KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS P1

MARKING GUIDELINE

SEPTEMBER 2023

PREPARATORY EXAMINATIONS

MARKS: 150

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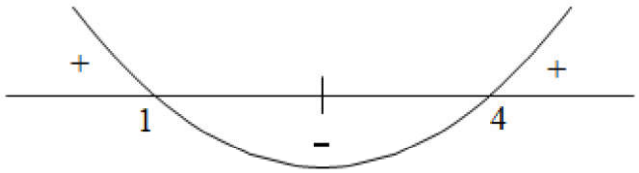
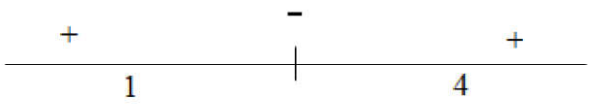
QUESTION 1			
1.1.1	$x=0$ or $x=4$	AA✓✓ answer	(2)
1.1.2	$2x^2+3x-7=0$ $x=\frac{-3\pm\sqrt{(3)^2-4(2)(-7)}}{2(2)}$ $x=1,27 or x=-2,77$ **Penalise 1 mark for incorrect rounding off .**	A✓ standard form CA✓ substitution into formula CA✓ 1,27 CA✓ −2,77	(4)
1.1.3	$(x-1)(x-4)>0$  $x<1$ or $x>4$ **OR** $(x-1)(x-4)>0$  $x<1$ or $x>4$	A✓ factors CA✓ $x<1$ CA✓ $x>4$ **OR** A✓ factors CA✓ $x<1$ CA✓ $x>4$	(3)

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1.1.4	$(3^x-3)(3^x-7)=0$ $3^x=3$ or $3^x=7$ $\log_3 7=x$ $x=1$ $1,77=x$ **OR** Let $3^x=m$ $\therefore 3^{2x}=m^2$ $m^2-10m+21=0$ $(m-3)(m-7)=0$ $m=3$ or $m=7$ $3^x=3$ or $3^x=7$ $\log_3 7=x$ $x=1$ or $1,77=x$	A✓ factors CA✓ $3^x=3$ or $3^x=7$ CA✓ using logs CA✓ $x=1$ CA✓ $x=1,77$ **OR** A✓ $m=3$ or $m=7$ CA✓ $3^x=3$ or $3^x=7$ CA✓ using logs CA✓ $x=1$ CA✓ $x=1,77$	(5)
1.2	$x=2-y$.....(3) $(2-y)^2+y^2+6(2-y)-4y+4=0$ $4-4y+y^2+y^2+12-6y-4y+4=0$ $2y^2-14y+20=0$ $y^2-7y+10=0$ $(y-2)(y-5)=0$ $y=2$ or $y=5$ $x=2-2=0$ $x=2-5=-3$	A✓ equation (3) CA✓ substitution CA✓ standard form CA✓ factors CA✓ y values CA✓ x values	(6)

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1.3	For equal roots $\Delta = 0$ $25 - n^2 = 0$ $(5-n)(5-n) = 0$ $n = \pm 5$ **OR** For equal roots $\Delta = 0$ $25 - n^2 = 0$ $25 = n^2$ $n = \pm 5$ **answer only = full marks**	A✓ $25 - n^2 = 0$ A✓ factors CA✓ answer **OR** A✓ $25 - n^2 = 0$ A✓ $25 = n^2$ CA✓ answer	(3)
			[23]

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QUESTION 2			
2.1.1	$3\ ;\ 7\ ;\ 11\ ;------\ ------\ 399.$ $a=3$ $d=4$ $n=20$ $T_n=a+(n-1)d$ $T_{20}=3+(20-1)4$ $T_{20}=79$ **OR** $3\ ;\ 7\ ;\ 11\ ;------\ ------\ 399.$ $4;\ 4;\ 4;\ \ldots\ldots$ $T_n=4n-1$ $T_{20}=4n-1$ $T_{20}=4(20)-1$ $T_{20}=79$	A✓ substitute into correct T_n formula CA✓ answer **OR** A✓ substitute into correct T_n formula CA✓ answer	(2)
2.1.2	$T_n=399$ $T_n=a+(n-1)d$ $399=3+(n-1)4$ $396=(n-1)4$ $99=n-1$ $100=n$ **OR** $T_n=399$ $T_n=4n-1$ $399=4n-1$ $400=4n$ $100=n$	A✓ substitute into correct T_n formula CA✓ answer **OR** A✓ substitute into correct T_n formula	

