education

Department:
Education
PROVINCE OF KWAZULU-NATAL

ENQUIRIES: MS A.P. MBATHA	DATE: 14 JUNE 2017

NATIONAL SENIOR CERTIFICATE: **COMMON TEST JUNE 2017: GRADE 12**

TO: THE CHIEF INVIGILATOR OF ALL SCHOOLS OFFERING MATHEMATICS P2

ERRATA

Please take note of the following change:

PAGE	NUMBER	ERROR	CORRECTION
6	4.2.4	show that the values of x for which $a\sin x = \tan bx$	show **algebraically** that the values of x for which $2\sin x = \tan \frac{1}{2}x$

Kindly ensure that candidates are informed of the Errata.

2017/06/14
DATE

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Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS P2

COMMON TEST

JUNE 2017

Marks: 125

Time: 2½ hours

N.B. This question paper consists of 10 pages, 3 diagram sheets, 1 information sheet and an answer book of 14 pages.

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INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 7 questions.

2. Answer ALL the questions.

3. Clearly show ALL calculations, diagrams, graphs, et cetera that you have used in determining your answers.

4. Answers only will not necessarily be awarded full marks.

5. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.

6. If necessary, answers should be rounded off to TWO decimal places, unless stated otherwise.

7. A diagram sheet for answering QUESTION 1.2, QUESTION 2, QUESTION 4.3, QUESTION 5, QUESTION 6 and QUESTION 7 is attached at the end of this question paper.
Write your name on these diagram sheets in the spaces provided and insert the diagram sheets inside the back cover of your ANSWER BOOK.

8. Diagrams are **NOT** necessarily drawn to scale.

9. An information sheet with formulae is included at the end of this question paper.

10. Number the answers correctly according to the numbering system used in this question paper.

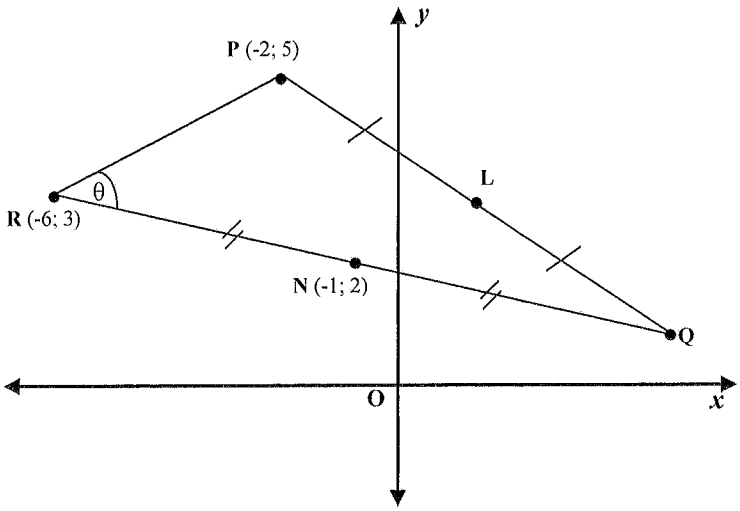
11. Write neatly and legibly.

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QUESTION 1

1.1 A (– 2 ; 4) , B (– 6 ; 2) and C (3 ; p) are points in the Cartesian plane.
Calculate the value of p if AB ⊥ AC (5)

1.2 In the diagram below, P (–2 ; 5) , R (– 6 ; 3) and Q are the vertices of Δ PRQ .
N (–1 ; 2) is the midpoint of RQ.



1.2.1 Calculate θ, rounded off to TWO decimal digits. (6)

1.2.2 Determine the equation of the line joining P and N. (4)

1.2.3 Calculate the coordinates of L, the midpoint of PQ. (5)

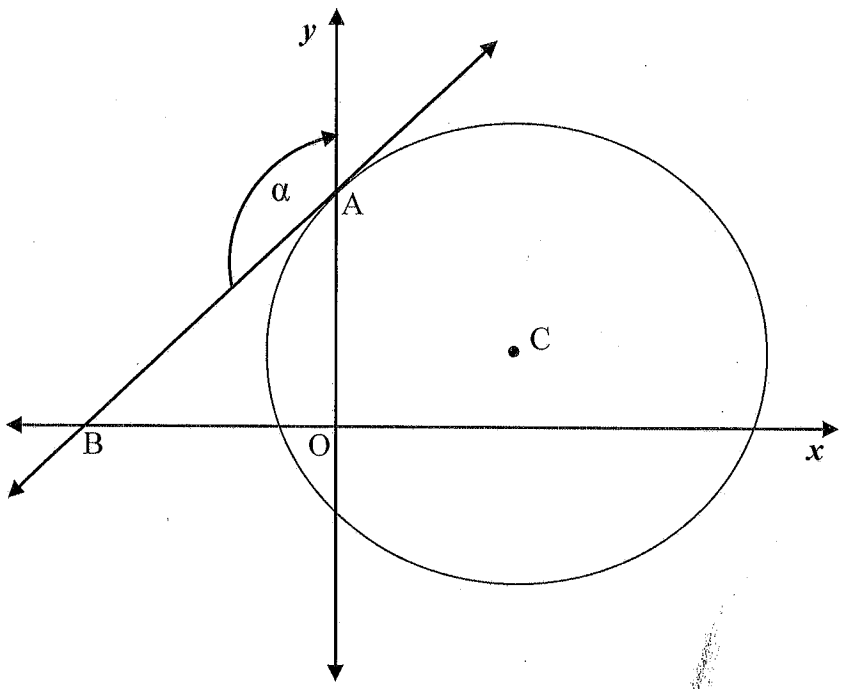
1.2.4 If RL cuts PN at A, calculate the coordinates of A. (3)

[23]

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QUESTION 2

In the diagram below, circle with centre C and with equation $x^2 - 6x + y^2 - 4y = 12$ cuts the y-axis at A. BA is a tangent to the circle. B lies on the x-axis. $B\hat{A}Y = \alpha$



Determine:

2.1 The coordinates of C. (5)

2.2 The coordinates of A. (4)

2.3 The equation of BA. (5)

2.4 The size of α, rounded off to ONE decimal digit. (3)

[17]

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QUESTION 3

3.1 If $\sin 161^\circ = t$, express the following in terms of t:

3.1.1 $\cos 19^\circ$ (3)

3.1.2 $\tan 71^\circ$ (3)

3.1.3 $\dfrac{1}{\cos\left(-341^\circ\right)}$ (2)

3.2 If $A + B = 90^\circ$ and $\tan A = 0{,}2$ then determine without the use of the calculator:

3.2.1 $\sin A$ (2)

3.2.2 $\cos(-180^\circ - B)$ (3)

3.3 Determine the maximum value of:

$8 - 10 \sin x \cos x$ (3)

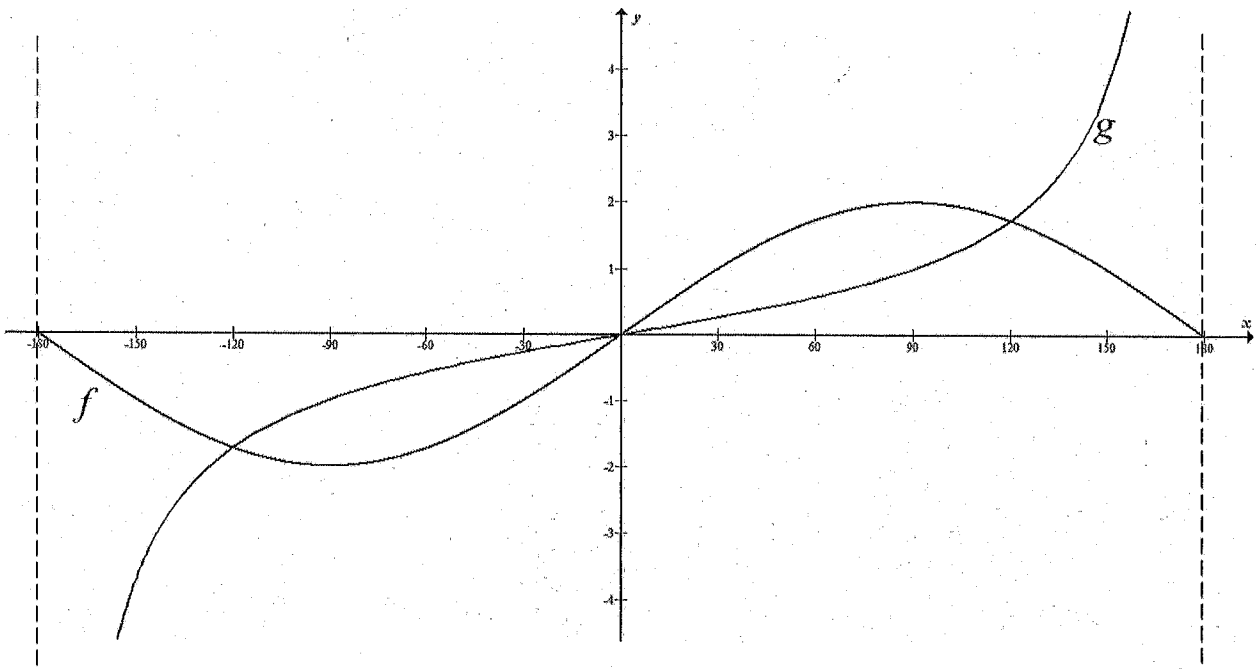
[16]

