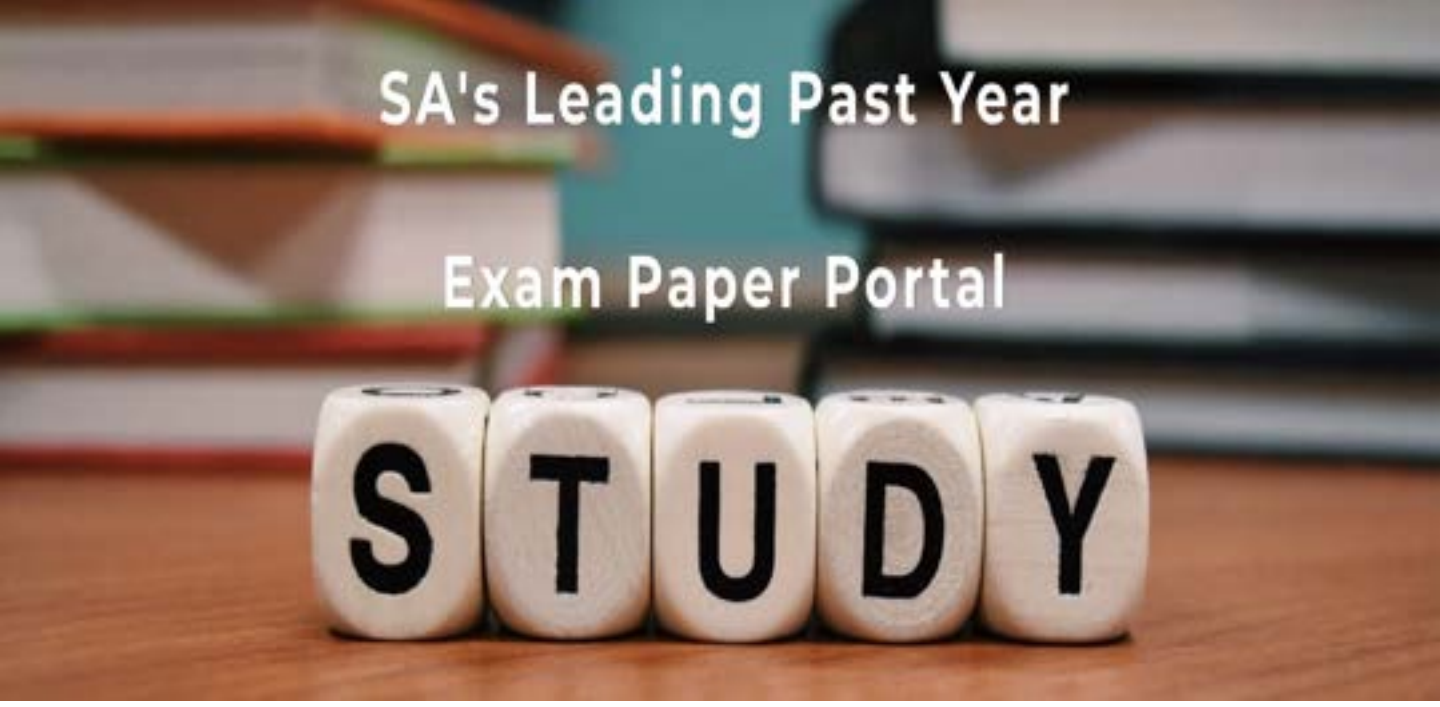

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MATHEMATICS P1

SEPTEMBER 2021

GRADE 12

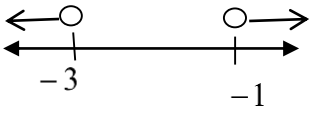
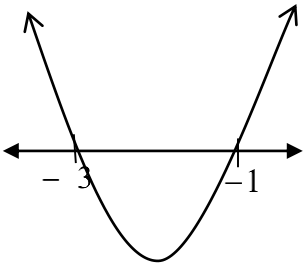
MEMORANDUM

MARKS: 150

TIME: 3 HOURS

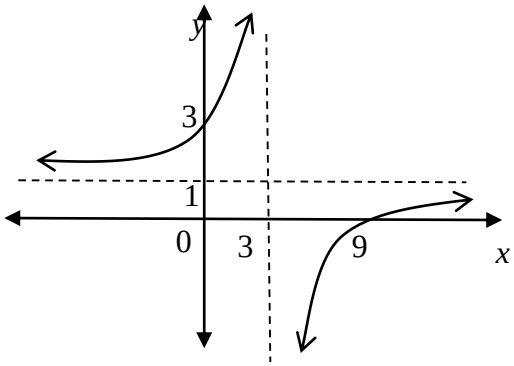
This MEMORANDUM consists of 11 pages.