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		CA✓ answer	(2)
2.2.1	$T_1 = a$ $T_{13} = a + 24$ $T_{13} = a + (13-1)d$ $a + 24 = a + 12d$ $24 = 12d$ $2 = d$	A✓ $a + 24 = a + 12d$ A✓ $d = 2$	(2)
2.2.2	$S_n = \frac{n}{2}\left[2a + (n-1)d\right]$ $S_{200} = \frac{200}{2}\left[2(a) + (200-1)2\right]$ $S_{200} = 100(2a + 398)$ $S_{200} = 200a + 39\ 800$ **OR** $T_n = a + (n-1)d$ $T_{200} = a + (200-1)(2)$ $= a + 398$ $S_n = \frac{n}{2}(a + l)$ $S_{200} = \frac{200}{2}\left[a + (a + 398)\right]$ $S_{200} = 100(2a + 398)$ $= 200a + 39\ 800$	CA✓ substitute into the correct formula CA✓ answer **OR** CA✓ substitute into the correct formula CA✓ answer	(2)
			[8]

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QUESTION 3			
3.1	1 ; 11 ; 27 ; 49 ; 77 ; 111 ; 151 ; ..... 10 ; 16 ; 22 ; 28 ; 34 ; 40 ; ..... 6 ; 6 ; 6 ; 6 ; 6 ; ..... The third term is 27	A✓ answer	(1)
3.2	Second difference is 6 $2a=6$ $a=3$ $10=3a+b$ $10=3(3)+b$ $1=b$ $1=3+1+c$ $-3=c$ $T_n=3n^2+n-3$ **OR** -; - ; 27 ; 49 ; 77 ; 111 ; 151 ; ..... -; 16 ; 22 ; 28 ; 34 ; 40 ; ..... 6 ; 6 ; 6 ; 6 ; ..... $2a=6$ $a=3$ $T_n=an^2+bn+c$ $49=3(4)^2+b(4)+c$ $77=3(5)^2+b(5)+c$ $49=48+4b+c$ .....(1) $77=75+5b+c$ .....(2) $28=27+b$ .....(2) – (1) $1=b$ $49=48+4(1)+c$ $-3=c$	A✓ $a=3$ CA✓ $b=1$ CA✓ $c=-3$ CA✓ answer **OR** A✓ $a=3$ CA✓ $b=1$ CA✓ $c=-3$ CA✓ answer	(4)

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	$T_n = 3n^2 + n - 3$		
3.3	First difference $10\ ;\ 16\ ;\ 22\ ;\ 28\ ;\ 34\ ;\ 40\ \ldots$ $6\ ;\ 6\ ;\ 6\ ;\ 6\ ;\ 6\ ;\ \ldots$ $T_n = 6n + 4$ $418 = 6n + 4$ $414 = 6n$ $69 = n$ $70 = n + 1$ $\therefore$ between T_{69} and T_{70} **OR** $418 = T_{n+1} - T_n$ $418 = 3(n+1)^2 + (n+1) - 3 - (3n^2 + n - 3)$ $418 = 3(n^2 + 2n + 1) + n + 1 - 3 - 3n^2 - n + 3$ $418 = 3n^2 + 6n + 3 + n - 2 - 3n^2 - n + 3$ $418 = 6n + 4$ $414 = 6n$ $69 = n$ $70 = n + 1$ $\therefore$ between T_{69} and T_{70}	A✓ $T_n = 6n + 4$ CA✓ value of n CA✓ between T_{69} and T_{70} **OR** A✓ $418 = T_{n+1} - T_n$ CA✓ value of n CA✓ between T_{69} and T_{70}	(3)
			[8]

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QUESTION 4			
4.1.1	$T_1 = x$ $T_2 = x+1$ $r = \frac{T_2}{T_1}$ $r = \frac{x+1}{x}$	A✓ answer	(1)
4.1.2	$T_3 = T_2 \times r$ $T_3 = (x+1) \times \frac{x+1}{x}$ $T_3 = \frac{(x+1)^2}{x}$	CA✓ $(x+1) \times \frac{x+1}{x}$ CA✓ answer	(2)
4.1.3	$r = \frac{(2+1)}{2} = \frac{3}{2}$ $\therefore$ no, since $r > 1$ OR No, for the series to converge: $-1 < r < 1$	CA✓ value of r CA✓ answer with motivation	(2)
4.2	For AP: $T_2 - T_1 = T_3 - T_2$ $a - 6 = b - a$ $2a - 6 = b$.....(1) For GP: $\frac{T_2}{T_1} = \frac{T_3}{T_2}$ $\frac{b}{a} = \frac{16}{b}$	A✓ equation (1)	

