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GRADE 12

MATHEMATICS P2

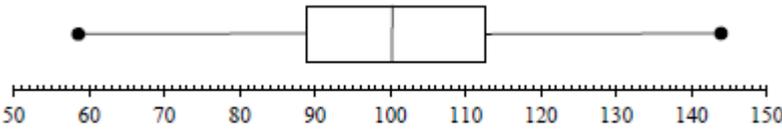
SEPTEMBER 2018

MARKS: 150

MARKING GUIDELINE

This marking guideline consists of 14 pages.

QUESTION 1

1.1	Lower quartile : $Q_1 = 89$ Upper quartile : $Q_3 = 113$	✓ 89 ✓ 113 (2)
1.2		✓ Min = 58 and max = 145 ✓ $Q_1 = 89$ and $Q_3 = 113$ ✓ $Q_2 = 100$ (3)
1.3	Symmetrical Marginally skewed to the right	accept both ✓ Answer (1)
1.4	Mean : $\bar{x} = \frac{1522}{15}$ $\bar{x} = 101,47$	✓✓ $\frac{1522}{15}$ (2)
1.5	Standard deviation : $\sigma = 19,07$	✓ $\sigma = 19,07$ (1)
1.6	$(\bar{x} - \sigma; \bar{x} + \sigma)$ $= (82,4; 120,54)$ 2 days	✓ 82,4 ✓ 120,54 ✓ 2 days (3)
		[12]

QUESTION 2

2.1	$r = -0,95$	✓ ✓ value of r (2)
2.2	There is a strong negative relationship.	✓ strong negative (1)
2.3	$a = 11,71323529$ $b = -1,11764$ $\hat{y} = 11,71 - 1,12x$	✓ $a = 11,71$ ✓ $b = -1,12$ ✓ correct equation (3)
2.4	$\hat{y} = 11,71 - 1,12(6)$ $\hat{y} = 4,99$ $\hat{y} \approx 5$ times OR $\hat{y} = 5,007$ $= 5$ times	✓ Substitution ✓ $y \approx 5$ times ✓ calculator ✓ $\hat{y} \approx 5$ times (2)
		[8]

QUESTION 3

3.1.1	$M_{EF} = M_{FG}$ $\frac{-1-3}{0-4} = \frac{1-(-1)}{t}$ $\frac{-4}{-4} = \frac{1+1}{t}$ $1 = \frac{2}{t}$ $t = 2$	✓ $M_{EF} = M_{FG}$ ✓ Substitution into the correct formula ✓ $1 = \frac{2}{t}$ ✓ Answer (4)
3.1.2	$M_{EF} \times M_{FG} = -1$ $1 \times \frac{2}{t} = -1$ $t = -2$	✓ $1 \times \frac{2}{t} = -1$ ✓ Answer (2)

3.2.1	$y = \frac{1}{2}x + 8$ $M_{QR} = M_{PS} = \frac{1}{2} \quad \text{QR//PS}$ $y - 5 = \frac{1}{2}(x - 4)$ $y = \frac{1}{2}x - 2 + 5$ $\therefore y = \frac{1}{2}x + 3$	<p>✓ rewrite equation of PR</p> <p>✓ $M_{PS} = \frac{1}{2}$</p> <p>✓ Substitute (4; 5) correctly</p> <p>✓ Equation (4)</p>
3.2.2	$0 = \frac{1}{2}x + 3$ $x = -6$ $\therefore S(-6; 0)$	<p>✓ $y = 0$</p> <p>✓ $S(-6; 0)$ (2)</p>
3.2.3	$M\left(\frac{2 + (-6)}{2}; \frac{6 + 0}{2}\right)$ $= M(-2; 3)$	<p>✓ $\frac{2 + (-6)}{2}$</p> <p>✓ $\frac{6 + 0}{2}$ (2)</p>
3.2.4	<p>Midpoint of QS = midpoint of PR (diagonals bisect)</p> $-2 = \frac{x + 4}{2}$ $x = -8$ $3 = \frac{y + 5}{2}$ $y = 1$ $\therefore R(-8; 1)$ <p>OR</p> $P \rightarrow Q : (x - 2; y + 1)$ $S \rightarrow R : (x - 2; y + 1)$ $\therefore R(-6 - 2; 0 + 1)$ $\therefore R(-8; 1)$	<p>✓ $-2 = \frac{x + 4}{2}$</p> <p>✓ $3 = \frac{y + 5}{2}$</p> <p>✓ $R(-8; 1)$ (3)</p> <p>✓ $\rightarrow R : (x - 2; y + 1)$</p> <p>✓✓ $\therefore R(-8; 1)$ (3)</p>
3.2.5	$m_{PS} = \frac{1}{2} \quad \text{PS // QR}$ $\tan \hat{O}SP = m_{PS} = \frac{1}{2}$ $\therefore \hat{O}SP = 26,57^\circ$ $m_{RS} = -\frac{1}{2}$ $R\hat{S}O = 180^\circ - 26,57^\circ$ $= 153,43^\circ$ $\therefore R\hat{S}P = 153,43^\circ - 26,57^\circ$ $= 126,86^\circ$	<p>✓ $\tan \hat{O}SP = m_{PS} = \frac{1}{2}$</p> <p>✓ $\hat{O}SP = 26,57^\circ$</p> <p>✓ $m_{RS} = -\frac{1}{2}$</p> <p>✓ $R\hat{S}O = 153,43^\circ$</p> <p>✓ $126,86^\circ$ (5)</p>