QUESTION 4

4.1 Simplify without using a calculator:

$$\sqrt[3]{\frac{-2\sin 225^\circ \cdot \cos 315^\circ}{\sin 120^\circ \cdot \tan 570^\circ \cdot \cos 300^\circ}} \quad (8)$$

4.2 The figure below, shows sketches of the functions $f = \{(x\,;y) / y = a \sin x\}$ and $g = \{(x\,;y) / y = \tan bx\}$



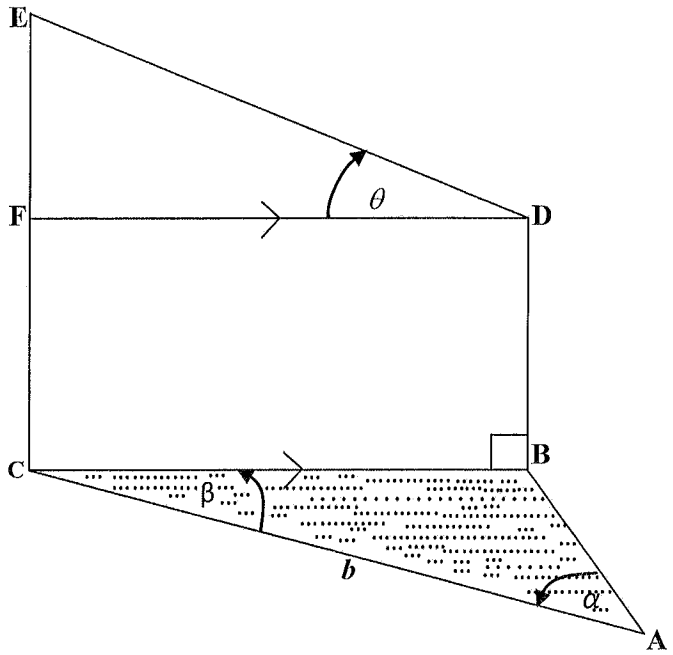
4.2.1 Determine the values of a and b. (2)

4.2.2 What is the period of f? (1)

4.2.3 What is period of g? (1)

4.2.4 If $x \in [-180^o\,;180^o]$, show that the values of x for which $a\sin x = \tan bx$ are $[-120^\circ; 0^0; 120^0]$. (8)

4.3 In the figure alongside, A, B and C are three points in the same horizontal plane. D is vertically above B and E is vertically above C. The angle of elevation of E from D is θ^0. F is a point on EC such that FD // CB. $B\hat{A}C = \alpha$, $A\hat{C}B = \beta$ and AC = b metres.



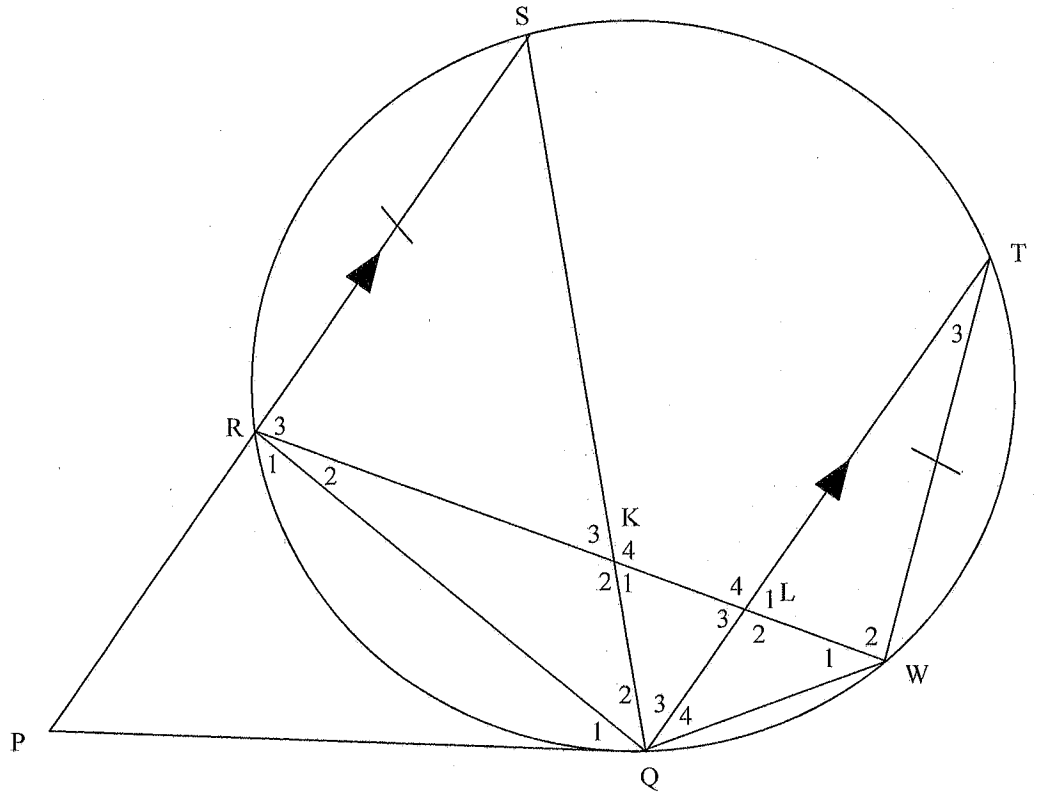
4.3.1 Express DE in terms of DF and θ (2)

4.3.2 Hence show that $DE = \dfrac{b \sin \alpha}{\sin(\alpha + \beta)\cos\theta}$ (5)

[27]

QUESTION 5

In the diagram below, PQ is a tangent at Q. PRS is a secant of circle RSTWQ. RW cuts SQ at K and QT at L. PS// QT and RS = TW.



Prove:

5.1 KQ is a tangent to circle LQW. (5)

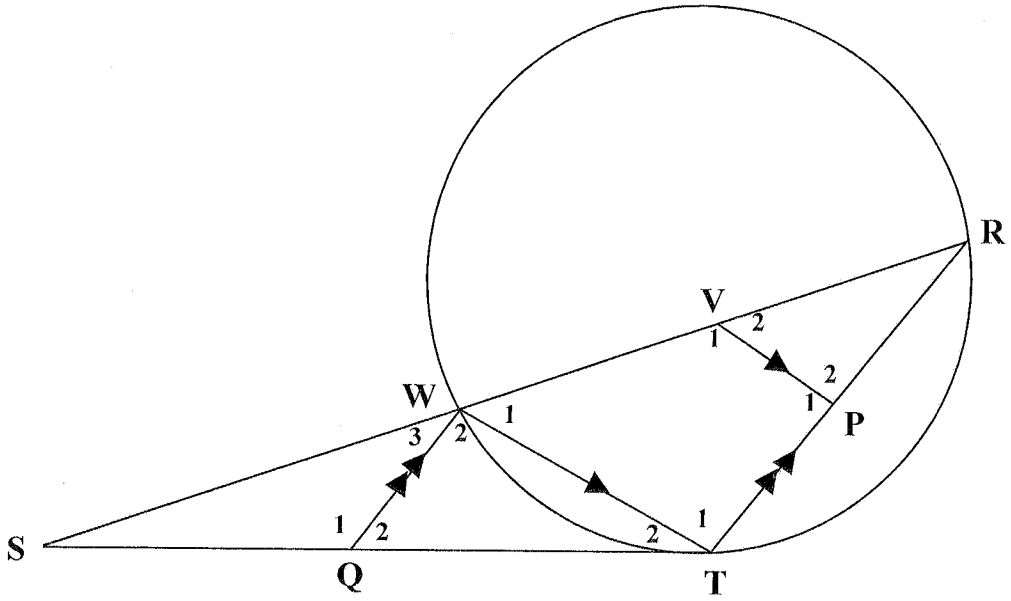
5.2 $\hat{R}_1 = \hat{L}_3$ (4)

5.3 PRKQ is a cyclic quadrilateral. (4)

[13]

QUESTION 6

In the diagram below, ST is a tangent to circle RWT at T. SWVR is a straight line. VP || WT with P on RT. WQ || RT with Q on ST.



