Province of the EASTERN CAPE EDUCATION

EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE
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REPUBLIC OF SOUTH AFRICA, Website: www.ecdoe.gov.za

2022 NSC CHIEF MARKER'S REPORT

SUBJECT	**MATHEMATICS**		
QUESTION PAPER	1	2 ✓	3
DURATION OF QUESTION PAPER	**3 HOURS**		
PROVINCE	**EASTERN CAPE**		
DATES OF MARKING	**07.12.2022 – 22.12.2022**		

SECTION 1: (General overview of Learner Performance in the question paper as a whole)

The class of 2022 has made us proud. They showed an increase of 5% in the raw marks.
Though we only had a 30.1% pass rate, we are pleased to say that 3 learners obtained full marks. It was clear whilst marking that the error in the paper caused panic and anxiety.
Many learners attempted all the questions but question 9 and 10 was answered poorly.
The learners who knew that there was something wrong with question 5.1 and did not answer question 5.1 will be disadvantaged. I trust that DBE will investigate and adjust the marks accordingly. Question 1 and question 3 were answered the best, followed by the introduction to grade 11 geometry, question 8. Learners also answered question 5, question 6 and question 7 poorly. According to our analysis, 39% of the paper was accessible to learners. We are also very please to announce that 3634 learners scored more than 50% for the paper and 220 learners scored above 80%.

Below is a summary of learner's performance according to the 7-point scale:
Level 1 = 33 455 = 69.9%
Level 2 = 6 944 = 14.5%
Level 3 = 3 833 = 8%
Level 4 = 1 941 = 4.1%
Level 5 = 1 030 = 2.2%
Level 6 = 443 = 0.9%
Level 7 = 220 = 0.5%

SECTION 2: Comment on candidates' performance in individual questions
(It is expected that a comment will be provided for each question on a separate sheet).

QUESTION 1

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

Question 1

Ques	1.1.1			1.1.2		1.2			1.3				1.4			1.5.1		1.5.2	
	0	1	2	0	1	0	1	2	0	1	2	3	0	1	2	0	1	0	1
%	18	29	53,7	33.1	66.9	57	32	11	30	4	5	59.8	37	3	60.5	88.7	11.3	89.9	10.1

The above table indicate that question 1.1.1, 1.1.2, 1.3 and 1.4 was answered very well and that **question 1.5, that we tabled as an unfair question** was answered very poorly. We can see that question 1.5.1, 88.7% of the candidates in the sample got 0 out of 1 and for question 1.5.2, 89,9% of the candidates got 0 out of 1.

Question 2

Ques	2.1		2.2		2.3			2.4			2.5		
	0	1	0	1	0	1	2	0	1	2	0	1	2
%	38	62.5	78.5	21.5	75.9	10	14	72.8	1	26	93.3	0	6.6

The above table indicate that question 2.1 was answered very well with 62.5% of candidates from the sample getting 1 out of 1. Questions 2.2, 2.3 and 2.4 were answered very poorly. In **question 2.5, that we also tabled as an unfair question**, we can see that 93,3% of candidates got 0 out of 2.
Having two unfair questions in the first two questions of the paper is disappointing. Generally, learners would expect only level 1 and level 2 questions in these sections, i.e. grade 11 and 12 statistics.

Question 3

Ques	3.1.1			3.1.2			3.1.3			3.1.4			3.2			
	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	3
%	10.2	4	86.2	26.5	30	43.3	13.3	7.2	79.4	42.6	14	43.3	23	14	9.95	52.7

Ques	3.3.1					3.3.2					
	0	1	2	3	4	0	1	2	3	4	5
%	70.1	6	9.9	3.3	11.1	87.3	6.6	1.4	0.5	0.9	3.1

Question 3.1.1, 3.1.3 and 3.2 was answered very well. 86.15%, 79.4% and 52.7% of learners getting full marks on each respective question. Question 3.1.4 and question 3.3 was answered poorly.

Question 4

Ques	4.1			4.2.1				4.2.2					
	0	1	2	0	1	2	3	0	1	2	3	4	5
%	53	7.3	39.3	36.5	21	9.7	33	41.7	2.8	14	5	6	30.7

Ques	4.3					4.4.1			4.4.2				
	0	1	2	3	4	0	1	2	0	1	2	3	4
%	92.7	4	1.5	1	1.3	98.8	0.3	0.9	93.2	1	2.6	1	2.2

Question 4 was not answered very well as we can see from the table above. 92,7%, 98.8% and 93.2% of candidates got 0 marks for question 4.3, 4.4.1 and 4.4.2.
Most learners attempted question 4 but as we can see from the table above, not even question 4.1 and question 4.2 was answered satisfactorily.