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	$16a = b^2$.....(2) $16a = (2a-6)^2$ $16a = 4a^2 - 24a + 36$ $0 = 4a^2 - 40a + 36$ $0 = a^2 - 10a + 9$ $0 = (a-1)(a-9)$ $a = 1$ or 9 $b = 2(9) - 6 = 12$ $b = 2(1) - 6 = -4$	A✓ equation (2) CA✓ standard form CA✓ values of a CA✓ values of b	(5)
			[10]

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QUESTION 5			
5.1	$x=3$ $y=-1$	A✓ answer A✓ answer	(2)
5.2	$x-$ intercept: $0=\frac{-3}{3-x}1$ $1=\frac{-3}{3-x}$ $3-x=-3$ $x=6$ $y-\text{intercept}=\frac{-3}{3-0}-1=-2$ **OR** $y=\frac{-3}{-(x-3)}-1$ $y=\frac{3}{x-3}-1$ $x-$ intercept: $0=\frac{3}{x-3}-1$ $1=\frac{3}{x-3}$ $x-3=3$ $x=6$ $y-\text{intercept}=\frac{3}{0-3}-1=-2$	A✓ sub $y=0$ CA✓ $x=6$ A✓ $y=-2$ **OR** A✓ sub $y=0$ CA✓ $x=6$ A✓ $y=-2$	(3)

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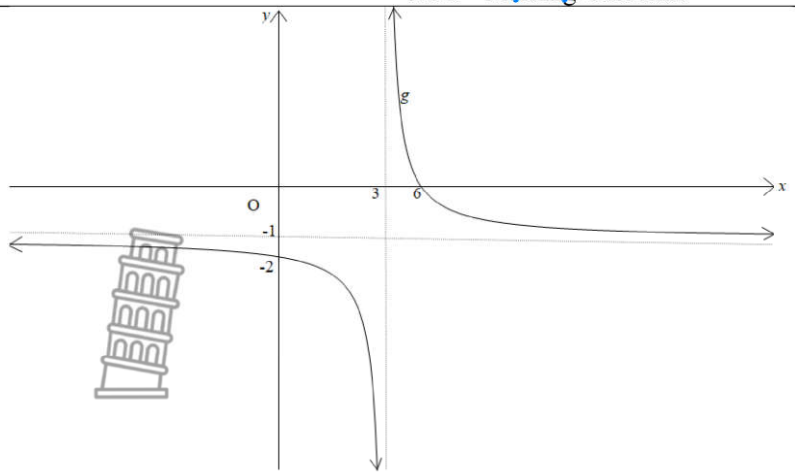
5.3		A✓ shape CA✓ intercepts CA✓ asymptotes	(3)
5.4	$y=-x+c$ $-1=-3+c$ $2=c$ $y=-x+2$ **OR** $y=\frac{-3}{-3-x}-1$ $y=(3-x)-1$ $y=-x+2$ **OR** $y=\frac{3}{x-3}-1$ $y=-(x-3)-1$ $y=-x+3-1$ $y=-x+2$	CA✓ sub $(3;-1)$ CA✓ answer **OR** A✓ $(3-x)-1$ CA✓ answer **OR** A✓ $-(x-3)-1$ CA✓ answer	(2)
			[10]

