education

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GRADE 12

MATHEMATICS P1

SEPTEMBER 2022

MARKING GUIDELINES

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MARKS: 150

These marking guidelines consist of 15 pages, and a cognitive grid of 2 pages.

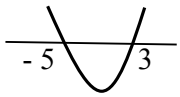
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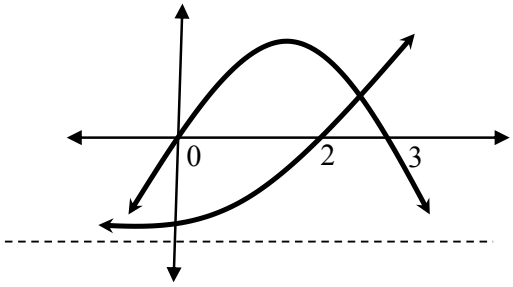
NSC – Marking guidelines

NOTE:

- If a candidate answers a question TWICE, only mark the FIRST attempt.
- Consistent Accuracy applies in ALL aspects of the marking guidelines.

QUESTION 1

1.1.1	$(3x-1)(x+2)=0$ $3x=1 \quad \text{or} \quad x=-2$ $x=\frac{1}{3}$	✓ $x=-2$ ✓ $x=\frac{1}{3}$ (2)
1.1.2	$5x^2-7x-11=0$ $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ $=\frac{-(-7)\pm\sqrt{(-7)^2-4(5)(-11)}}{2(5)}$ $x=2,34 \quad \text{or} \quad x=-0,94$	✓ substitution into correct formula ✓ $x=2,34$ ✓ $x=-0,94$ (3)
1.1.3	$x^2+2x-15\geq 0$ $(x+5)(x-3)\geq 0$ $\therefore \quad x\leq -5 \quad \text{or} \quad x\geq 3$ 	✓ factors ✓ critical values ✓ $x\leq -5$ ✓ $x\geq 3$ (4)
1.2	$x+2y=3$ $x=3-2y$ $x^2-y^2=x+y$ $(3-2y)^2-y^2=(3-2y)+y$ $9-12y+4y^2-y^2-3+y=0$ $3y^2-11y+6=0$ $(y-3)(3y-2)=0$ $y=3 \quad \text{or} \quad y=\frac{2}{3}$ $x=3-2(3) \quad \text{or} \quad x=3-2\left(\frac{2}{3}\right)$ $=-3 \qquad\qquad =\frac{5}{3}$ **OR**	✓ $x=3-2y$ ✓substitution ✓ standard form ✓ factors/formula ✓ both y-values ✓ both x-values (6)

	$x + 2y = 3$ $2y = 3 - x$ $y = \frac{3-x}{2}$ $x^2 - y^2 = x + y$ $x^2 - \left(\frac{3-x}{2}\right)^2 = x + \left(\frac{3-x}{2}\right)$ $x^2 - \left(\frac{9-6x+x^2}{4}\right) = x + \left(\frac{3-x}{2}\right)$ $4x^2 - 9 + 6x - x^2 = 4x + 6 - 2x$ $3x^2 + 4x - 15 = 0$ $(3x - 5)(x + 3) = 0$ $x = \frac{5}{3}$ or $x = -3$ $y = \frac{3-\frac{5}{3}}{2}$ $y = \frac{3-(-3)}{2}$ $= \frac{2}{3}$ $= 3$	✓ $y = \frac{3-x}{2}$ ✓substitution ✓ standard form ✓ factors/formula ✓ both x-values ✓ both y-values (6)
1.3.1	$3x - x^2 = 0$ $x(3 - x) = 0$ $x = 0$ or $x = 3$	✓ $3x - x^2 = 0$ ✓ factors ✓ both answers (3)
1.3.2	$2^x - 4 = 0$ $2^x = 4$ $2^x = 2^2$ $x = 2$	✓ $2^x - 4 = 0$ ✓ $x = 2$ (2)
1.3.3	 $\frac{3x - x^2}{2^x - 4} \leq 0$ $\therefore$ signs differ $\therefore 0 \leq x < 2$ or $x \geq 3$	✓ sketch/method ✓ $0 \leq x < 2$ ✓ $x \geq 3$ (3) **[23]**