Question 5

Ques	5.2						5.3						
	0	1	2	3	4	5	0	1	2	3	4	5	6
%	30	15.1	18.1	17.9	7	11.9	69.2	6	6.1	5.9	5.1	3.8	4

Ques	5.4.1					5.4.2				5.5.1					5.5.2	
	0	1	2	3	4	0	1	2	3	0	1	2	3	4	0	1
%	55.7	27.5	11.3	2	3.5	90.7	3.5	2.2	3.6	88.2	4.9	2.8	2.8	1.4	99.7	0.3

Question 5.1 was eliminated from the question paper for marking as it contained an error. This sub question was worth 7 marks and it caused panic and anxiety amongst learners. It was supposed to be a level 1 question and most learners would have gotten a good mark for this question. The table shows that question 5.2, 5.3, 5.4 and question 5.5 was answered very poorly with 30.1%, 69,2%, 55.7%, 90.7% and 88.2% and 99.7% of learners getting 0 marks for each respective sub question.

Question 6

Ques	6.1		6.2.1		6.2.2		6.3			6.4			6.5			
	0	1	0	1	0	1	0	1	2	0	1	2	0	1	2	3
%	62	38.1	69.3	30.7	86.1	13.9	88.1	5	6.7	99	0	0.8	98	1	1	0

The whole of question 6 was answered very poorly. Question 6.4 and 6.5 were the only two higher order questions. The table shows that 99% and 98.% of candidates scored 0 marks for these two questions. Questions 6.1 – 6.3 were level 1 questions, attempted by all learners and answered below average.

Question 7

Ques	7.1			7.2						7.3			
	0	1	2	0	1	2	3	4	5	0	1	2	3
%	64.9	13	21.8	88.7	3.7	3.3	0.7	1.5	2.1	89.9	2.9	1.5	5.7

The application to sin, cos and area rule was also answered very poorly. In question 7.1, 7.2 and 7.3, 64.9%, 88.7% and 89.9% of learners scored 0 marks for those respective questions.

Question 8

Ques	8.1.1			8.1.2			8.1.3			8.2.1		8.2.2						
	0	1	2	0	1	2	0	1	2	0	1	0	1	2	3	4	5	6
%	62	6.1	32.2	55.8	8.9	35.3	69.7	4.5	25.8	87.8	12.2	70.8	7.5	8.1	4.2	2.6	2.8	4

Question 8.1 was introduction to gr 11 geometry – level 1 work, yet, only 32.2% of candidates scored full marks. Question 8.2 was a mixture of the midpoint theorem and the proportionality theorem. Disappointingly, 87.8% and 70.8% of candidates scored 0 marks for question 8.2.1 and question 8.2.2.

Question 9

Ques	9.1						9.2.1						9.2.2				
	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4
%	32.3	12.4	26.8	17.5	8.4	2.6	86.1	2.4	6.9	1.3	2.2	1	91.4	1.2	4.5	0.9	2

Question 9.1 was attempted by all learners but answered poorly. In question 9.2.1 and 9.2.2, 86.1% and 91.4% of learners scored 0 marks. We identified **question 9.2.1 as an unfair question** because relevant part of the diagram was too small. Learners could not identify (see) the angles in the same segment that are supposed to be equal. For teachers it might be obvious to notice the angles in the same segment, but the majority of the learners could not identify
$O\hat{T}G = G\hat{B}O = 90°$ because the line OB obstructed their view. It is a fact that $O\hat{T}G$ and $B\hat{T}G$ were too small. The examiner could have enlarged the area around $\hat{T}$ and name the angles as $\hat{T}_1$, $\hat{T}_2$ and $\hat{T}_3$.
Because of the error in the paper, many learners could not finish the paper.

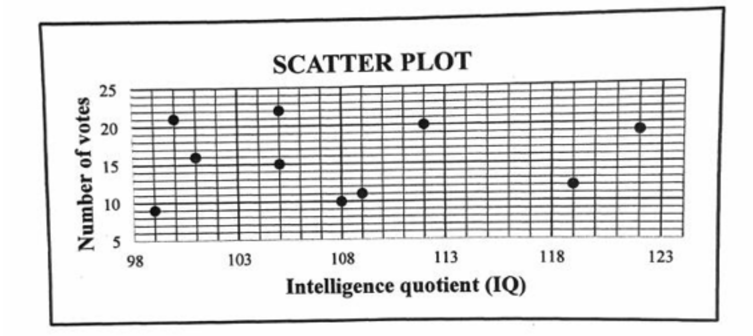
Question 10

Ques	10.1					10.2						10.3				
	0	1	2	3	4	0	1	2	3	4	5	0	1	2	3	4
%	85.5	10.6	2.8	0.1	1	86.8	6	4	1.3	1.1	0.9	97.7	2	0	0	0.3