QUESTION 1		**[23]**
1.1.1	$x(2-x)=0$ $x=0 \quad or \quad x=2$	✓ ✓ answers (2)
1.1.2	$(2x+3)(3-x)=2$ $6x-2x^2+9-3x-2=0$ $2x^2+3x+7=0$ $x=\frac{-(3)\pm\sqrt{(3)^2-4(-2)(-2)}}{2(-2)}$ $x=\frac{-3\pm\sqrt{65}}{-4}$ $x=2{,}77 \quad or \quad x=-1{,}27$ –1 for rounding	✓ standard form ✓ substitution into correct formula ✓ $\sqrt{65}$ ✓ answers (4)
1.1.3	$27^x \cdot 9^{x-2}=1$ $(3^3)^x \cdot (3^2)^{x-2}=1$ $3^{3x+2x-4}=3^0$ $5x=4$ $x=\frac{4}{5}$	✓ exponential law ✓ 3^0 ✓ answer (3)
1.1.4	$\sqrt{5-2x}=\frac{x}{2}+4$ $\left(\sqrt{5-2x}\right)^2=\left(\frac{x}{2}+4\right)^2$ $5-2x=\frac{x^2}{4}+4x+16$ $20-8x=x^2+16x+64$ $x^2+24x+44=0$ $(x+2)(x+22)=0$ $x=-2 \quad or \quad x\neq -22$	✓ squaring both sides ✓ standard form ✓ factors ✓ both x-values ✓ exclusion (5)

1.1.5	$x(x+4) \geq -3$ $x^2 + 4x + 3 \geq 0$ $(x+3)(x+1) \geq 0$   $x \leq -3$ *or* $x \geq -1$ OR $x \in (-\infty;-3] \cup [-1;\infty)$	✓ standard form ✓ factors ✓ method ✓ answer (4)
1.2	$x - y = 1$ $x = y + 1$ $(2x-y)(x+2y-3) = 0$ $(2(y+1)-y)((y+1)+2y-3) = 0$ $(y+2)(3y-2) = 0$ $y = \frac{2}{3}$ *or* $y = -2$ $x = \frac{2}{3} + 1 = \frac{5}{3}$ $x = -2+1 = -1$ OR $y = x - 1$ $(2x-y)(x+2y-3) = 0$ $(2x-(x-1))(x+2(x-1)-3) = 0$ $(x+1)(3x-5) = 0$ $x = \frac{5}{3}$ *or* $x = -1$ $y = \frac{5}{3} - 1 = \frac{2}{3}$ $y = -1-1 = -2$	✓isolation ✓substitution ✓standard form ✓ *y*-values ✓ *x*-values (5) ✓isolation ✓substitution ✓standard form ✓*x*-values ✓*y* - values (5)

QUESTION 2		**[25]**
2.1.1	$1 ; -5 ; -13; -23$ $-6 \quad -8 \quad -10$ $-2 \quad -2$ $2a = -2 \quad 3a + b = -6 \quad a + b + c = 3$ $a = -1 \quad 3(-1) + b = -6 \quad -1 - 3 + c = 1$ $b = -3 \quad c = 5$ $T_n = -n^2 - 3n + 5$	✓value of a ✓value of b ✓value of c ✓equation (4)
2.1.2	$T_n = -n^2 - 3n + 5$ $-643 = -n^2 - 3n + 5$ $n^2 + 3n - 648 = 0$ $(n - 24)(n + 27) = 0$ $n = 24 \text{ or } n = -27$ $T_{24} = -648$	✓ standard form ✓ factors ✓answer (3)
2.2	$S_n = \frac{n}{2}[a + l]$ $155 = \frac{n}{2}[2 + 29]$ $310 = 31n$ $n = 10$ $T_n = a + 9d$ $29 = 2 + 9d$ $9d = 27$ $d = 3$	✓substitution into the correct formula ✓ value of n ✓ substitution into the correct formula ✓answer (4)
2.3	$\sum_{3}^{14}(15 - 4n)$ $3 - 1 - 5.....$ $S_n = \frac{n}{2}[2a + (n-1)d]$ $= \frac{12}{2}[2(3) + 11(-4)]$ $= -228$	✓value of a , d and n ✓ substitution into the correct formula ✓ answer (3)