6.1 Prove that $\Delta STW \text{ /// } \Delta SRT$. (4)

6.2 Hence, write ST^2 in terms of the sides of ΔSTW and ΔSRT. (2)

6.3 Hence, calculate the length of WR if ST = 6cm and SW = 4cm (4)

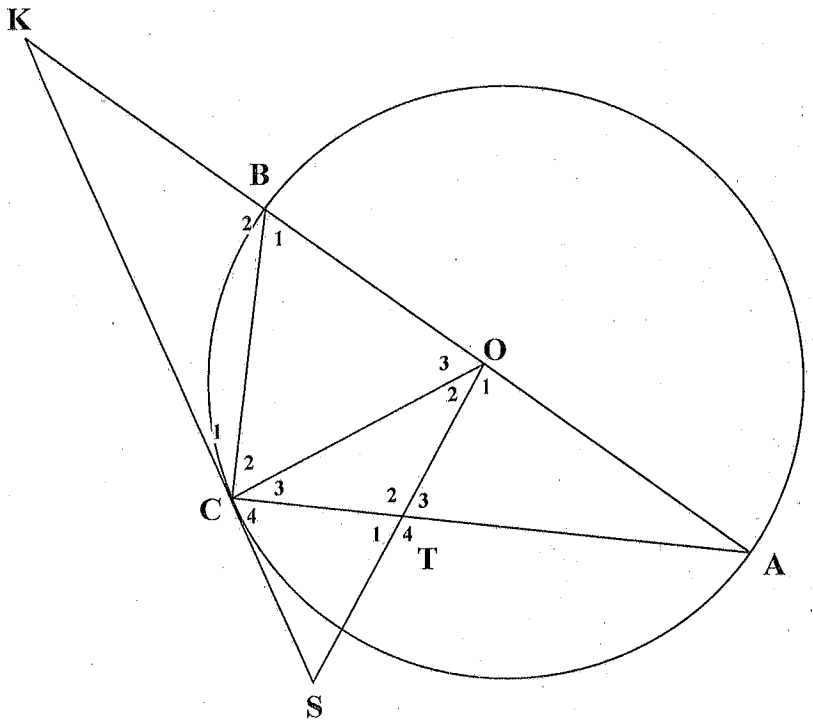
6.4 Name, without stating reasons, ONE other pair of similar triangles in the diagram. (2)

[12]

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QUESTION 7

In the diagram below, AB is the diameter of the circle with centre O. SK is a tangent to the circle at C. OS ⊥ AB.CA and OS intersect at T. KBOA is a straight line. Let $\hat{A} = x$



Prove that:

7.1 $K\hat{C}T = \hat{T}_2$ (6)

7.2 $\Delta CKB \text{ /// } \Delta AKC \text{ /// } \Delta COT$ (6)

7.3 $BK \cdot AK = \dfrac{OT^2 \cdot CA^2}{CT^2}$ (5)

[17]

TOTAL MARKS: [125]

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INFORMATION SHEET: MATHEMATICS
INLIGTINGSBLAD: WISKUNDE

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$A = P(1+ni) \qquad A = P(1-ni) \qquad A = P(1-i)^n \qquad A = P(1+i)^n$$

$$T_n = a + (n-1)d \qquad S_n = \frac{n}{2}\left(2a + (n-1)d\right)$$

$$T_n = ar^{n-1} \qquad S_n = \frac{a\left(r^n - 1\right)}{r-1} \; ; \quad r \neq 1 \qquad S_\infty = \frac{a}{1-r} \; ; \; -1 < r < 1$$

$$F = \frac{x\left[(1+i)^n - 1\right]}{i} \qquad P = \frac{x[1-(1+i)^{-n}]}{i}$$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \qquad \mathrm{M}\left(\frac{x_1 + x_2}{2}; \frac{y_1 + y_2}{2}\right)$$

$$y = mx + c \qquad y - y_1 = m(x - x_1) \qquad m = \frac{y_2 - y_1}{x_2 - x_1} \qquad m = \tan\theta$$

$$(x-a)^2 + (y-b)^2 = r^2$$

In ΔABC: $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$ $\qquad a^2 = b^2 + c^2 - 2bc.\cos A$ $\qquad area\ \Delta ABC = \dfrac{1}{2}ab.\sin C$

$$\sin(\alpha + \beta) = \sin\alpha.\cos\beta + \cos\alpha.\sin\beta \qquad \sin(\alpha - \beta) = \sin\alpha.\cos\beta - \cos\alpha.\sin\beta$$

$$\cos(\alpha + \beta) = \cos\alpha.\cos\beta - \sin\alpha.\sin\beta \qquad \cos(\alpha - \beta) = \cos\alpha.\cos\beta + \sin\alpha.\sin\beta$$

$$\cos 2\alpha = \begin{cases} \cos^2\alpha - \sin^2\alpha \\ 1 - 2\sin^2\alpha \\ 2\cos^2\alpha - 1 \end{cases} \qquad \sin 2\alpha = 2\sin\alpha.\cos\alpha$$

$$\bar{x} = \frac{\sum fx}{n} \qquad \sigma^2 = \frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}{n}$$

$$P(A) = \frac{n(A)}{n(S)} \qquad P\ (A\ or\ B) = P\ (A) + P\ (B) - P\ (A\ and\ B)$$

$$\hat{y} = a + bx \qquad b = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sum(x - \bar{x})^2}$$

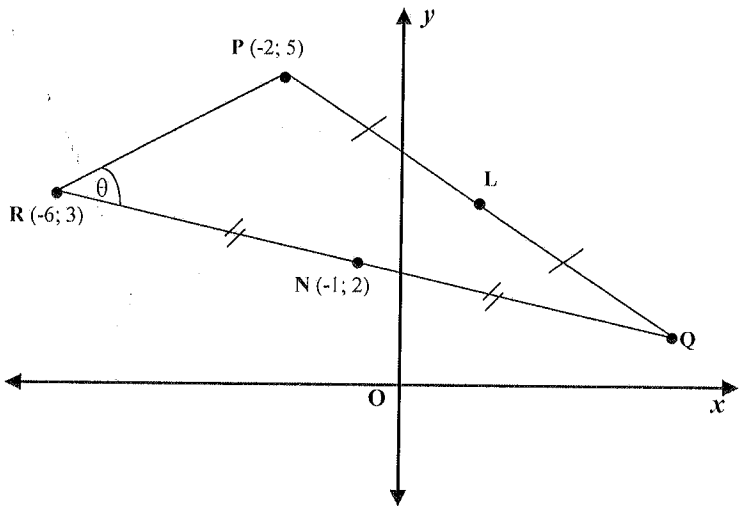
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PLEASE TEAR ON DOTTED LINES