All of question 10 was a higher order question. Many learners attempted question 10.1but did very poorly. 85.5%, 86.8% and 97.7% of candidates scored 0 marks for question 10.1, 10.2 and 10.3 respectively.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Question 1



Popularity score (x)	32	89	35	82	50	59	81	40	79	65
Number of votes (y)	9	22	10	21	11	15	20	12	19	16

1.1.1) **Calculate the mean number of votes that these 10 learners received.**
Many learners calculated the mean of the popularity score instead of the mean number of votes.

1.1.2) **Calculate the standard deviation of the number of votes.**
Many learners calculated the standard deviation of the popularity score instead of the standard deviation of the number of votes.

1.2) **The learners who received fewer votes than one standard deviation below the mean were not invited. How many learners were invited?**
Many learners knew that they had to subtract the standard deviation from the mean, but they did not know what to do after that. Some learners also worked out the mean number of votes but the standard deviation of the popularity score. If they mixed the two, we could not CA their answer. The table above shows that only 11% of candidates scored full marks for this question.

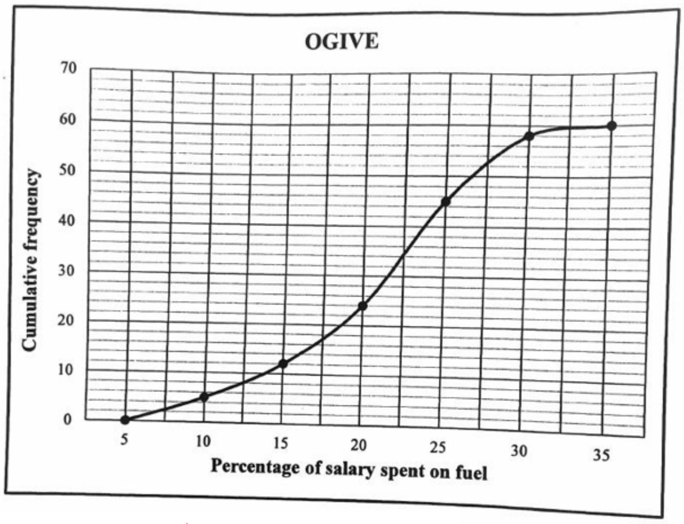
1.5) This was the first unfair question identified in the paper. **The learners were asked to use the scatter plot and the table above, to provide a reason why:**

1.5.1) **IQ is not a good indicator of the number of votes that a learner could receive**.
Many learners were not sure how to use both the scatter plot and the table. The question should have read in 1.5.1, Use the scatter plot only, to provide a reason . . .

1.5.2) **The prediction in QUESTION 1.4 is reliable.**
The question should have read in 1.5.2, Use the table only, to provide a reason . . .

Many teachers also felt that the scatter plot should have only been shown at the start of question 1.5

Question 2



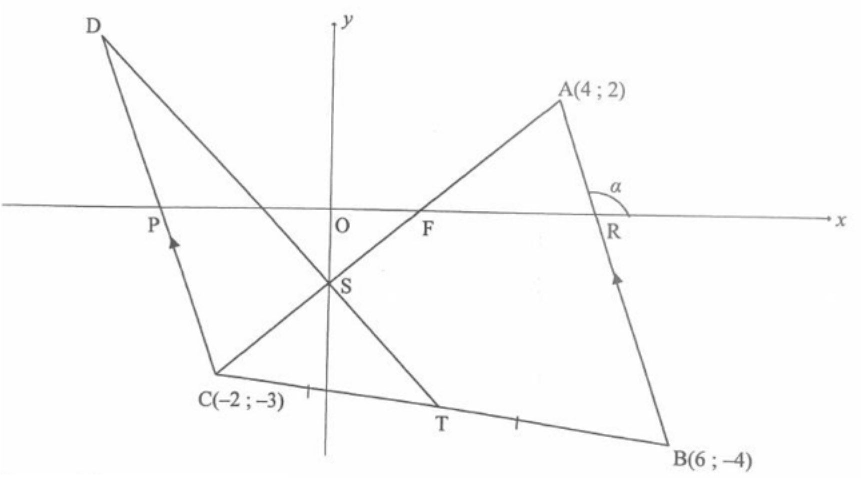
2.2) **Write down the modal class of the data.**
Many learners do not know the definition of the modal class and that is the reason why this question was answered so poorly. The interval o the ogive where the jump is the biggest, represents the modal class of the data.