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QUESTION 6			
6.1	$m = \tan 135^0$ $m = -1$ $\therefore y = -x + 2$	A✓ $m = \tan 135^0$ A✓ $m = -1$	(2)
6.2	$0 = -x + 2$ $x = 2$ $\therefore S(2;0)$ **Answer only = full marks**	A✓ equating to zero A✓ answer	(2)
6.3	$y = a(x - x_1)(x - x_2)$ $y = a\left(x + \frac{1}{2}\right)(x - 2)$ $-12 = a\left(1 + \frac{1}{2}\right)(1 - 2)$ $-12 = \frac{-3a}{2}$ $8 = a$ $y = 8\left(x + \frac{1}{2}\right)(x - 2)$ $y = 8\left(x^2 - \frac{3}{2}x - 1\right)$ $y = 8x^2 - 12x - 8$ **Accept method of simultaneous equations**	A✓ sub $x = -\frac{1}{2}$ and $x = 2$ A✓ sub $(1;-12)$ A✓ $a = 8$ A✓ $y = 8\left(x^2 - \frac{3}{2}x - 1\right)$	(4)
6.4	$x = \frac{-b}{2a}$ $x = \frac{-(-12)}{2(8)} = \frac{3}{4}$ $y = 8\left(\frac{3}{4}\right)^2 - 12\left(\frac{3}{4}\right) - 8$ $y = \frac{-25}{2}$ $V\left(\frac{3}{4}; \frac{-25}{2}\right)$	A✓ x value CA✓ substitution CA✓ y value	

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	OR		
	$g'(x)=16x-12$		
	$0=16x-12$	A✓ $0=16x-12$	
	$12=16x$		
	$\frac{3}{4}=x$	CA✓ x value	
	$y=8\left(\frac{3}{4}\right)^2-12\left(\frac{3}{4}\right)-8$		
	$y=\frac{-25}{2}$	CA✓ y value	
	$V\left(\frac{3}{4};\frac{-25}{2}\right)$		
	OR		
	x-intercepts S(2;0) and $R\left(-\frac{1}{2};0\right)$	**OR**	
	midpoint $x=\frac{\frac{-1}{2}+2}{2}$	A✓ subst into correct midpoint formula	
	$x=\frac{3}{4}$	CA✓ x value	
	$y=8\left(\frac{3}{4}\right)^2-12\left(\frac{3}{4}\right)-8$		
	$y=\frac{-25}{2}$		
	$V\left(\frac{3}{4};\frac{-25}{2}\right)$	CA✓ y value	
	OR		
	$y=8\left[x^2-\frac{12}{8}x-1\right]$	**OR**	
	$y=\left[\left(x^2-\frac{3}{2}x+\frac{9}{16}\right)-1-\frac{9}{16}\right]$		
	$y=8\left[\left(x-\frac{3}{4}\right)^2-\frac{25}{16}\right]$	A✓ completing the squarc	

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	$y=8\left(x-\frac{3}{4}\right)^2-\frac{25}{2}$ $V\left(\frac{3}{4};\frac{-25}{2}\right)$	CA✓✓ x value and y value	(3)
6.5	$k>\frac{-25}{2}$	CA✓ answer	(1)
6.6	$x>\frac{3}{4}$ **OR** $(-1)(16x-12)<0$ $-16x<-12$ $x>\frac{3}{4}$	CA✓ answer **OR** A✓ answer	(1)
6.7	$T\left(-1;\frac{1}{2}\right)$	A✓ x – coordinate A✓ y – coordinate	(2)
			[15]

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QUESTION 7			
7.1	$(4;-1)$	A✓ answer	(1)
7.2	$y=\log_a x$ $-1=\log_a 4$ $a^{-1}=4$ $a=\frac{1}{4}$	A✓ sub $(4;-1)$ A✓ $a^{-1}=4$	(2)
7.3	$y=\left(\frac{1}{4}\right)^x$	A✓ answer	(1)
7.4	A$(-1;4)$ and B$(1;0)$ $AB=\sqrt{(-1-1)^2+(4-0)^2}$ $AB=\sqrt{4+16}=\sqrt{20}$ $AB=2\sqrt{5}=4,47$	A✓ B$(1;0)$ CA✓ sub points A and B CA✓ answer	(3)
7.5	$x>4$	A✓ answer	(1)
			[8]

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QUESTION 8

8.1	$A = P(1-i)^n$ $10767,26 = 15800\left(1-\frac{12}{100}\right)^n$ $\frac{10767,26}{15800} = (0,88)^n$ $\log_{(0,88)}\left(\frac{10767,26}{15800}\right) = n$ $2,999998... = n$ $n = 3\text{ years}$	A✓ sub into correct formula CA✓ correct use of logs CA✓ answer	(3)
8.2	$\left(1+\frac{r}{100}\right) = \left(1+\frac{i}{m}\right)^m$ $\left(1+\frac{r}{100}\right) = \left(1+\frac{7,64}{200}\right)^2$ $r = 100\left[\left(1+\frac{7,64}{200}\right)^2 - 1\right]$ $r = 7,79\%$	A✓ subst into correct formula CA✓ answer	(2)
8.3.1	T_0 T_1 T_2 T_3 ... T_{24} R500 R500 R500 R500 $F = \frac{x\left[(1+i)^n - 1\right]}{i}$		