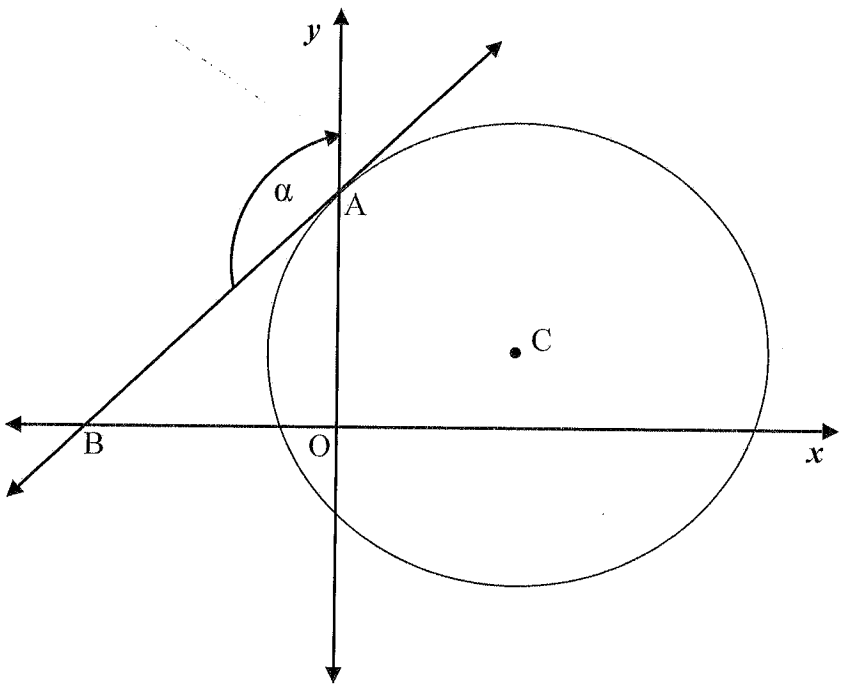
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DIAGRAM SHEET 1

QUESTION 1.2



QUESTION 2

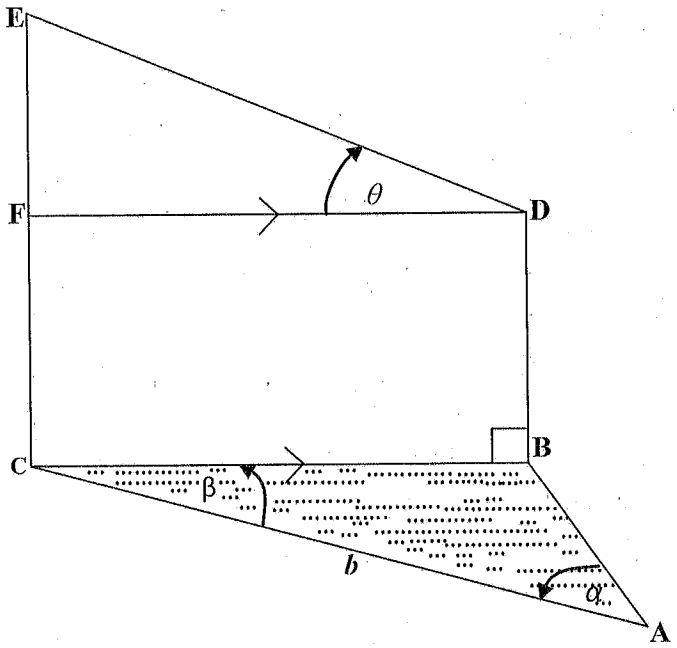


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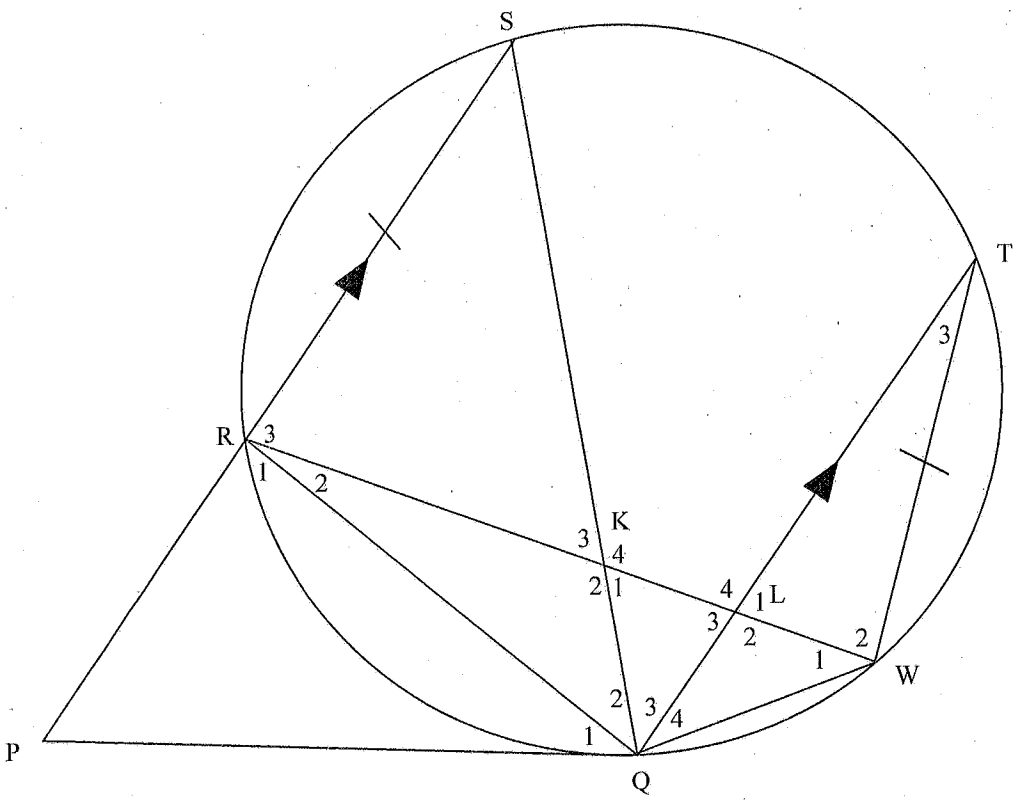
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DIAGRAM SHEET 2

QUESTION 4.3



QUESTION 5

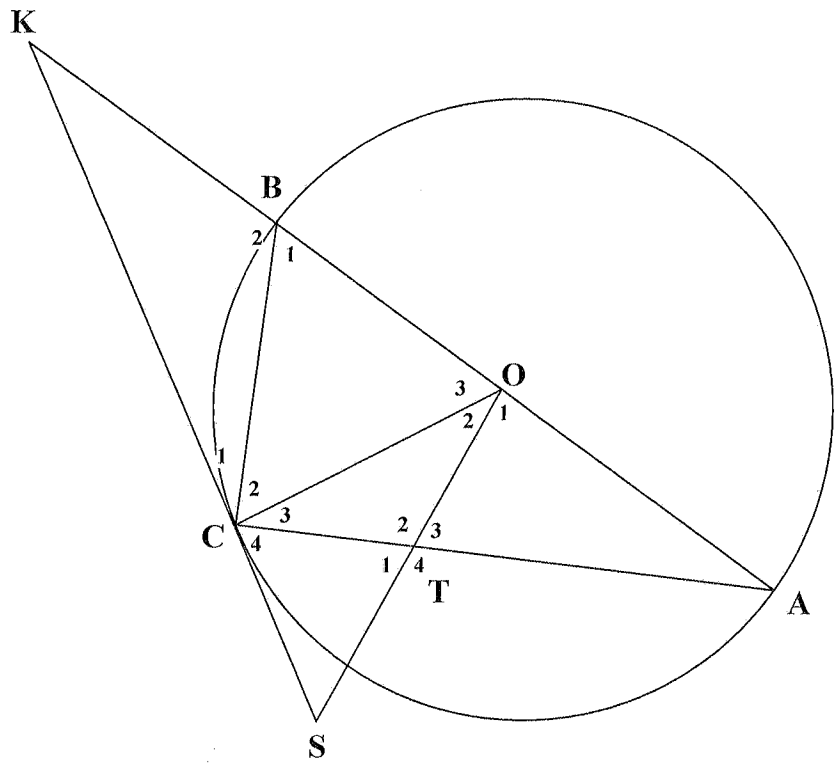


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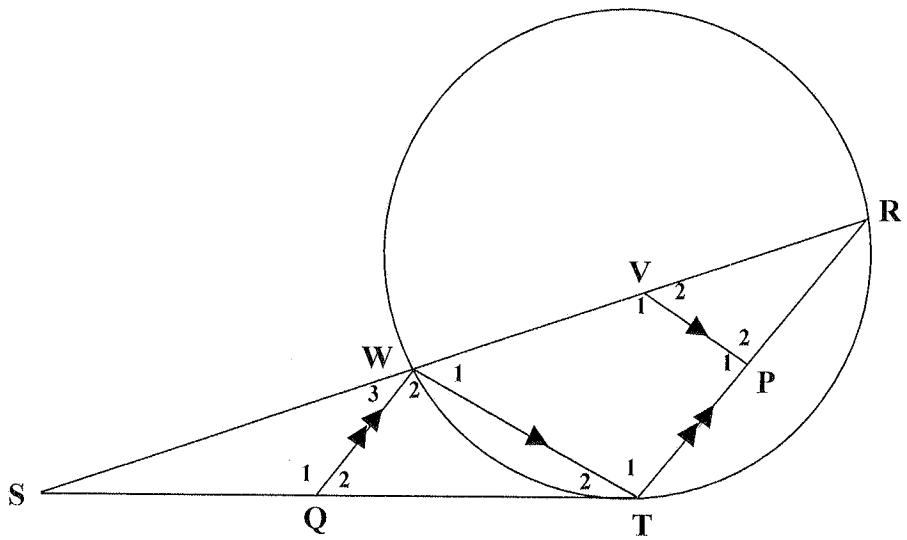
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DIAGRAM SHEET 3