2.4	$S_8 : S_4 = 97 : 81$ $\frac{S_8}{S_4} = \frac{a(r^8-1)}{r-1} \div \frac{a(r^4-1)}{r-1} = \frac{97}{81}$ $\frac{a(r^4-1)(r^4+1)}{r-1} \times \frac{r-1}{a(r^4-1)} = \frac{97}{81}$ $1 + r^4 = \frac{97}{81}$ $r^4 = \frac{16}{81}$ $r^4 = \frac{2^4}{3^4}$ $r = \frac{2}{3}$ Sequence: 9 ; 6 ; 4	✓substitution into the correct formula ✓factors of $r^8 - 1$ ✓ $r^4 = \frac{16}{81}$ ✓ value of r ✓ sequence (5)
2.5	$2(p-5) + (p-5)^2 + \frac{1}{2}(p-5)^3 + ...p \neq 5$	
2.5.1	$r = \frac{1}{2}(p-5)$ $-1 < r < 1$ $-1 < \frac{1}{2}(p-5) < 1$ $-2 < p-5 < 2$ $3 < p < 7$	✓ value of r ✓$-1 < r < 1$ ✓answer (3)
2.5.2	$2(4-5) + (4-5)^2 + \frac{1}{2}(4-5)^3 + ...p \neq 5$ $-2 ; 1 ; -\frac{1}{2}$ $S_\infty = \frac{a}{1-r}$ $S_\infty = \frac{-2}{1-(-\frac{1}{2})}$ $= -\frac{4}{3}$	✓ value of a and r ✓substitution into the correct formula ✓ answer (3)

QUESTION 3 **[14]**		
3.1	$g(x) = \frac{-6}{x-3} + 1$	
3.1.1	$x = 3$ $y = 1$	✓ $x = 3$ ✓ $y = 1$ (2)
3.1.2	$y = \frac{-6}{0-3} + 1$ $y = 3$	✓ answers (1)
3.1.3	$0 = \frac{-6}{x-3} + 1$ $-6 = -1(x-3)$ $x = 9$	✓✓ answers (2)
3.1.4		✓ asymptotes ✓ intercepts ✓ shape (3)
3.2	$x < 3$ or $9 < x$ **OR** $x \in (-\infty\ ;\ 3) \cup (9\ ;\ \infty)$	✓✓ answers (2)
3.3	$h(x) = x + c$ $1 = 3 + c$ $c = -2$	✓substitution ✓value of c (2)
3.4	Reflection $y = 1$ Translation 6 units to the left	✓ reflection $y = 1$ ✓6 units to the left (2)

QUESTION 4		
4.1.1	$f(x) = 2^0 - 8$ $f(x) = 1 - 8$ $\quad B(0\,;-7)$ $0 = 2^x - 8$ $2^x = 2^3$ $x = 3$ $\quad C(3\,;0)$	✓value of y ✓ $y = 0$ ✓value of x (3)
4.1.2	$y = a(x+p)^2 + q$ $4{,}5 = a(0-3)^2 + 0$ $a = \frac{1}{2}$ $y = \frac{1}{2}(x-3)^2 + 0$ $y = \frac{1}{2}(x^2 - 6x + 9)$ $b = -3$	✓substitution of A(0 ; 4,5) ✓substitution of C(3 ; 0) ✓value of a ✓value of b (4)
4.1.3	$-f(x) = -2^x + 8$ $\therefore y \leq 8$ **OR** $y \in (-\infty\,;8]$	✓ ✓answer (2)
4.1.4	$h(x) = f(2x) + 8$ $= 2^{2x} - 8 + 8$ $h(x) = 4^x$ $h^{-1}(x) = \log_4 x$	✓ $h(x) = 4^x$ ✓ swop x and y ✓ answer (3)
4.1.5.a	$x \leq 3$ OR $x \in (-\infty\,;3]$	✓✓ answers (2)
4.1.5.b	$g'(x) = x - 3$ $x > 3$ or $x < 0$ **OR** $x \in (3;\infty) \cup (-\infty;0)$	✓ $x > 3$ ✓$x < 0$ answers (2)
4.2	$y = 4x - x^2$ $y' = 4 - 2x$ $m_{OA} = 4$ $\tan X\hat{O}A = 4$ $X\hat{O}A = 75{,}96°$ $\tan X\hat{O}B = \frac{1}{2}$	✓ y' ✓ gradient of OA ✓ $X\hat{O}A = 75{,}96°$ ✓ $X\hat{O}B = 26{,}56°$