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QUESTION 2

2.1.1	$S_n = 3n^2 + 2n$ $S_{10} = 3(10)^2 + 2(10)$ $= 320$	✓ substitution ✓ answer (2)
2.1.2	$S_1 = 3(1)^2 + 2(1)$ $S_2 = 3(2)^2 + 2(2)$ $= 5$ $= 16$ $S_3 = 3(3)^2 + 2(3)$ $= 33$ $T_1 = S_1 = 5$ $T_2 = S_2 - S_1 = 16 - 5$ $= 11$ $T_3 = S_3 - S_2 = 33 - 16$ $= 17$ $\therefore 5 + 11 + 17 \ldots$	✓ $S_2 = 16$ & $S_3 = 33$ ✓ $T_1 = 5$ ✓ $T_2 = 11$ ✓ $T_3 = 17$ (4)
2.1.3	Arithmetic	✓ answer (1)
2.1.4	$T_n = a + (n-1)d$ $161 = 5 + (n-1)(6)$ $156 = (n-1)(6)$ $26 = n - 1$ $n = 27$ $\therefore$ there are 27 terms in the series	✓ substitution ✓ simplification ✓ answer (3)

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2.2	$S_\infty = \frac{a}{1-r}$ $18 = \frac{a}{1-r}$ $18(1-r) = a$ $S_n = \frac{a(1-r^n)}{1-r}$ $\frac{130}{9} = \frac{a(1-r^4)}{1-r}$ $\frac{130}{9} = \frac{18(1-r)(1-r^4)}{1-r}$ $\frac{65}{81} = 1-r^4$ $r^4 = \frac{16}{81}$ $r = \pm\frac{2}{3}$	✓ equation ✓ a subject ✓ equation ✓ substitution of a ✓ simplification ✓ answer (6) **[16]**

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QUESTION 3

3.1	Black : 5; 6; 7	✓ sequence (1)
3.2	$T_n = n + 4$	✓ answer (1)
3.3	$6^2 - 8$ $= 28$	✓ $6^2 - 8$ ✓ answer (2)
3.4	White: 4 10 18 28 6 8 10 2 2 $2a = 2$ $a = 1$ $3a + b = T_2 - T_1$ $3(1) + b = 6$ $b = 3$	✓ $a = 1$ ✓ $b = 3$

	$a + b + c = T_1$ $1 + 3 + c = 4$ $c = 0$ $\therefore T_n = n^2 + 3n$	✓ $c = 0$ (3)
3.5	$T_n = n + 4$ $32 = n + 4$ $\therefore n = 28$ $T_n = n^2 + 3n$ $= (28)^2 + 3(28)$ $= 868$	✓ $n = 28$ ✓ substitution ✓ answer (3) **[10]**

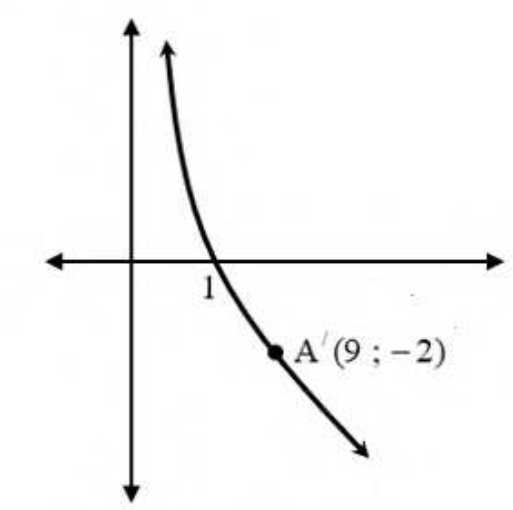
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QUESTION 4