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	$F = \dfrac{500\left[\left(1+\dfrac{5,8}{1200}\right)^{24}-1\right]}{\dfrac{5,8}{1200}}$ $= \text{R}12\,691,25$	A✓ values of i & n CA✓ subst into correct CA✓ answer	(3)
8.3.2	R368 400 - R12 691,25 = R355 708,75 $P = \dfrac{x\left[1-(1+i)^{-n}\right]}{i}$ $355708,75 = \dfrac{x\left[1-\left(1+\dfrac{10,4}{1200}\right)^{-72}\right]}{\dfrac{10,4}{1200}}$ $R6661,78 = x$	CA✓ R355 708,75 A✓ $n = 72$ CA✓ sub into correct formula CA✓ answer	(4)
8.3.3	Balance Outstanding = $\text{P}(1+\text{i})^{n} - \dfrac{x\left[(1+i)^{n}-1\right]}{i}$ $= 355708,75\left(1+\dfrac{10,4}{1200}\right)^{56} - \dfrac{6661,78\left[\left(1+\dfrac{10,4}{1200}\right)^{56}-1\right]}{\dfrac{10,4}{1200}}$ Balance outstanding = R99 128,46 **OR** Remaining instalments = $72-56=16$ $\text{Balance} = \dfrac{6661,78\left[1-\left(1+\dfrac{10,4}{1200}\right)^{-16}\right]}{\dfrac{10,4}{1200}}$	CA✓ $355708,75\left(1+\dfrac{10,4}{1200}\right)^{56}$ CA✓ $\dfrac{6661,78\left[\left(1+\dfrac{10,4}{1200}\right)^{56}-1\right]}{\dfrac{10,4}{1200}}$ CA✓ R99 128,46 **OR** A✓ $n = 16$ CA✓ subst into correct formula	

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	$= R99128,52$	CA✓ $R99128,52$	(3)
			[15]

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QUESTION 9

Penalise ONCE for incorrect notation, either in 9.1 or 9.2.

9.1	$f(x)=2x^2+9$ $f(x+h)=2(x+h)^2+9$ $=2x^2+4xh+2h^2+9$ $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $f'(x)=\lim_{h\to 0}\frac{2x^2+4xh+2h^2+9-2x^2-9}{h}$ $f'(x)=\lim_{h\to 0}\frac{4xh+2h^2}{h}$ $f'(x)=\lim_{h\to 0}\frac{h(4x+2h)}{h}$ $f'(x)=\lim_{h\to 0}4x+2h$ $f'(x)=4x$	A✓ calculating $f(x+h)$ CA✓ sub into formula CA✓ simplifying CA✓ factors CA✓ answer	(5)
9.2.1	$y=2x^2+x$ $\frac{dy}{dx}=4x+1$	A✓ product CA✓ answer	(2)
9.2.2	$\sqrt{y+x}=x+3$ $\left(\sqrt{y+x}\right)^2=(x+3)^2$ $y+x=x^2+6x+9$ $y=x^2+5x+9$ $\frac{dy}{dx}=2x+5$	A✓ squaring both sides A✓ correct product CA✓ answer	(3)
9.2.3	$\frac{d}{dx}\left[4x^{-1}+\sqrt{3}x^{-\frac{1}{2}}\right]$ $=-4x^{-2}-\frac{\sqrt{3}}{2}x^{-\frac{3}{2}}$	A✓ $4x^{-1}+\sqrt{3}x^{-\frac{1}{2}}$ CA CA✓✓ each term	(3)

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9.3.1	$f(x)=x^3+1$	A✓ A ✓ answer	(2)
9.3.2	At P $x=2 \therefore y=2^3+1=9$ $P(2;9)$ $m=12$ $y=12x+c$ $9=12(2)+c$ $-15=c$ $y=12x-15$	CA✓ $y-$coordinate CA✓ $m=12$ CA✓ answer	(3)
			[18]

