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GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2022

MARKING GUIDELINES

MATHEMATICS (PAPER 1) (10611)

23 pages

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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.

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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** $x\geq 2$  	✓ standard form ✓ factors ✓ answers	(3)

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

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1.2	$x-2y=1$ and $2x^2-xy-5y-3y^2-2=0$ $x=2y+1 \quad \cdots(1)$ $2x^2-xy-5y-3y^2-2=0 \cdots.(2)$ Substitute (1) into (2): $2(2y+1)-{}^{2}2y+1(y-5)y-3y^2-2=0$ $3y^2+2y=0$ $y(3y+2)=0$ $y=0$ **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)

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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**	

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	$x^2 + rx + m = 0$ 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]

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QUESTION 2

2.1	2.1.1	**20 12 10 14** **–8 –2 4** **6 6** $2a = 6$ $3a + b = -8$ $a + b + c = 20$ $a = 3$ $3(3) + b = -8$ $3 - 17 + c = 20$ $b = -17$ $c = 34$ $T_n = 3n^2 - 17n + 34$	✓ 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 28th 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]

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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.: $-1 < r < 1$ $\therefore \quad -2 < x < 2$ **ANSWER ONLY: Award full marks.**	✓ $-1 < r < 1$ ✓ answer	(2)
3.3	$r > 1$ $\therefore \frac{x}{2} > 1$ $\therefore \quad x > 2$ **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]

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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)

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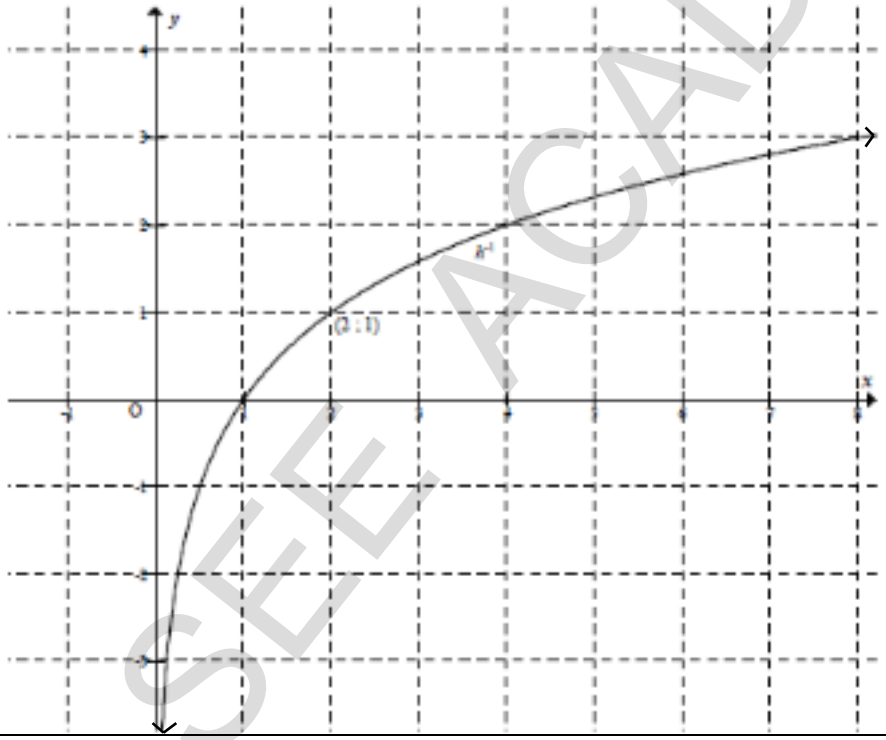
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4.5	$k(x) = -g(x)$ $\therefore k(x) = -(\frac{2}{x-1} + 2)$ $\therefore k(x) = \frac{-2}{x-1} - 2$	✓ $k(x) = -g(x)$ ✓ answer	(2)
4.6	$x > 1$ or $0 < x < 1$ **OR** $x \in (1; \infty)$ or $(0 < x < 1)$ **OR** $x > 0$; $x \neq 1$ **OR** $x \in (0; \infty)$;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

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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)