QUESTION 6



QUESTION 7



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MATHEMATICS P2

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JUNE 2017

ANSWER BOOK

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GRADE 12

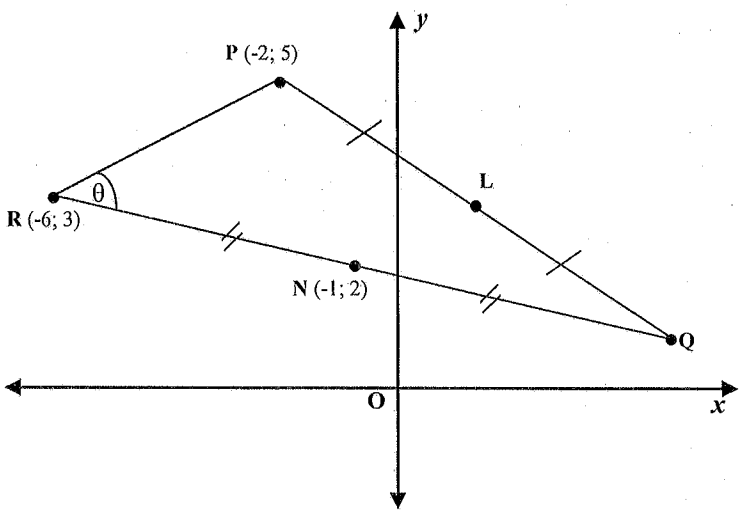
Marks: 125

Time: 2½ hours

N.B. This answer book consists of 14 pages.

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	Solution/*Oplossing*	**Marks/ *Punte***
1.1		(5)



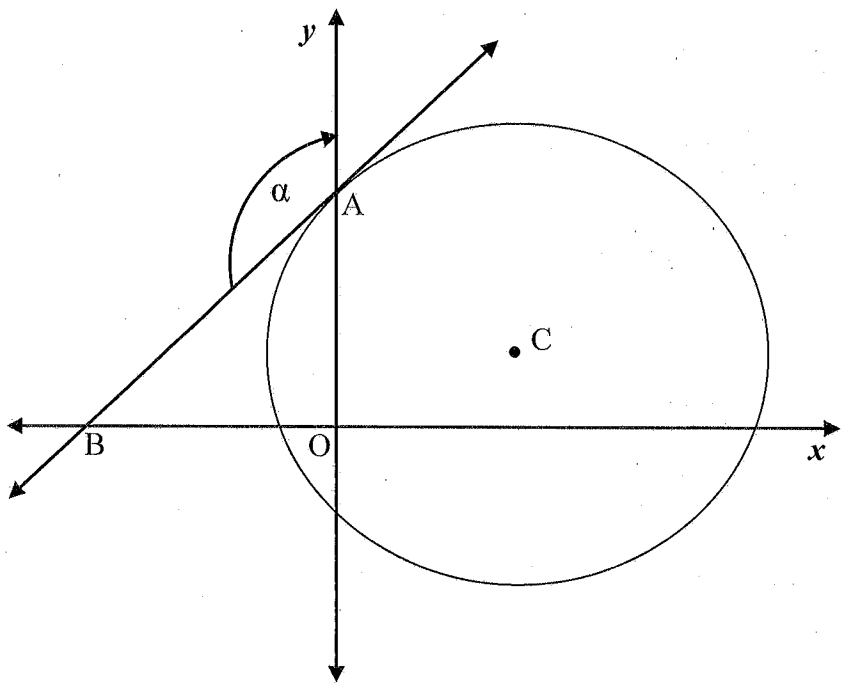
	Solution/*Oplossing*	**Marks/ *Punte***
1.2.1		

	Solution/*Oplossing*	**Marks/ *Punte***
1.2.1 **(contd)**		(6)
1.2.2		(4)
1.2.3		(5)

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	Solution/*Oplossing*	**Marks/ *Punte***
1.2.4		(3)
		[23]

QUESTION 2



	Solution/*Oplossing*	**Marks/ *Punte***
2.1		(5)

	Solution/*Oplossing*	**Marks/ *Punte***
2.2		(4)
2.3		(5)
2.4		(3)
		[17]

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QUESTION 3

	Solution/*Oplossing*	**Marks/ *Punte***
3.1.1		(3)
3.1.2		(3)
3.1.3		(2)
3.2.1		(2)

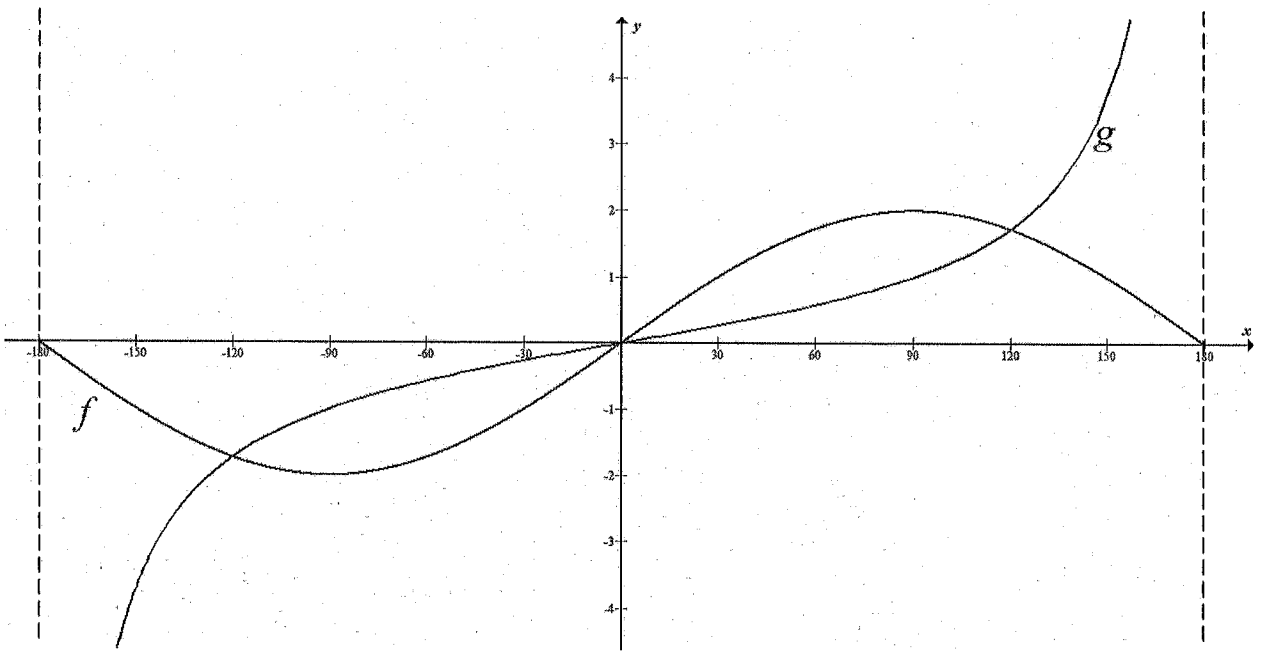
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	Solution/*Oplossing*	**Marks/ *Punte***
3.2.2		(3)
3.3		(3)
		[16]

QUESTION 4

	Solution/*Oplossing*	**Marks/ *Punte***
4.1		(8)