4.1	$x \in \mathrm{R};\ x \neq 0$ **OR** $x \in (-\infty\ ;\ 0) \cup (0\ ;\infty)$	✓ $x \in \mathrm{R}$ ✓ $x \neq 0$ (2) ✓ $(-\infty\ ;\ 0)$ ✓ $(0\ ;\infty)$ (2)
4.2	$y = x + 8$ $7 = m + 8$ $m = -1$	✓ substitution ✓ answer (2)
4.3	$n = 8$	✓ answer (1)
4.4	$p = 1;\ q = 8$	✓$p = 1$ ✓ $q = 8$ (2)
4.5	$f(x) = -2x^2 - 4x + 6$ $0 = -2x^2 - 4x + 6$ $0 = x^2 + 2x - 3$ $0 = (x + 3)(x - 1)$ $x = -3$ or $x = 1$	✓ $f(x) = 0$ ✓ factors/formula ✓ both answers (3)
4.6	$E(-1\ ;\ 7)$ therefore $D(-1\ ;\ y)$ $y = \frac{-3}{-1} + 8$ $= 11$ $\therefore D(-1\ ;\ 11)$	✓ substitution ✓ answer (2)

4.7	$g(x) = -\frac{3}{x} + 8$ $= -3x^{-1} + 8$ $g'(x) = 3x^{-2}$ $= \frac{3}{x^2}$ $g'(-1) = \frac{3}{(-1)^2}$ $= 3$ $y - y_1 = m(x - x_1)$ $y - 11 = 3(x + 1)$ $y = 3x + 14$	✓ $-3x^{-1}$ ✓ $g'(x) = 3x^{-2}$ ✓ substitution ✓ substitution ✓ answer (5)
4.8	$y = \frac{3}{x - 4} + 8$	✓ 3 ✓ $x - 4$ ✓ $y = \frac{3}{x - 4} + 8$ (3)
4.9	g shifts 4 units left $\therefore D'(-5\ ;\ 11)$ with an asymptote at $y = 8$ $\therefore g$ must shift more than 8 units down, but less than 11 units down. $8 < -k < 11$ $-11 < k < -8$	✓ $D'(-5\ ;\ 11)$ ✓ 8 ✓ notation (3) **[23]**

QUESTION 5

5.1	$f: y = 2x^2;\ y \geq 0$ $f^{-1}: x = 2y^2$ $y^2 = \frac{x}{2}$ $y = \pm\sqrt{\frac{x}{2}};\ x \geq 0$	✓ swop x and y ✓ answer for y ✓ restriction for x (3)
5.2	 $A'(9\ ;-2)$ $\therefore 1 \leq x \leq 9$	✓ $A'(9\ ;-2)$ ✓ 1 ✓ notation (3)
5.3	$f\left(\frac{1}{x}\right) + \frac{1}{f(x)} + \left[f^{-1}(x)\right]^2$ $= 2\left(\frac{1}{x}\right)^2 + \frac{1}{2x^2} + \frac{x}{2}$ $= \frac{2}{x^2} + \frac{1}{2x^2} + \frac{x}{2}$ $= \frac{5 + x^3}{2x^2}$	✓ $2\left(\frac{1}{x}\right)^2$ ✓ $\frac{1}{2x^2}$ ✓ answer (3) **[9]**

QUESTION 6

6.1	$1 + i_{eff} = \left(1 + \frac{i_{nom}}{m}\right)^m$ $= \left(1 + \frac{0,13}{12}\right)^{12}$ $= 1,138032482$ $\therefore i_{eff} = 0,1380$ $\therefore r = 13,80\%$	✓ substitution ✓ simplification ✓ answer (3)
6.2	$F = \frac{x\left[(1+i)^n - 1\right]}{i}$ $1\,800\,000 = \frac{x\left[\left(1 + \frac{0,13}{12}\right)^{133} - 1\right]}{\frac{0,13}{12}}$ $x = R6\,109,77$	✓ $i = \frac{0,13}{12}$ ✓ $n = 133$ ✓ substitution ✓ answer (4)
6.3	Future shortage because of the withdrawals $= 20\,000\left(1 + \frac{0,13}{12}\right)^{6\times12} + 20\,000\left(1 + \frac{0,13}{12}\right)^{4\times12} +$ $20\,000\left(1 + \frac{0,13}{12}\right)^{2\times12}$ $= R102\,895,78$	✓ substitution into the correct formula ✓ $n = 6\times12$ ✓ $n = 4\times12$ ✓ $n = 2\times12$ ✓ answer (5)
6.4	$F = \frac{x\left[(1+i)^n - 1\right]}{i}$ $1\,800\,000 + 102\,895,78 = \frac{x\left[\left(1 + \frac{0,13}{2}\right)^{133} - 1\right]}{\frac{0,13}{2}}$ $x = R6\,459,03$	✓ enlarged F value ✓ substitution into correct formula ✓ answer (3) **[15]**