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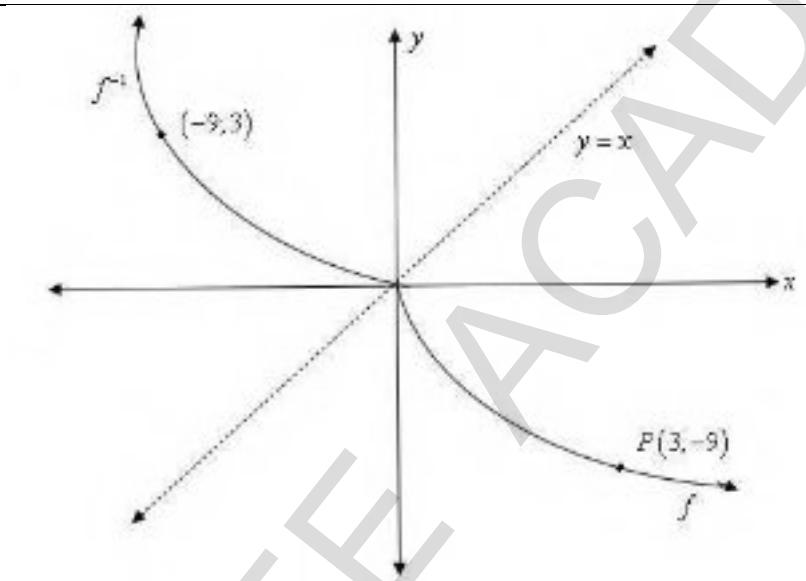
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5.7	$g(x) = 100.3^x$ ... $h(x) = 2^x$ *if* ... $g(x) = h(x)$ $\therefore 100.3^x = 2^x$ $\therefore 100 = \frac{2^x}{3^x}$ $\therefore 100 = (\frac{2}{3}^{\ x})$ $\therefore x = \log_{\frac{2}{3}} 100$ $\therefore x = -11,36$ **OR** $2 + x\log 3 =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

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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]

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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)

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

QUESTION 8

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

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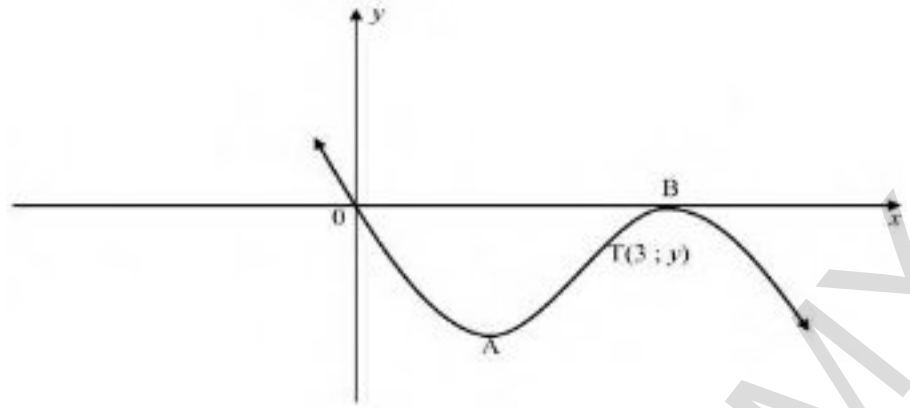
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8.2	$y = 4\sqrt{x} - \frac{8}{\sqrt{x}} + \pi^3 \quad x$ $y = 4x^{\frac{1}{2}} - 8x^{-\frac{1}{2}} + \pi^3 \quad x$ $\frac{dy}{dx} = 2x^{-\frac{1}{2}} + 4x^{-\frac{3}{2}} + 2\pi + 3x$ **NOTE:** Accept $\frac{2}{x^{\frac{1}{2}}} + \frac{4}{x^{\frac{3}{2}}} + 3\pi x^2$ **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]

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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 $\therefore \quad h(2) = -32$ $\therefore$ 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)

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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]

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QUESTION 10

10.1	Rent Occupation (Rented) Income R500 72 R36 000 R600 72 – 2 Number of increases: $\frac{x-500}{100}$ Occupation (Rented): $72-2\left(\frac{x-500}{100}\right)$ Income(I) = $x\left[72-\frac{2x}{100}+\frac{1\,000}{100}\right]$ $=x\left[\frac{7\,200-2x+1\,000}{100}\right]$ $=x\left[\frac{8\,200-2x}{100}\right]$ $=82x-\frac{x^2}{50}$	✓ $\frac{x-500}{100}$ ✓ $72-2\left(\frac{x-500}{100}\right)$ ✓ substitution ✓ $x\left[\frac{7\,200-2x+1\,000}{100}\right]$ ✓ $=x\left[\frac{8\,200-2x}{100}\right]$	(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]

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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)

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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.

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

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