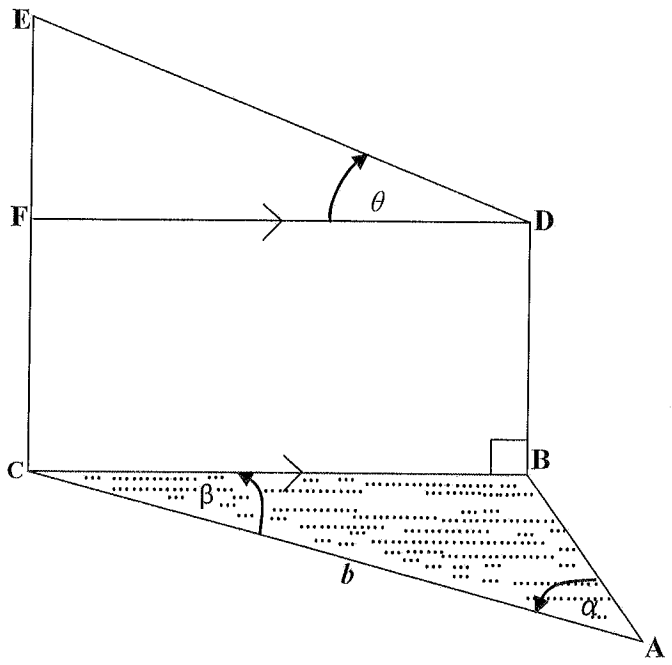
4.2



	Solution/*Oplossing*	Marks/ *Punte*
4.2.1		(2)
4.2.2		(1)
4.2.3		(1)
4.2.4		

	Solution/*Oplossing*	**Marks/ *Punte***
4.2.4 **(contd)**		(8)

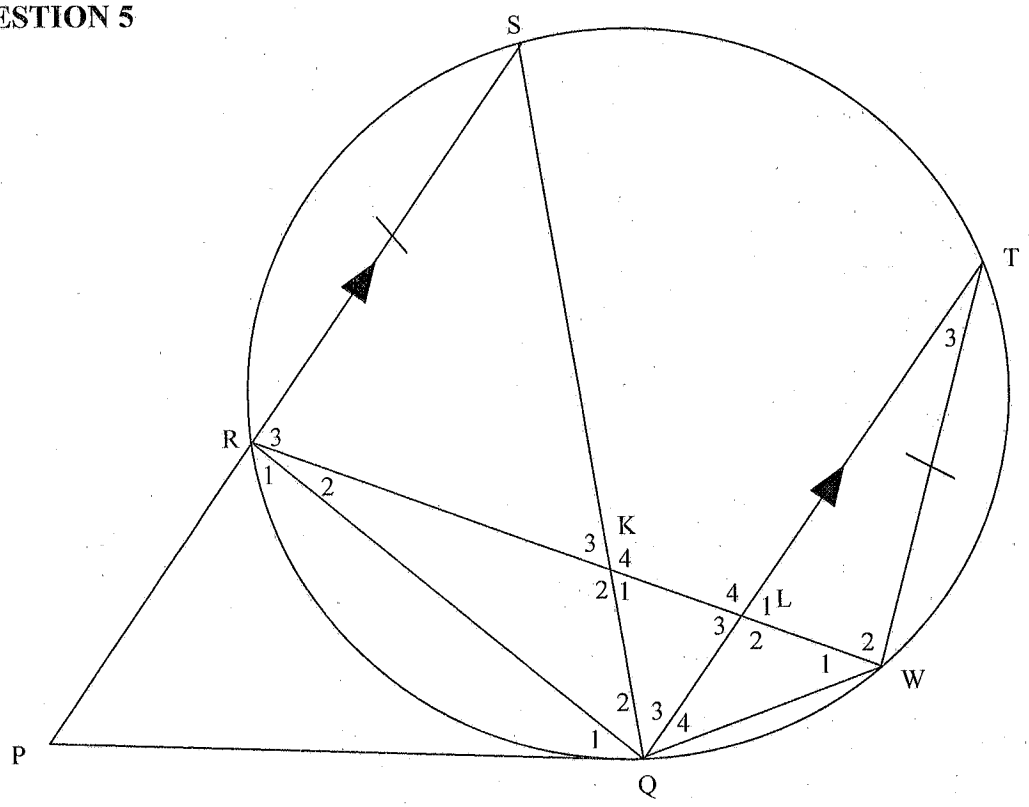
4.3



	Solution/*Oplossing*	**Marks/ *Punte***
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	Solution/*Oplossing*	Marks/ *Punte*
4.3.2		(5)
		[27]

QUESTION 5

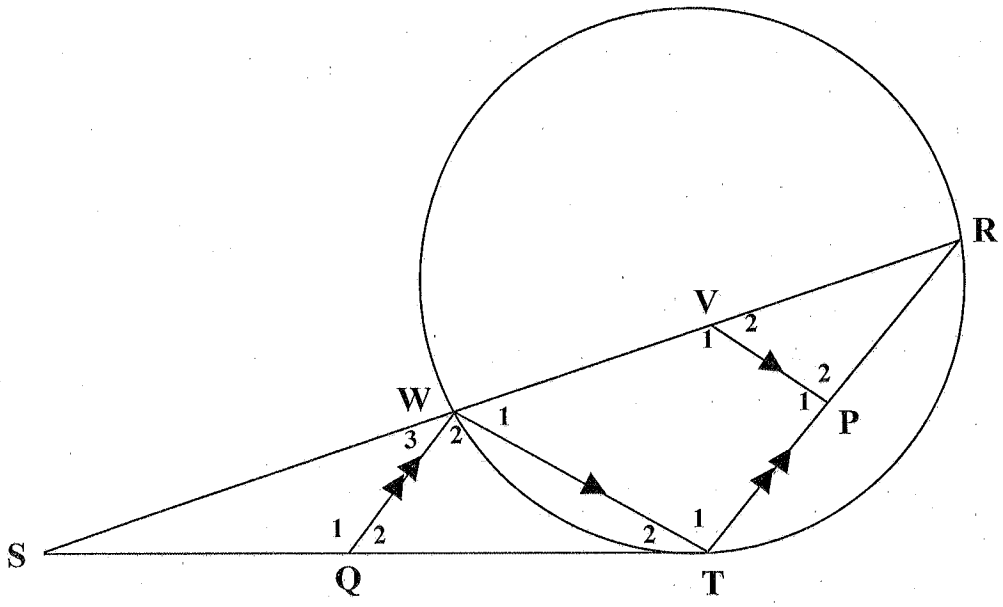


	Solution/*Oplossing*	Marks/ *Punte*
5.1		(5)

	Solution/*Oplossing*	**Marks/ *Punte***
5.2		(4)
5.3		(4)
		[13]

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QUESTION 6



	Solution/*Oplossing*	Marks/ *Punte*
6.1		(4)
6.2		(2)
6.3		(4)

	Solution/*Oplossing*	**Marks/ *Punte***
6.4		(2)
		[12]

QUESTION 7

	Solution/*Oplossing*	**Marks/ *Punte***
7.1		(6)
7.2		(6)

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	Solution/*Oplossing*	**Marks/ *Punte***
7.3		(5)
		[17]

TOTAL/*TOTAAL*: 125

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Grade 12 MATHS + M. LIT P2

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MATHEMATICS P2

JUNE 2017 – COMMON TEST

MEMORANDUM

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARKS: 125

This memorandum consists of 10 pages.