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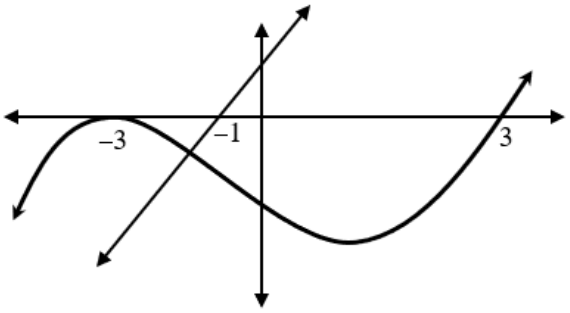
QUESTION 7

7.1	$f(x) = 5x^2 - x + 3$ $f(x+h) = 5(x+h)^2 - (x+h) + 3$ $= 5(x^2 + 2xh + h^2) - x - h + 3$ $= 5x^2 + 10xh + 5h^2 - x - h + 3$ $f(x+h) - f(x) = (5x^2 + 10xh + 5h^2 - x - h + 3)$ $- (5x^2 - x + 3)$ $= 10xh + 5h^2 - h$ $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \to 0} \frac{10xh + 5h^2 - h}{h}$ $= \lim_{h \to 0} \frac{h(10x + 5h - 1)}{h}$ $= \lim_{h \to 0} (10x + 5h - 1)$ $= 10x - 1$ **OR** $f(x) = 5x^2 - x + 3$ $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ $f'(x) = \lim_{h \to 0} \frac{[5(x+h)^2 - (x+h) + 3] - (5x^2 - x + 3)}{h}$ $= \lim_{h \to 0} \frac{5(x^2 + 2xh + h^2) - x - h + 3 - 5x^2 + x - 3}{h}$ $f'(x) = \lim_{h \to 0} \frac{5x^2 + 10xh + 5h^2 - x - h + 3 - 5x^2 + x - 3}{h}$ $= \lim_{h \to 0} \frac{10xh + 5h^2 - h}{h}$ $= \lim_{h \to 0} \frac{h(10x + 5h - 1)}{h}$ $= \lim_{h \to 0} (10x + 5h - 1)$ $= 10x - 1$	✓ $5(x+h)^2 - (x+h) + 3$ ✓ simplification ✓ simplification ✓ substitution into formula ✓ factors ✓ answer (6) ✓ $5(x+h)^2 - (x+h) + 3$ ✓ substitution into formula ✓ simplify $f(x+h)$ ✓ simplification ✓ factors ✓ answer (6)
7.2	$\frac{d}{dt}\left[(2t-1)(t+4)\right]$ $= \frac{d}{dt}\left[2t^2 + 7t - 4\right]$ $= 4t + 7$	✓ simplification ✓ 4t ✓ 7 (3)

7.3	$9p^2 - 3pq - q = 1$ $9p^2 - 1 = 3pq + q$ $9p^2 - 1 = q(3p + 1)$ $q = \frac{9p^2 - 1}{3p + 1}$ $= \frac{(3p + 1)(3p - 1)}{3p + 1}$ $= 3p - 1$ $\frac{dq}{dp} = 3$	✓ factorise q ✓ factorise p ✓ expression for q ✓ answer (4) **[13]**