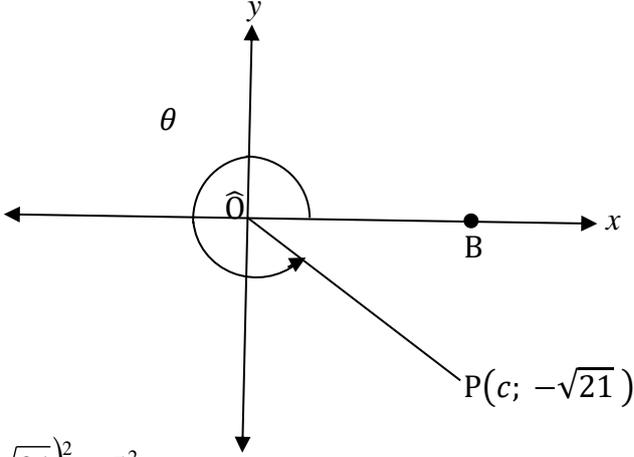
	[22]
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QUESTION 4

4.1	$M\left(\frac{-2+4}{2}; \frac{3+(-7)}{2}\right)$ $= M(1; -2)$ <p>\therefore centre of the circle is $(1; -2)$</p> $(x-1)^2 + (y-(-2))^2 = r^2$ $(-2-1)^2 + (3+2)^2 = r^2$ $9 + 25 = r^2$ $\therefore 34 = r^2$ $(x-1)^2 + (y+2)^2 = 34$	<ul style="list-style-type: none"> ✓ Subst. into the correct formula ✓ Centre of the circle ✓ Subst. $N(-2; 3)$ ✓ $34 = r^2$ ✓ Equa of the circle (5)
4.2	$M_{rad} = \frac{-2-3}{1-(-2)}$ $= \frac{-5}{3}$ $M_{tan} = \frac{3}{5} \qquad \text{radius} \perp \text{tangent}$ $y-3 = \frac{3}{5}(x-(-2))$ $\therefore y = \frac{3}{5}x + \frac{6}{5} + 3$ $= \frac{3}{5}x + \frac{21}{5}$	<ul style="list-style-type: none"> ✓ Subst. into the correct formula ✓ $M_{rad} = \frac{-5}{3}$ ✓ $M_{tan} = \frac{3}{5}$ ✓ Subst. $N(-2; 3)$ and gradient ✓ Equation (5)