	$X\hat{O}B = 26{,}56°$ $\therefore A\hat{O}B = 75{,}96° - 26{,}56° = 49°$	✓ 49° (rounded to nearest degree) (5) **[21]**

QUESTION 5
[15]

5.1.1	$A = P(1+i)^n$ $150\,000 = 18\,000\left(1+\frac{0.12}{12}\right)^{12n}$ $\log(1.01)^{12n} = \log\left(\frac{150}{18}\right)$ $12n = \frac{\log\left(\frac{150}{18}\right)}{\log(1{,}01)}$ $12n = 213{,}084$ $n = 17{,}76$ $\therefore$ 18 years	✓substitution into correct formula ✓correct use of logs ✓ n value ✓ answer (4)
5.1.2	$F = \frac{x\,[(1+i)^n - 1]}{i}$ $= \frac{150\left[\left(1+\frac{0{,}12}{12}\right)^{216} - 1\right]}{\frac{0{,}12}{12}}$ $F = \text{R}113\,679{,}09$	✓ i value ✓ n value ✓ substitution into correct formula ✓ answer (4)
5.2.1	$\left(1+\frac{i}{2}\right)^2 = \left(1+\frac{0{,}16}{4}\right)^4$ $= (1{,}04)^4$ $i = 2\left[(1{,}04)^2 - 1\right]$ $= 0{,}1632$ Rate = 16,32%	✓ $\left(1+\frac{i}{2}\right)^2$ ✓ $\left(1+\frac{0{,}16}{4}\right)^4$ ✓ simplification (3)
5.2.2	$P = \frac{x\left[1-(1+i)^{-n}\right]}{i}$ $P = \frac{2500\left[1-\left(1+\frac{0{,}1632}{2}\right)^{-15}\right]}{\frac{0{,}1632}{2}}$	✓ substitution into correct formula ✓value of i ✓value of n

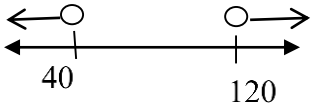
	$= R21\,191{,}22$	✓answer (4)

Penalty of –1 for notation in Question 6

QUESTION 6		**[14]**
6.1	$f(x) = 3x^2 - 2$ $f(x+h) = 3(x+h)^2 - 2$ $f(x+h) = 3x^2 + 6xh + 3h^2 - 2$ $f'(x) = \lim_{h\to 0} \frac{f(x+h)^2 - f(x)}{h}$ $f'(x) = \lim_{h\to 0} \frac{3x^2 + 6xh + 3h^2 - 2 - (3x^2 - 2)}{h}$ $f'(x) = \lim_{h\to 0} \frac{3x^2 + 6xh + 3h^2 - 2 - 3x^2 + 2}{h}$ $f'(x) = \lim_{h\to 0} \frac{6xh + 3h^2}{h}$ $f'(x) = \lim_{h\to 0} \frac{h(6x+3h)}{h}$ $= 6x$	✓substitute $f(x+h)$ ✓correct substitution into formula and notation ✓simplification ✓common factor ✓ answer (5)
6.2.1	$f(x) = 3x^2 - 5x$ $f'(x) = 6x - 5$	✓ $6x$ ✓ -5 (2)
6.2.2	$D_x\left[\frac{-2x+\sqrt{x}}{x^2}\right]$ $= D_x\left[-\frac{2x}{x^2} + \frac{x^{\frac{1}{2}}}{x^2}\right]$ $= D_x\left[-2x^{-1} + x^{\frac{-3}{2}}\right]$ $= 2x^{-2} - \frac{3}{2}x^{\frac{-5}{2}}$	✓ $\sqrt{x} = x^{\frac{1}{2}}$ ✓simplified expression ✓ $2x^{-2}$ ✓ $-\frac{3}{2}x^{\frac{-5}{2}}$ (4)
6.3	$y = \left(\frac{1-8x^3}{1-2x}\right)$ $y = \left(\frac{(1-2x)(1+2x+x^2)}{1-2x}\right)$ $y = 1 + 2x + x^2$ $\frac{dy}{dx} = 2 + 2x$	✓ factors ✓✓derivative (3)