QUESTION 8

8.1	$f''(x) = 6x + 6$	✓ $6x$ ✓ 6 (2)
8.2	$x = -1$	✓ answer (1)
8.3	$x > -1$ The graph is concave up when $f''(x) > 0$ Thus concave up where the graph of $f''(x)$ lies above the x-axis.	✓ answer ✓ reason (2)
8.4	$f(x) = px^3 + qx^2 + rx - 27$ $f'(x) = 3px^2 + 2qx + r$ $f''(x) = 6px + 2q$ $\therefore 6p = 6 \quad 2q = 6$ $p = 1 \quad q = 3$ $f'(x) = 3(1)x^2 + 2(3)x + r$ $= 3x^2 + 6x + r$ $0 = 3(1)^2 + 6(1) + r$ $r = -9$	✓ $f'(x) = 3px^2 + 2qx + r$ ✓ $f''(x) = 6px + 2q$ ✓ $6p = 6$ ✓ $2q = 6$ ✓ $f'(1) = 0$ (5)
8.5	$f'(x) = 3x^2 + 6x - 9$ $0 = 3t^2 + 6t - 9$ $0 = t^2 + 2t - 3$ $0 = (t + 3)(t - 1)$ $t = -3$ or $t = 1$ n.a **OR**	✓ $f'(x) = 3x^2 + 6x - 9$ ✓ $f'(x) = 0$ ✓ only $t = -3$ (3)

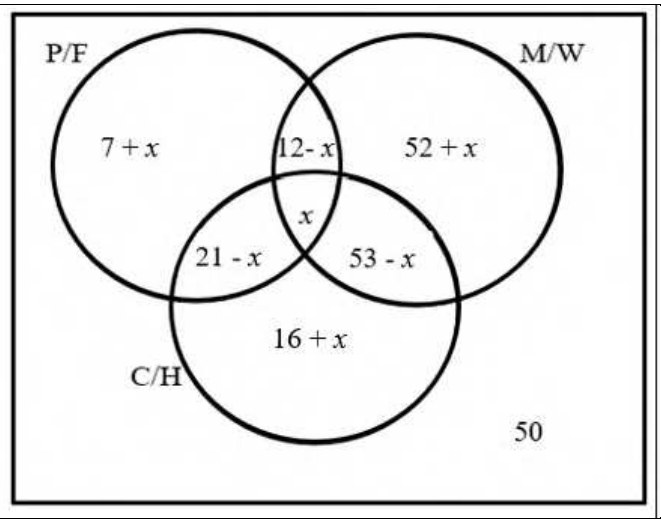
	$f(x) = x^3 + 3x^2 - 9x - 27$ $f(3) = (3)^3 + 3(3)^2 - 9(3) - 27$ $= 0$ $\therefore x - 3$ is a factor of $f(x)$ $\therefore f(x) = (x - 3)(x^2 + 6x + 9)$ $= (x - 3)(x + 3)(x + 3)$ $\therefore x = 3$ or $x = -3$ or $x = -3$ $x-$intercepts repeat $\therefore x = -3$ is the turning point $\therefore t = -3$	✓ x-intercepts ✓ $x = -3$ is turning point ✓ $t = -3$ (3)
8.6	 $x \leq -1$ or $x \geq 3$	✓ x-intercept: $x = 3$ ✓ $x = -3$ ✓ graph of f ✓ $x \leq -1$ ✓ $x \geq 3$ (5) **[18]**

QUESTION 9

9.1	$h(x) = -x^2 + 4x - 3$ $h'(x) = -2x + 4$	✓ answer (1)
9.2	$\frac{-x^2 + 4x - 3}{x} = -2x + 4$ $-x^2 + 4x - 3 = -2x^2 + 4x$ $x^2 - 3 = 0$ $x^2 = 3$ $x = \pm\sqrt{3}$ $\therefore x = \sqrt{3}$ $\therefore m = -2(\sqrt{3}) + 4$ $= 0,54$ $\therefore \tan\theta = 0,54$ $\theta = 28,19°$ $\therefore$ The soldier must use an angle of $28,19°$ **OR** $y = mx \quad y = -x^2 + 4x - 3$ $mx = -x^2 + 4x - 3$ $x^2 - 4x + mx + 3 = 0$ $x^2 + (m - 4)x + 3 = 0$ $\Delta = b^2 - 4ac$ $= (m - 4)^2 - 4(1)(3)$ To touch $\Delta = 0$ $0 = m^2 - 8m + 16 - 12$ $0 = m^2 - 8m + 4$ $m = \frac{8 \pm \sqrt{(-8)^2 - 4(1)(4)}}{2(1)}$ $m = 7,46 \quad$ or $\quad m = 0,54$ n.a $\therefore \tan\theta = 0,54$ $\theta = 28,19°$ $\therefore$ The soldier must use an angle of $28,19°$	✓ equation ✓ standard form ✓ x-value ✓ gradient ✓ $\tan\theta = 0,54$ ✓ answer (6) ✓ equating ✓ standard form ✓ $\Delta = 0$ ✓ value for m ✓ $\tan\theta = 0,54$ ✓ answer (6) **[7]**