<p>4.3</p>	<p>Let the angle of inclination of line NP be α and the angle adjacent to it be θ</p> $\tan \alpha = \frac{-5}{3}$ $\alpha = 180^\circ - \tan^{-1}\left(\frac{5}{3}\right)$ $\therefore \alpha = 180^\circ - 59,036243\dots^\circ$ $= 120,96^\circ$ $\theta = 59,04^\circ$ <p>OR</p> $\widehat{NPQ} = 180^\circ - (59,04^\circ + 90^\circ)$ $= 30,96^\circ$ <p>OR</p> $\widehat{NQP} = 90^\circ \quad \text{diameter subtends a right angle}$ $NQ = 6 \text{ and } PQ = 10$ $\therefore \tan \widehat{NPQ} = \frac{6}{10}$ $\therefore \widehat{NPQ} = 30,96^\circ$	$\checkmark \tan \alpha = -\frac{5}{3}$ $\checkmark \alpha = 120,96^\circ$ $\checkmark \theta = 59,04^\circ$ $\checkmark \widehat{NPQ} = 30,96^\circ \quad (4)$ $\checkmark \widehat{NQP} = 90^\circ$ $\checkmark NQ = 6 \text{ and } PQ = 10$ $\checkmark \tan \widehat{NPQ} = \frac{6}{10}$ $\checkmark \widehat{NPQ} = 30,96^\circ \quad (4)$
<p>4.4</p>	<p>QP = 10 units and NQ = 6 units</p> $\text{Area } \Delta NPQ = \frac{1}{2} (6)(10) \checkmark$ $= 30 \text{ square units}$ $\therefore \frac{\text{Area } \Delta NPQ}{\text{Area of circle}} = \frac{30 \checkmark}{34\pi \checkmark}$ $= 0,28 \checkmark$	<p>(4)</p>
<p>[17]</p>		

QUESTION 5

<p>5.1.1</p>	<p>Reflex $\widehat{BOP} = \theta$</p>  <p> $c^2 + (\sqrt{21})^2 = 5^2$ $c^2 = 25 - 21$ $c^2 = 4$ $\therefore c = 2$ </p>	<p>✓ subst into pyth</p> <p>✓ Answer</p> <p>(2)</p>
<p>5.1.2</p>	<p>a) $\cos \theta = \frac{2}{5}$</p>	<p>✓ Answer</p> <p>(1)</p>
	<p>b) $= \frac{-\sqrt{21}}{2} + \left(\frac{-\sqrt{21}}{5}\right)^2$ $= \frac{-25\sqrt{21} + 42}{50}$</p>	<p>✓ $\frac{\sqrt{21}}{2} + \left(\frac{\sqrt{21}}{5}\right)^2$ for corr subst</p> <p>✓ Answer</p> <p>(2)</p>
	<p>c) $2 \sin \theta \cos \theta$ $= 2 \left(\frac{-\sqrt{21}}{5}\right) \left(\frac{2}{5}\right)$ $= \frac{-4\sqrt{21}}{25}$</p>	<p>✓ Identity</p> <p>✓ Answer</p> <p>(2)</p>
<p>5.2</p>	<p>$\frac{(-\sin x) \cdot \tan x \cdot \cos(360^\circ - 30^\circ)}{(\sin x)^2}$ $= \frac{-\sin x \cdot \tan x (\cos 30^\circ)}{\sin^2 x}$ $= \frac{-\sqrt{3}}{2} \tan x \div \sin x$ $= \frac{-\sqrt{3} \sin x}{2 \cos x} \times \frac{1}{\sin x}$ $= \frac{-\sqrt{3}}{2 \cos x}$</p>	<p>✓ $-\sin x$ ✓ $(\sin x)^2$ ✓ $\cos 30^\circ$</p> <p>✓ $\frac{\sin x}{\cos x}$ ✓ answer</p> <p>(5)</p>
<p>[12]</p>		