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QUESTION 1

1.1	$m_{AB} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2-4}{-6+2}$ $= \frac{1}{2}$ $m_{AC} = \frac{p-4}{3+2}$ $= \frac{p-4}{5}$ Now $m_{AB} \times m_{AC} = -1$ $\frac{1}{2}\left(\frac{p-4}{5}\right) = -1$ $p - 4 = -10$ $\therefore p = -6$	✓A correct substitution into formula ✓CA $\frac{1}{2}$ ✓A $\frac{p-4}{5}$ ✓CA substitution into $m_{AB} \times m_{AC} = -1$ ✓CA answer (5)
1.2.1	$PR = \sqrt{(x_1 - x_2)^2 + (y_2 - y_1)^2}$ $= \sqrt{(-2+6)^2 + (5-3)^2}$ $= \sqrt{20}$ $RN = \sqrt{(-6+1)^2 + (3-2)^2}$ $= \sqrt{26}$ $PN = \sqrt{(-2+1)^2 + (5-2)^2}$ $= \sqrt{10}$ In ΔPRN: $\cos R = \frac{PR^2 + RN^2 - PN^2}{2.PR \,.\, RN}$ $= \frac{(\sqrt{20})^2 + (\sqrt{26})^2 - (\sqrt{10})^2}{2(\sqrt{20})(\sqrt{26})}$ $= \frac{20 + 26 - 10}{45{,}607}$ $= 0{,}789$ $\hat{R} = \cos^{-1}(0{,}789)$ $\hat{R} = 37{,}87°$	✓A $\sqrt{20}$ ✓A $\sqrt{26}$ ✓A $\sqrt{10}$ ✓CA substitution into cosine rule ✓CA simplification ✓CA answer (6)

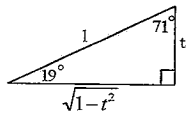
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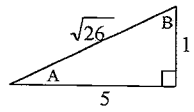
1.2.2	$m_{PN} = \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{2-5}{-1-(-2)}$ $= -3$ ∴ Equation of PN: $y - y_1 = m(x - x_1)$ $y - 2 = -3(x+1)$ OR $y - 5 = -3(x+2)$ $y = -3x - 1$	✓A substitution ✓CA value of m_{PN} ✓CA substitution of gradient and point ✓CA answer (4)
1.2.3	Let Q be the point $(x\,;y)$. $\frac{x-6}{2} = -1$ $\frac{y+3}{2} = 2$ $x = 4$ $y = 1$ ∴ Q is the point (4 ; 1). $L\left(\frac{x_1 + x_2}{2}\,;\frac{y_1 + y_2}{2}\right)$ $= L\left(\frac{4-2}{2}\,;\frac{1+5}{2}\right)$ $= L(1\,;3)$	✓A substitution into formula (for both coordinates) ✓CA $x = 4$ ✓CA $y = 1$ ✓CA substitution ✓CA answer (5)
1.2.4	Since R(–6; 3) and L (1; 3) have the same y – value, the equation of RL is $y = 3$ Subst. $y = 3$ into the equation of PN: $3 = -3x - 1$ $x = -\frac{4}{3}$ $\therefore A\left(-\frac{4}{3}\,;3\right)$	✓CA $y = 3$ ✓CA $-\frac{4}{3}$ ✓CA 3 (3) **[23]**

QUESTION 2

2.1	$x^2 - 6x + 3)^2 + y^2 - 4y + 2^2 = 25$ $(x-3)^2 + (y-2)^2 = 25$ $\therefore C(3\,;2)$	✓✓A A completing square ✓✓CA CA simplification & factorising ✓CA answer (provided positive values for x and y) (5)
2.2	A(0; y) is the y – intercept of the circle: $0^2 - 6(0) + y^2 - 4y - 12 = 0$ $(y-6)(y+2) = 0$ $\therefore y = 6$ only ∴ A(0; 6)	✓A substituting $x = 0$ ✓CA factorising ✓CA $y = 6$ ✓CA answer (4)
2.3	$m_{AC} = \frac{6-2}{0-3} = -\frac{4}{3}$ $\therefore m_{BA} = \frac{3}{4}$ (radius AC ⊥ tangent BA) Equation of BA: $y - 6 = \frac{3}{4}(x - 0)$ $y = \frac{3}{4}x + 6$	✓CA calculating m_{AC} ✓ CA calculating m_{BA} ✓ CA subst. into formula ✓✓CA CA answer (5)
2.4	$\tan A\hat{B}O = m_{BA} = \frac{3}{4}$ $A\hat{B}O = \tan^{-1}\left(\frac{3}{4}\right)$ $A\hat{B}O = 36.9°$ $\therefore \alpha = 90° + 36.9°$ $\alpha = 126.9°$	✓CA $\tan A\hat{B}O = m_{BA}$ ✓CA size of $A\hat{B}O$ ✓CA answer ($A\hat{B}O + 90°$) (2) **[17]**

QUESTION 3

3.1.1 $\sin 161° = t$ $\sin (180° - 19°) = t$ $\sin 19° = t$ $\cos 19° = \frac{\sqrt{1-t^2}}{1}$ $= \sqrt{1-t^2}$ 	✓A $\sin (180° - 19°)$ ✓A $\sin 19° = t$ ✓CA answer (3)
3.1.2 $\tan 71° = \frac{\sqrt{1-t^2}}{t}$ OR $\tan 71° = \tan (90° - 19°)$ $= \frac{\sin (90° - 19°)}{\cos (90° - 19°)}$ $= \frac{\cos 19°}{\sin 19°}$ $= \frac{1}{\tan 19°}$ $= \frac{1}{\frac{t}{\sqrt{1-t^2}}}$ $= \frac{\sqrt{1-t^2}}{t}$	✓CA CA CA answer (using sketch) OR ✓ A $\tan (90° - 19°)$ ✓ A $\frac{1}{\tan 19°}$ ✓ CA $\frac{\sqrt{1-t^2}}{t}$ (3)
3.1.3 $\frac{1}{\cos (-341°)} = \frac{1}{\cos (341°)}$ $= \frac{1}{\cos (360° - 19°)}$ $= \frac{1}{\cos 19°}$ $= \frac{1}{\sqrt{1-t^2}}$	✓ A $\cos (360° - 19°)$ ✓ CA answer (2)

3.2.1 $\sin A = \frac{1}{\sqrt{26}}$  Answer only: full marks	✓ A diagram (instead of using 1 and 5, could also use e.g. 2 and 10 or 0,2 and 1) ✓ CA answer $\frac{1}{\sqrt{26}}$ (or e.g. $\frac{2}{\sqrt{104}}$) (2)
3.2.2 $\cos (-180° - B)$ $= \cos [-(180° + B)]$ $= \cos (180° + B)$ $= -\cos B$ $= -\frac{1}{\sqrt{26}}$ OR $\cos (-180° - B)$ $= \cos [-(180° + B)]$ $= \cos (180° + B)$ $= -\cos B$ $= -\cos(90° - A)$ $= -\sin A$ $= -\frac{1}{\sqrt{26}}$ OR $\cos (-180° - B)$ $= \cos (-180° - B + 360°)$ $= \cos (180° - B)$ $= -\cos B$ $= -\frac{1}{\sqrt{26}}$	✓A simplification ✓A $-\cos B$ ✓CA answer $-\frac{1}{\sqrt{26}}$ (or e.g. $-\frac{2}{\sqrt{104}}$) OR ✓A simplification ✓A $-\cos B$ ✓CA answer OR ✓A simplification ✓A $-\cos B$ ✓CA answer (3)
3.3 $8 - 10 \sin x \cos x$ $= 8 - 5 (2 \sin x \cos x)$ $= 8 - 5 \sin 2x$ $= 8 +$ maximum value of $(-5 \sin 2x)$ $\therefore$ The maximum value is 13	✓A $5 \times 2 \sin x \cos x$ ✓A $5 \sin 2x$ ✓A answer (3) **[16]**

QUESTION 4

4.1	$\sqrt[3]{\dfrac{-2\sin 225^\circ \cdot \cos 315^\circ}{\sin 120^\circ \cdot \tan 570^\circ \cdot \cos 300^\circ}}$ $= \sqrt[3]{\dfrac{-2\left(-\sin 45^\circ\right)\cdot \cos 45^\circ}{\sin 60^\circ \cdot \tan 30^\circ \cdot \cos 60^\circ}}$ $= \sqrt[3]{\dfrac{-2\left(\dfrac{-1}{\sqrt{2}}\right)\cdot\dfrac{1}{\sqrt{2}}}{\dfrac{\sqrt{3}}{2}\cdot\dfrac{1}{\sqrt{3}}\cdot\left(\dfrac{1}{2}\right)}}$ $= \sqrt[3]{\dfrac{\frac{2}{2}}{\frac{1}{4}}}$ $= \sqrt[3]{4}$	✓A $-\sin 45^0$, ✓A $\cos 45^0$ ✓A $\sin 60^0$, ✓A $\tan 30^\circ$ ✓A $\cos 60^\circ$ ✓CA correct numerator values ✓CA correct denominator values ✓CA answer (8)
4.2.1	$a = 2$ $b = \dfrac{1}{2}$	✓A $a = 2$ (accept a value close to 2: e.g. 1,9 or 2,1) ✓A $b = \dfrac{1}{2}$ (2)
4.2.2	Period of f: 360°	✓A 360° (1)
4.2.3	Period of g: 360°	✓A 360° (1)