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QUESTION 10

10.1		7 values need to be placed in the correct position: 1 or 2 correct: 1 mark 3 or 4 correct: 2 marks 5 or 6 correct: 3 marks 7 correct: 4 marks (4)
10.2	$50 + 7 + x + 12 - x + x + 21 - x + 52 +$ $x + 53 - x + 16 + x = 220$ $211 + x = 220$ $x = 9$	✓ equation ✓ answer (2)
10.3	P(M or P or C) $= \frac{61 + 16 + 25}{220}$ $= \frac{102}{220} = \frac{51}{110} = 0,46$	✓ $\frac{61 + 16 + 25}{220}$ ✓ answer (2) **[8]**

QUESTION 11

11.1	$(10)(9!)(9) = 32\ 659\ 200$	✓ (10)(9) ✓ 9! (2)
11.2	$\frac{(2)(1)(5)(4)(7!)}{2(9!)}$ $= \frac{201\ 600}{725\ 760}$ $= \frac{5}{18}$	✓ (2)(1) ✓ (5)(4) ✓ 7! ✓ ✓ 2(9!) ✓ answer (6) **[8]**
		TOTAL: 150

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COGNITIVE LEVELS **MATHEMATICS P1**

	COGNITIVE LEVELS				TOPICS						
	LEVEL 1 (20%)	LEVEL 2 (35%)	LEVEL 3 (30%)	LEVEL 4 (15%)							
QUESTION	KNOWLEDGE	ROUTINE PROCEDURES	COMPLEX PROCEDURES	PROBLEM SOLVING	ALGEBRA	PATTERNS	FUNCTIONS	FINANCE	DIFFERENTIATION	PROBABILITY	TOTAL MARKS
1.1.1	2				2						
1.1.2	3				3						
1.1.3		4			4						
1.2		6			6						
1.3.1		3			3						
1.3.2		2			2						
1.3.3			3		3						**23**
2.1.1	2					2					
2.1.2		4				4					
2.1.3	1					1					
2.1.4		3				3					
2.2			6			6					**16**
3.1	1					1					
3.2	1					1					
3.3				2		2					
3.4			3			3					
3.5				3		3					**10**
4.1	2						2				
4.2		2					2				
4.3	1						1				
4.4	2						2				
4.5		3					3				
4.6	2						2				
4.7			5				5				
4.8	3						3				
4.9				3			3				**23**
5.1		3					3				
5.2			3				3				
5.3			3				3				**9**
6.1		3						3			
6.2		4						4			
6.3				5				5			
6.4			3					3			**15**
7.1		6							6		
7.2		3							3		
7.3				4					4		**13**
8.1	2								2		
8.2	1								1		
8.3	2								2		

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8.4			5						5		
	COGNITIVE LEVELS				**TOPICS**						
	LEVEL 1 (25%)	**LEVEL 2 (30 %)**	**LEVEL 3 (30%)**	**LEVEL 4 (15%)**							
QUESTION	**KNOWLEDGE**	**ROUTINE PROCEDURES**	**COMPLEX PROCEDURES**	**PROBLEM SOLVING**	**ALGEBRA**	**PATTERNS**	**FUNCTIONS**	**FINANCE**	**DIFFERENTIATION**	**PROBABILITY**	**TOTAL MARKS**
8.5		3							3		
8.6			5						5		**18**
9.1		1							1		
9.2				6					6		**7**
10.1	4									4	
10.2		2								2	
10.3	2									2	**8**
11.1			2							2	
11.2			6							6	**9**
TOT	**31**	**52**	**44**	**23**	**23**	**26**	**32**	**15**	**38**	**16**	**150**
%	**20.7%**	**34.7%**	**29.3%**	**15.3%**							
PoI	**20%**	**35%**	**30%**	**15%**	**25**	**25**	**35**	**15**	**35**	**15**	**150**

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