QUESTION 6

<p>6.1</p>	$LHS = \frac{2 \sin^2 x}{2 \frac{\sin x}{\cos x} - 2 \sin x \cos x}$ $= \frac{2 \sin^2 x}{2 \sin x \left(\frac{1}{\cos x} - \cos x \right)}$ $= \frac{\sin x}{\frac{1 - \cos^2 x}{\cos x}}$ $= \sin x \times \frac{\cos x}{\sin^2 x}$ $= \frac{\cos x}{\sin x}$ <p>$\therefore LHS = RHS$</p>	<p>✓ $\frac{\sin x}{\cos x}$</p> <p>✓ $2 \sin x \cos x$</p> <p>✓ $2 \sin x \left(\frac{1}{\cos x} - \cos x \right)$</p> <p>✓ $\frac{\sin x}{\frac{1 - \cos^2 x}{\cos x}}$</p> <p>✓ $\sin^2 x$</p> <p>(5)</p>
<p>6.2</p>	<p>This identity will be undefined when</p> $2 + 2 \cos 2x = 0$ $\cos 2x = -1$ $\therefore 2x = 180^\circ + k \cdot 360^\circ \quad k \in \mathbb{Z}$ $x = 90^\circ + k \cdot 180^\circ$ <p>NB: Penalise 1 mark for leaving out $k \in \mathbb{Z}$</p> <p style="text-align: center;">OR</p> $2 + 2 \cos 2x = 0$ $1 + \cos 2x = 0$ $1 + 2 \cos^2 x - 1 = 0$ $\cos x = 0$ $\therefore x = 90^\circ$ $x = \pm 90^\circ + 360^\circ k; k \in \mathbb{Z}$	<p>✓ $\cos 2x = -1$</p> <p>✓ $2x = 180^\circ + k \cdot 360^\circ; k \in \mathbb{Z}$</p> <p>✓ $x = 90^\circ + k \cdot 180^\circ; k \in \mathbb{Z}$</p> <p>(4)</p> <p>✓ Identity</p> <p>✓ $\cos x = 0$</p> <p>✓ $\pm 90^\circ + k \cdot 360^\circ; k \in \mathbb{Z}$</p> <p>(4)</p>
<p>[9]</p>		

QUESTION 7

7.1	$D\hat{E}F = 180^\circ - \theta$ opp angle of cyclic quad	✓ Answer (1)
7.2	$DF = \sqrt{r^2 + r^2 - 2r^2 \cos(180^\circ - \theta)}$ $= \sqrt{2r^2 + 2r^2 \cos \theta}$ $= r\sqrt{2 + 2 \cos \theta} \quad \text{given}$	✓ correct sub into cosine rule ✓ simplification (2)
7.3	$D\hat{F}G = 90^\circ$ angl in semi circle In $\triangle DFG$: $\sin \theta = \frac{DF}{DG}$ $\sin \theta = \frac{r\sqrt{2 + 2 \cos \theta}}{2r}$ $(2 \sin \theta)^2 = (\sqrt{2 + 2 \cos \theta})^2$ $4 \sin^2 \theta = 2 + 2 \cos \theta$ $2 \sin^2 \theta = 1 + \cos \theta$	$\checkmark \sin \theta = \frac{r\sqrt{2 + 2 \cos \theta}}{2r}$ ✓ $4 \sin^2 \theta = 2 + 2 \cos \theta$ $\checkmark 2 \sin^2 \theta = 1 + \cos \theta$ (3)
7.4	$2(1 - \cos^2 \theta) = 1 + \cos \theta$ $2 - 2 \cos^2 \theta = 1 + \cos \theta$ $-2 \cos^2 \theta - \cos \theta + 1 = 0$ $2 \cos^2 \theta + \cos \theta - 1 = 0$ $(2 \cos \theta - 1)(\cos \theta + 1) = 0$ $\cos \theta = \frac{1}{2} \quad \text{or } \cos \theta \neq -1$ $\therefore \theta = 60^\circ \quad \theta \neq 180^\circ$	$\checkmark 2(1 - \cos^2 \theta) = 1 + \cos \theta$ ✓ standard form ✓ factors ✓ both equations $\checkmark \theta = 60^\circ$ (5)
		[11]

QUESTION 8

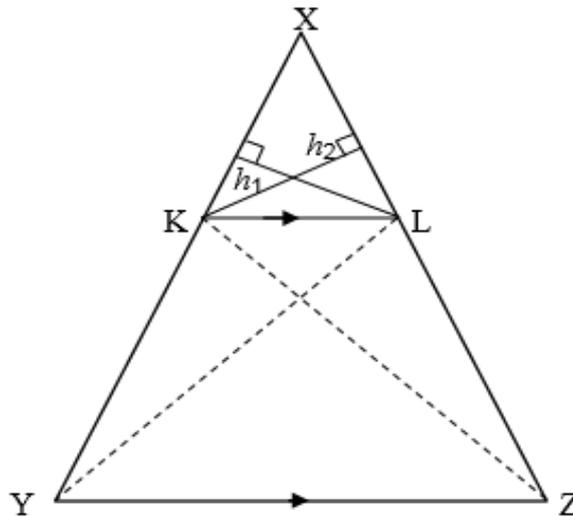
8.1	$a = 1$ $b = 2$ $c = 2$ $d = 1$	✓ $a = 1$ ✓ $b = 2$ ✓ $c = 2$ ✓ $d = 1$ (4)
8.2	$P(21,44^\circ; 0,73)$	✓ correct substitution (2)
8.3.1	$x = 90^\circ$	✓ 90° (1)
8.3.2	$x \in [45^\circ; 135^\circ]$ OR $45^\circ \leq x \leq 135^\circ$	✓ 45° and 135° ✓ Notation (2)
		[9]