4.2.4	$2\sin x = \tan\dfrac{x}{2}$ $2\sin 2\left(\dfrac{x}{2}\right) = \dfrac{\sin\frac{x}{2}}{\cos\frac{x}{2}}$ $2\left[2\sin\dfrac{x}{2}\cdot\cos\dfrac{x}{2}\right] = \dfrac{\sin\frac{x}{2}}{\cos\frac{x}{2}}$ $4\sin\dfrac{x}{2}\cdot\cos^2\dfrac{x}{2} - \sin\dfrac{x}{2} = 0$ $\sin\dfrac{x}{2}\cdot\left[4\cos^2\dfrac{x}{2} - 1\right] = 0$ If $x \in [-180^\circ; 180^\circ]$, then $\dfrac{x}{2} \in [-90^\circ; 90^\circ]$: For $\sin\dfrac{x}{2} = 0$: $\dfrac{x}{2} = 0^\circ$ for $\dfrac{x}{2} \in [-90^\circ; 90^\circ]$ and $x = 0^\circ$ For $4\cos^2\dfrac{x}{2} - 1 = 0$: $\cos\dfrac{x}{2} = \pm\dfrac{1}{2}$ But $\cos\dfrac{x}{2} = +\dfrac{1}{2}$ only for $\dfrac{x}{2} \in [-90^\circ; 90^\circ]$ $\dfrac{x}{2} = -60^\circ; 60^\circ$ for $\dfrac{x}{2} \in [-90^\circ; 90^\circ]$ and $x = -120^\circ; 120^\circ$	✓A $\sin[2\left(\frac{x}{2}\right)]$ ✓A $\dfrac{\sin\frac{x}{2}}{\cos\frac{x}{2}}$ ✓A $2\sin\dfrac{x}{2}\cdot\cos\dfrac{x}{2}$ ✓A factorisation ✓A $\sin\dfrac{x}{2} = 0$ ✓A $\dfrac{x}{2} = 0^\circ$ ✓A $\cos\dfrac{x}{2} = \pm\dfrac{1}{2}$ ✓A $\dfrac{x}{2} = -60^\circ; 60^\circ$ (8)

4.3.1	$\cos\theta = \frac{DF}{DE}$ $\therefore DE = \frac{DF}{\cos\theta}$	✓A using $\cos\theta$ ✓A $\frac{DF}{\cos\theta}$ (2)
4.3.2	$\frac{AC}{\sin A\hat{B}C} = \frac{BC}{\sin \hat{A}}$ $\frac{b}{\sin[180° - (\alpha+\beta)]} = \frac{BC}{\sin\alpha}$ $\frac{b}{\sin(\alpha+\beta)} = \frac{BC}{\sin\alpha}$ $BC = \frac{b\sin\alpha}{\sin(\alpha+\beta)}$ but BC = DF $\therefore DF = \frac{b\sin\alpha}{\sin(\alpha+\beta)}$ But $DE = \frac{DF}{\cos\theta}$ $= \frac{b\sin\alpha}{\sin(\alpha+\beta)} \times \frac{1}{\cos\theta}$ $= \frac{b\sin\alpha}{\sin(\alpha+\beta)\cos\theta}$	✓A using sine rule ✓A substitution ✓A $\alpha+\beta$ ✓A BC subject of formula ✓A applying from 4.3.1 $DE = \frac{DF}{\cos\theta}$ (5) **[27]**

QUESTION 5

5.1	$\hat{Q}_1 = \hat{S} = W_1$ (tan-chord-theorem) $\hat{Q}_3 = \hat{S}$ .... (alt ∠'s; RS ∥ QT) $\therefore \hat{Q}_3 = \hat{W}_1$ i.e. KQ is a tangent to circle LQW (converse tan chord theorem)	✓S ✓R ✓S/R ✓S: $\hat{Q}_3 = \hat{W}_1$ ✓R (5)
5.2	$\hat{Q}_2 = \hat{Q}_4$ (subtended by equal chords RS and TW) $\hat{R}_1 = \hat{S} + \hat{Q}_2$ (ext ∠ of ΔRSG) $\hat{L}_3 = \hat{W}_1 + \hat{Q}_4$ (ext ∠ of ΔLWG) $\therefore \hat{R}_1 = \hat{L}_3$ ($\hat{S} = W_1$; $\hat{Q}_2 = \hat{Q}_4$)	✓S ✓R ✓S/R ✓S/R (4)
5.3	$\hat{R}_3 = \hat{Q}_3 + \hat{Q}_4$ ... (∠s in in same segment) $= \hat{Q}_1 + Q_2$ ... (proved that $\hat{Q}_1 = \hat{Q}_3$ and $\hat{Q}_2 = \hat{Q}_4$) ∴ PRKQ is cyclic (converse: ext ∠ of cyclic quad)	✓S ✓R ✓S ✓R (4) **[13]**

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QUESTION 6

6.1	In Δ STW and Δ SRT 1) $\hat{S} = \hat{S}$ (common) 2) $\hat{T}_2 = \hat{R}$ (tan chord theorem) 3) $S\hat{W}T = S\hat{T}R$ (remaining ∠s) ∴ Δ STW ||| Δ SRT (∠ ∠ ∠)	✓ S ✓ S/R ✓ S/R ✓ R (4)
6.2	$\frac{ST}{SR} = \frac{SW}{ST}$ (from similar triangles) $\therefore ST^2 = SW \cdot SR$	✓S/R ✓ $ST^2 = SW \cdot SR$ (2)
6.3	$ST^2 = SW.SR = SW(SW + WR)$ $6^2 = 4(4 + WR)$ $16 + 4WR = 36$ $4WR = 20$ $WR = 5$ cm	✓ (SW + WR) ✓ substitution of values ✓ simplification ✓ answer (4)
6.4	ΔRVP ||| ΔRWT or ΔSQW ||| ΔSTR	✓✓ for any correct pair (2) **[12]**

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QUESTION 7

7.1	$\hat{A} = \hat{C}_1 = x$ (tan chord theorem) $B\hat{C}A = 90°$ ($\angle$ in semi – circle) $K\hat{C}T = B\hat{C}A + \hat{C}_1$ $= 90° + x$ $\hat{T}_2 = \hat{O}_1 + \hat{A}$ (ext $\angle$ of ΔTOA) $= 90° + x$ $\therefore K\hat{C}T = \hat{T}_2$	✓S ✓R ✓S/R ✓ 90^0+x ✓S ✓R (6)
7.2	In Δ CKB and Δ AKC 1) $\hat{C}_1 = \hat{A}$ ... (proved in 7.1) 2) $\hat{K} = \hat{K}$ ... (common) 3) $\hat{B}_2 = A\hat{C}K$ ... (3^{rd} $\angle$ in Δ) $\therefore \Delta CKB \,|||\, \Delta AKC$ ($\angle\angle\angle$) In Δ COT and Δ AKC 1) $\hat{C}_3 = \hat{A}$ ($\angle s$ opp equal sides) 2) $\hat{T}_2 = A\hat{C}K$ (proved in 7.1) 3) $\hat{O}_2 = \hat{K}$ (3^{rd} $\angle$ in Δ) $\therefore \Delta$ COT ||| Δ ACK ($\angle\angle\angle$) $\therefore \Delta$ CKB ||| Δ AKC ||| Δ COT OR Similar to the above method: Prove Δ CKB ||| Δ COT. Prove Δ CKB ||| Δ AKC Then conclude that Δ CKB ||| Δ AKC ||| Δ COT	✓ S/R ✓ S ✓ R ✓ S/R ✓ S/R ✓R (6)
7.3	$\frac{AC}{CT} = \frac{CK}{TO}$ ($\Delta AKC \,|||\, \Delta COT$; from 7.2) $CK = \frac{AC.TO}{CT}$ $CK^2 = \frac{OT^2.CA^2}{CT^2}$ $\frac{CK}{AK} = \frac{KB}{CK}$ ($\Delta AKC \,|||\, \Delta CKB$; from 7.2) $\therefore CK^2 = BK.AK$ $\therefore BK.AK = \frac{OT^2.CA^2}{CT^2}$	✓ S ✓ making CK subject of formula ✓ squaring both sides ✓ $\frac{CK}{AK} = \frac{KB}{CK}$ ✓ $CK^2 = BK.AK$ (5) [17]

TOTAL MARKS: [125]

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