2.3) **How many employees spent more than 22.5% of their monthly salary on fuel?**
The learners were supposed to draw a vertical dotted line from where $x = 22.5$, up until the ogive and then move towards the y axis. That answer must then be subtracted from 60. Some learners only got the value on the y axis but did not subtract it from 60.
As our results indicate, only 10% of learners in our sample scored 1 and only 14% scored 2 out of 2.

2.4) **An employee spent R 2400 of his salary on fuel in that particular month. Determine the monthly salary of this employee if he spends 7% of his salary on fuel.**
This was a simple level 1 question. Learners had to solve the equation
$0.07x = 2400 \therefore x = R\ 34\ 285.71$

2.5) This was our second unfair question identified in the paper.
The monthly salaries of these employees remain constant and the number of litres of fuel used in each month also remains constant. If the fuel price increases from R 21.43 per litre to R 22.79 per litre at the beginning of the next month, how will the above ogive change.
The ogive given was the percentage of salary spent on fuel against the cumulative frequency. Since we do not know what the employees' salaries are, it is very difficult to state what effect the increase in fuel price will have on the ogive.
Many learners calculated the percentage increase in the fuel price but did not know how that would affect the ogive.

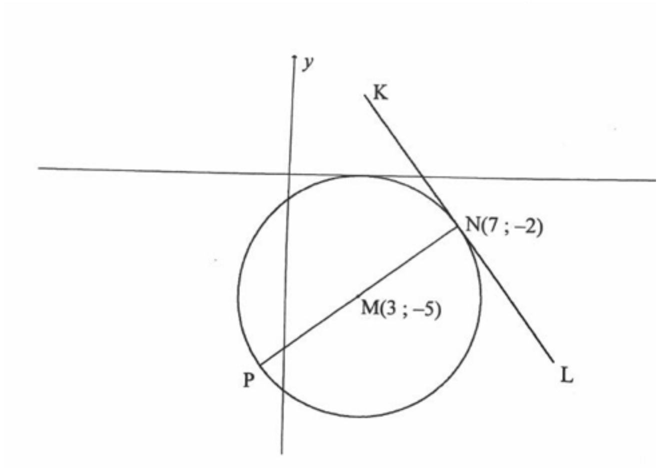
Question 3



3.1.4) **Determine the coordinates of S.**
The equation of AC was given as $5x - 6y = 8$ and S was the y – intercept.
To calculate the y – intercept of any graph, we make x = 0
That gave us the answer of S(0; $\frac{-4}{3}$). Was an easy level 1 question.
It is very disappointing that only 43.3% of candidates in our sample scored 2 out 2.

3.3.1) **Calculate the size of D$\hat{C}A$.**
There were many different ways to answer this question. The learners were expected to calculate the angle of inclination of lines AC and AB. Since their gradients were known, it was not difficult to calculate the angles of inclination. They would then have been able to calculate the size of $\hat{A}$ and then use alternate angles to get to D$\hat{C}A$. Only 11.1% of our candidates from our sample scored 4 out of 4.

3.3.2) **Calculate the area of POSC**.
This was definitely a higher order question. Learners are expected to know how to calculate the area of a right-angled triangle as well as the area of a non – right – angled triangle, using the area rule.
Learners do not know the properties of the different quadrilaterals. Some assumed that POSC was a trapezium and others even said that POSC is a parallelogram.

Question 4

Question 4.3 and 4.4 were both higher order questions – level 4. The word secant in 4.3 was not known to many learners and the integration with Calculus from paper 1 and analytical geometry in paper 2 was just too difficult for 99% of our learners. 4.3) For which value of k will $y = \frac{-4}{3}x + k$ be a secant to the circle? This was a higher order question and it was not aimed at learners getting level 1 and 2. Had learners known that the other tangent must be drawn at P for the line to be a secant, then learners would have known to substitute the coordinates of P into $y = \frac{-4}{3}x + k$ and solve for k. 4.4) Points A($t;t$) and B are not shown on the diagram. From point A, another tangent is drawn to touch the circle with centre M at B. 4.4.1) **Show that the length of tangent AB is given by $\sqrt{2t^2 + 4t + 9}$.** Learners had to visualize where the points A and B were to be and then use Pythagoras. $AB^2 = AM^2 - MB^2$ $= (3 - t)^2 + (-5 - t)^2 - 5^2$ 4.4.2) **Determine the minimum length of AB.** This was the most difficult question in the paper, definitely level 4. All that the learners were supposed to do was to find the value of t that will minimize the value of AB. There were four ways how they could have done it. Option 1: Use $t = \frac{-b}{2a}$ Option 2: found the derivative of $2t^2 + 4t + 9$ and make it = 0 Option 3: They could have completed the square Option 4: minimum value = $\frac{-\Delta}{4a}$