QUESTION 9

9.1.1	$\hat{C} = \hat{A}_1 = 78^\circ$ alt \angle 's AP // CB	✓ R (1)
9.1.2	$\hat{A}\hat{B}\hat{C} = \hat{A}_1 = 78^\circ$ tan chord theorem	✓ S ✓ R (2)
9.1.3	$\hat{A}_3 = \hat{C} = 78^\circ$ tan chord theorem	✓ S (1)
9.1.4	$\hat{A}_1 + \hat{A}_2 + \hat{A}_3 = 180^\circ$ straight line $78^\circ + \hat{A}_2 + 18^\circ = 180^\circ$ $\hat{A}_2 = 24^\circ$	✓ S (1)

9.2.1	$\hat{Y}_1 = a$ $\hat{Y}_1 = Y\hat{X}P = a$ $Y\hat{X}P = \hat{Q} = a$ $\hat{Y}_2 = \hat{Q} = a$	tan chord theorem alt angle $XY \parallel QT$ = angles opp = <i>sides</i> angles in same circle segment	\checkmark S \checkmark R \checkmark \checkmark S \checkmark S \checkmark S \checkmark R \checkmark	(6)
9.2.2	$\hat{T}_2 = X\hat{Y}T$ $= \hat{Y}_1 + \hat{Y}_2$ $= \hat{T}_1 + \hat{T}_1$ $= 2\hat{T}_1$	alt angles; $XY \parallel QT$	\checkmark S/R \checkmark	(2)
9.2.3	$\hat{T}_2 + \hat{T}_1 = 90^\circ$ $\hat{T}_2 = 90^\circ - a$	angle in $\frac{1}{2}\odot$	S \checkmark R \checkmark	(2)
9.2.4	$\hat{T}_2 = 90^\circ - a$ But $Y\hat{O}Q = 2\hat{T}_2$ $= 2(90^\circ - a)$ $= 180^\circ - 2a$ $Q\hat{O}R = 180^\circ - 180^\circ + 2a$ $= 2a$ \therefore SORT is a cyclic quad ext angl = opp int angle OR $X\hat{Y}O = 90^\circ$ $X\hat{O}Y = 90^\circ - a$ $X\hat{O}Y = \hat{T}_2$ \therefore SORT is a cyclic quad/converse: ext. <s of cyclic quad OR $X\hat{O}Y = 2\hat{T}_1$ $X\hat{O}Y = \hat{T}_2$ \therefore SORT is a cyclic quad/converse: ext. < of cyclic quad	proven angle at centre = 2 angl on circle tan \perp radius sum of < s of Δ < at centre = 2 < at circum.	\checkmark S \checkmark R \checkmark S \checkmark R \checkmark S \checkmark R	(2)
9.2.5	$\hat{T}_1 + \hat{T}_2 = 90^\circ$ $a + 2a = 90^\circ$ $3a = 90^\circ$ $\therefore a = 30^\circ$		\checkmark S \checkmark answer	(2)
9.2.6	$X\hat{Y}O = 90^\circ$ $\hat{R}_2 = 90^\circ$ $\therefore TR = RQ$ chord	rad \perp tangent alt.angles; $XY \parallel TQ$ line from centre of circle \perp	\checkmark S \checkmark S \checkmark R	(3)
				[22]