QUESTION 7		**[13]**
7.1	$f(x) = (x+2)(x-1)(x-3)$ $= (x+2)(x^2-4x+3)$ $= x^3-4x^2+3x+2x^2-8x+6$ $= x^3-2x^2-5x+6$ $b=-2 \;\; c=-5 \;\; d=6$	✓substitution into correct formula ✓simplification (2)
7.2	$3x^2-4x-5=0$ $x=\frac{-(-4)\pm\sqrt{(-4)^2-4(3)(-5)}}{2(3)}$ $x=\frac{4\pm\sqrt{76}}{6}$ $x=2{,}12 \quad or \quad x=-0{,}79$	✓ derivative = 0 ✓ formula ✓ x – values (3)
7.3	f is decreasing	✓answers (1)
7.4	$6x-4>0$ $x>\frac{2}{3}$	✓inequality ✓answer (2)
7.5	$PQ = x^3-2x^2-5x+6-2x$ $= x^3-2x^2-7x+6$ Max/Min: $3x^2-4x-7=0$ $(3x-7)(x+1)=0$ $x=\frac{7}{3} \quad or \quad x=-1$ $PQ=(-1)^3-2(-1)^2-7(-1)+6$ $= 10$	✓ length of PQ in terms of x ✓ derivative ✓ x – values ✓ substitution ✓ value of PQ (5)

QUESTION 8		**[10]**
8.1	$-\frac{3}{80}x^2+6x-180=0$ $x^2-160x+4800=0$ $(x-120)(x-40)=0$ $x=120 \quad or \quad x=20$ ∴No profit at 120km/h or 40km/h	✓P = 0 ✓factors ✓answer (3)
8.2	$-\frac{6}{80}x+6=0$ $x=80$ $P=-\frac{3}{80}(80)^2+6(80)-180$ $P=60$ ∴ Most economical speed is 80km/h And a Profit of R60/h	✓ derivative ✓ value of x ✓substitution into correct formula ✓value of P (4)

8.3	$-\frac{3}{80}x^2+6x-180<0$ $x^2-160x+4800>0$ $(x-120)(x-40)>0$  $30\le x<40$ *or* $x>120$	✓ inequality ✓ method ✓ answer (3)

QUESTION 9		**[15]**
9.1.1	Not Mutually exclusive because P(A and B) ≠0	✓No ✓ P(A and B) ≠0 (2)
9.1.2	P(Male and Vodacom) $=\frac{48}{236}=\frac{12}{59}=0,203$	✓answer (1)
9.1.3	P(Male) $=\frac{120}{236}=0,508$ P(Vodacom) $=\frac{100}{236}=0,424$ P(Male) × P(Vodacom) $=0,508\times0,424=0,215$ P(Male) × P(Vodacom) ≠ P(Male and Vodacom) ∴not independent	✓ 0,508 ✓ 0,424 ✓ P(Male) × P(Vodacom) ≠ P(Male and Vodacom) (3)
9.2	$\frac{2!\times5!}{7!}=\frac{1}{21}$	✓ 2! 5! ✓ 7! ✓ answer (3)
9.3.1	$7^3=343$	✓ 7^3 ✓ answer (2)
9.3.2	$\frac{7!}{4!}=210$ OR $7\times6\times5=210$	✓ $\frac{7!}{4!}$ ✓ answer (2)
9.3.3	$4\times7\times2-1=55$ OR $14\times4-1=55$	✓ $4\times7\times2$ ✓ answer (2)

TOTAL: 150