}.\frac{5}{39}) + (\frac{5}{40}.\frac{35}{39})$ $= \frac{35}{156}$ ***or*** 0,22	✓ formula (may be implied) ✓ substitution ✓ answer	(3)
	11.2.3	Defective (D) P(D and D) $= \frac{5}{40}.\frac{4}{39}$ $= \frac{20}{1560}$ ***or*** $\frac{1}{78}$ ***or*** 0,01	✓ $\frac{5}{40}$ ✓ $\frac{4}{39}$ ✓ answer	(3)

11.3	11.3.1	7 x 6 x 5 x 4 x 3 x 2 x 1 **OR** 7! **OR** 5 040	✓ answer	(1)
	11.3.2	Total number of arrangements = 2! x 6! **OR** 1 440	✓ answer	(1)
	11.3.3	Economics books = 4! Life Sciences books = 3! Economics and Life Sciences = 2! Total number = 4! x 3! x 2! **OR** 24 x 6 x 2 **OR** 288	✓ combinations for all criteria ✓ answer	(2)
				[14]
			TOTAL:	**144**

Note: The mark out of 144 MUST be converted to 150.

DETAILED EXPLANATION OF QUESTION 10

- For every R100 that the price of a room increases, 2 rooms less are let.
- To determine the amount of rooms that been let, the number of increases of R100 must be determined because that value must be multiplied by 2 to subtract from 72.
- Example: If the rooms are let for R800 per day, then the number of increases of R100 is 3.

Therefore: Number of increases $= \frac{800 - 500}{100}$

Therefore, 72 - 2(3) = 66 rooms let.

Income will be: R800 x 66 = R52 800.

Now, the new price is not R800, but R*x,* making the formula:

$$\text{Number of increases} = \frac{x - 500}{100}$$

Therefore, the number of rooms let = $72 - 2\left(\frac{x - 500}{100}\right)$

Therefore, the income = $= x\left[72 - 2\left(\frac{x - 500}{100}\right)\right]$