QUESTION 10



<p>10.1.1</p>	<p>Const: Join KZ & LY & draw h_1 from $K \perp XL$ & h_2 from $L \perp XK$</p> <p>Proof</p> $\frac{\text{Area } \Delta XKL}{\text{Area } \Delta LYK} = \frac{\frac{1}{2}XK \times h_1}{\frac{1}{2}KY \times h_1} = \frac{XK}{KY}$ $\frac{\text{Area } \Delta XKL}{\text{Area } \Delta KLZ} = \frac{\frac{1}{2}XL \times h_2}{\frac{1}{2}LZ \times h_2} = \frac{XL}{LZ}$ <p>Area of $\Delta XKL = \text{Area } \Delta XKL$ common</p> <p>But Area $\Delta LKY = \text{Area } \Delta KLZ$ same base & height; LK // YZ</p> $\frac{\text{Area } \Delta XKL}{\text{Area } \Delta LYK} = \frac{\text{Area } \Delta XKL}{\text{Area } \Delta KLZ}$ $\therefore \frac{XK}{KY} = \frac{XL}{LZ}$	<p>✓ const</p> $\checkmark \frac{\text{Area } \Delta XKL}{\text{Area } \Delta LYK} = \frac{XK}{KY}$ $\checkmark \frac{\text{Area } \Delta XKL}{\text{Area } \Delta KLZ} = \frac{XL}{LZ}$ <p>✓ R</p> <p>✓ S</p> <p style="text-align: right;">(5)</p>
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10.2.1	$\frac{ED}{DC} = \frac{AT}{AC} = \frac{2}{3}$ <p style="text-align: center;">line // to one side of \triangle</p> $DE = \frac{2}{3} \times 9$ $= 6$ <p>$\therefore D$ is the midpoint of BE</p>	<p>✓ S ✓ R</p> <p>✓ DE = 6</p> <p style="text-align: right;">(3)</p>
10.2.2	<p>BF = FT line from midpt drawn // to 2nd side bisect 3rd</p> <p>FD = $\frac{1}{2}$TE midpoint theorem</p> <p>$\therefore TE = 4$</p>	<p>✓ S/R</p> <p>✓ R</p> <p>✓ TE = 4</p> <p style="text-align: right;">(3)</p>
10.2.3(a)	$\frac{\text{Area of } \triangle ADC}{\text{Area of } \triangle ABD}$ $= \frac{DC}{BD} \quad \text{same height}$ $= \frac{3y}{2y}$ $= \frac{3}{2}$	<p>✓ same height</p> <p>✓ $\frac{3}{2}$</p> <p style="text-align: right;">(2)</p>
10.2.3(b)	$\frac{\frac{1}{2} \times TC \times EC \times \sin C}{\frac{1}{2} \times AC \times BC \times \sin C}$ $= \frac{(x)(y)}{(3x)(5y)}$ $= \frac{1}{15}$	$\frac{\frac{1}{2} \times TC \times EC \times \sin C}{\frac{1}{2} \times AC \times BC \times \sin C}$ <p>✓ $\frac{(x)(y)}{(3x)(5y)}$</p> <p>✓ $\frac{1}{15}$</p> <p style="text-align: right;">(3)</p>
		[16]

QUESTION 11

11.1	<p>In $\triangle TPS$ and $\triangle QSR$</p> $\frac{PS}{QS} = \frac{1,5}{4} = \frac{3}{8}$ $\frac{TP}{SR} = \frac{4,5}{12} = \frac{3}{8}$ $\frac{TS}{QR} = \frac{3,6}{9,6} = \frac{3}{8}$ <p>$\therefore \triangle TPS \sim \triangle QSR$ sides of triangles in proportion</p> <p>$\therefore \hat{P} = \hat{Q}$ \triangles are equiangular</p> <p>$\therefore TP$ is a tangent converse of tan chord theorem</p>	$\checkmark \frac{PS}{QS} = \frac{1,5}{4}$ $\checkmark \frac{TP}{SR} = \frac{4,5}{12}$ $\checkmark \frac{TS}{QR} = \frac{3,6}{9,6}$ $\checkmark \checkmark S/R$ $\checkmark \hat{P} = \hat{Q}$ $\checkmark R$ <p style="text-align: right;">(7)</p>
11.2	<p>$\hat{P} = \hat{Q}$ \triangles are equiangular</p> <p>$QS \parallel TP$ corres. \angles are =</p> $\frac{TQ}{9,6} = \frac{1,5}{12}$ <p>$\therefore TQ = 1,2$</p>	$\checkmark S/R$ $\checkmark S/R$ $\checkmark \checkmark S/R$ $\checkmark TQ = 1,2$ <p style="text-align: right;">(5)</p>
		[12]

TOTAL: 150