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QUESTION 10

10.1	$f(x)=ax^3+bx^2$ $f(1)=a(1)^3+b(1)^2=a+b$ $f(2)=a(2)^3+b(2)^2=8a+4b$ Ave grad $=\dfrac{f(2)-f(1)}{2-1}$ Ave grad $=\dfrac{8a+4b-a-b}{1}$ $5,5=7a+3b$ .....(1) $f'(x)=3ax^2+2bx$ $f'(6)=3a(6)^2+2b(6)$ $-18=108a+12b$.....(2) $(1)\times 4:\quad 22=28a+12b$.....(3) $40=-80a$.....(3)$-$(2) $\dfrac{-1}{2}=a$ $5,5=7\left(\dfrac{-1}{2}\right)+3b$ $5,5=-3,5+3b$ $9=3b$ $3=b$	A✓ subst $x=1$ & $x=2$ A✓ correct subst into average gradient formula A✓ equation (1) A✓ equation (2) A✓ solving simultaneously	(5)
10.2	$f'(x)=\dfrac{-3x^2}{2}+6x$ $0=\dfrac{-3x^2}{2}+6x$ $0=-3x^2+12x$ $0=x^2-4x$ $0=x(x-4)$	A✓ $f'(x)$ CA✓ equating $f'(x)=0$	

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	$x=0$ or $x=4$ $\therefore x=4$ At N $x=4 \therefore y=\frac{-1}{2}(4)^3+3(4)^2=16$ N$(4;16)$	CA✓ $x=4$ CA✓ $y=16$	(4)
10.3	$f''(x)=-3x+6$ $-3x+6>0$ $-3x>-6$ $x<2$ $k=2$ OR $f''(x)=-3x+6$ $0=-3x+6$ $x=2$ $\therefore k=2$ OR $Midpt\ x=\frac{0+4}{2}=2$ $x=2$ $\therefore k=2$	CA✓ $f''(x)$ CA✓ $-3x+6>0$ CA✓ answer	(3)
			[12]

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QUESTION 11			
11.1	Volume = lbh $25 = (1,5x)(x)h$ $\frac{25}{1,5x^2} = h$	A✓ substitution A✓ answer	(2)
11.2	Area = $4(1,5x)h + 3(1,5x)x + 2xh$ Area = $4(1,5x) \times \frac{25}{1,5x^2} + 3(1,5x^2) + 2x \times \frac{25}{1,5x^2}$ Area = $\frac{100}{x} + 4,5x^2 + \frac{50}{1,5x}$	A✓ substitution in to SA formula A✓ substituting h	(2)
11.3	A= $100x^{-1} + 4,5x^2 + \frac{50x^{-1}}{1,5}$ $\frac{dA}{dx} = -100x^{-2} + 9x - \frac{100x^{-2}}{3}$ $0 = \frac{-100}{x^2} + 9x - \frac{100}{3x^2}$ $0 = -300 + 27x^3 - 100$ $0 = 27x^3 - 400$ $400 = 27x^3$ $x = \sqrt[3]{\frac{400}{27}}$ $x = 2,46$	A✓ $\frac{dA}{dx} = 0$ CA✓ simplification CA✓ value of x	(3)
			[7]

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QUESTION 12			
12.1	$a=4$ $b=13$ $c=5$ $d=4$ $e=6$	A✓ A✓ A✓ CA✓ CA✓	(5)
12.2	Greybound bus = 23 people	CA✓ answer	(1)
12.3	P(only one bus) $= \frac{6+4+2}{40} = \frac{12}{40} = \frac{3}{10}$	CA✓ adding CA✓ answer	(2)
			[8]

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QUESTION 13			
13.1	$8!$ ways $=40\ 320$ ways	A✓ $8!$ OR 40 320	(1)
13.2	$1\times6!\times1+1\times6!\times1=1440$ ways **OR** $2\times6!\times1=1440$ ways	A✓ $6!$ A✓ $1\times6!\times1$ A✓ 1440	(3)
13.3	$1-\left[\frac{(2!\times5!)}{1440}+\frac{(2!\times5!)}{1440}\right]=\frac{2}{3}$ OR $\frac{1440-(2!5!+2!5!)}{1440}$ $=\frac{2}{3}$	A✓ subtracting from 1 CA✓ denominator A✓ $2!5!$ CA✓ answer	(4)
			[8]

TOTAL MARKS: 150

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