Question 5

In question 5.1, $\sin x = \frac{-3}{\sqrt{13}}$, where $x \in (0°; 90°)$, which makes the question unsolvable.
DBE has decided to withdraw the question and to use a conversion table.
The error in the paper really confused learners, caused panic and anxiety and the damage is unmeasurable. I trust that DBE will sympathise with learners when we recommend an upward adjustment of marks.

5.2) **Determine the value of the following expression**, *without using a calculator*.

$$\frac{\cos(90°+\theta)}{\sin(\theta-180°)+3\sin(-\theta)}$$

This was an easy level 2 question. It seems like learners do not understand reduction formulae and negative angles. Both these topics were taught in grade 11.

5.3) Determine the general solution of the following equation:
$(\cos x + 2\sin x)(3\sin 2x - 1) = 0$
69.2% of learners scored 0 marks.
The first mark was simply for making both brackets = 0. The general solution was also taught in grade 11. It would appear that learners did not go over their grade 11 work.

5.4) **Given the identity: $\cos(x+y) \times \cos(x-y) = 1 - \sin^2 x - \sin^2 y$**

5.4.1) **Prove the identity.**

Most learners attempted the question. The compound angles were given on the formula sheet. Learners had to multiply the compound angles out and use square identities to prove that LHS = RHS. Most of the learners had forgotten the square identity and could not prove that the LHS = RHS. Many learners also confuse $\sin^2 x$ with $\sin 2x$ and $\cos^2 x$ with $\cos 2x$.

5.4.2) **Hence, determine the value of $1 - \sin^2 45° - \sin^2 15°$, without the use of a calculator.**

Our table indicates that 90,7% of learners in the sample scored 0 marks.
This was another higher order question. Learners had to identify that $x = 45$ and $y = 15$.
Use the LHS as $\cos(45° + 15°) \times \cos(45° - 15°)$ and use special angles to simplify.
Most of the learners could not notice that. There are other alternate methods also to simplify the expression, without the use of a calculator.

5.5.) **Consider the expression: $16\sin x \cdot \cos^3 x - 8\sin x \cdot \cos x$**

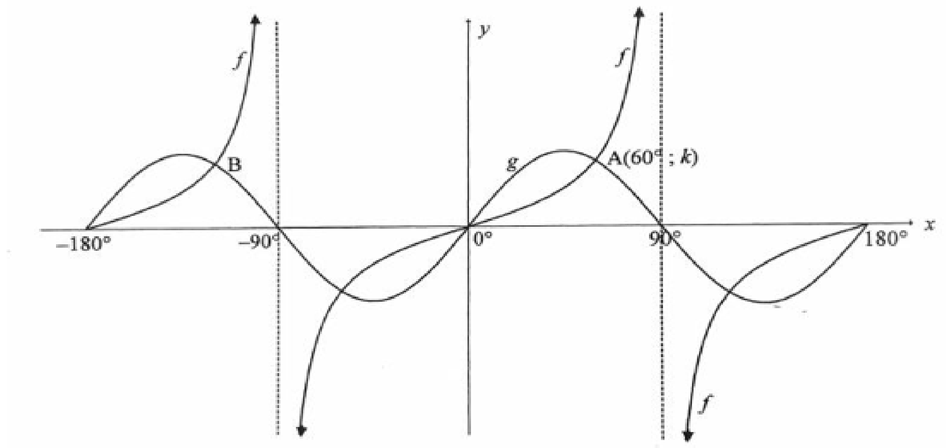
5.5.1) **Rewrite the expression as a single trigonometric ratio.**

This was another higher order question. Learners were supposed to take a common factor and then use double angles afterwards. Most learners could not factorise and that is why 88.2% scored 0 marks.

5.5.2) **For which value of x in the interval $x \in [0; 90]$ will $16\sin x \cdot \cos^3 x - 8\sin x \cdot \cos x$ have its minimum value.**

Definitely another level 4 question. Learners had to know at which x value the sin graph has a minimum value and then use their correct answer from 5.5.1 to calculate the value of x. Since most learners did not get any marks for 5.5.1, even more learners did not get any marks for question 5.5.2.
99.7% of the learners in our sample scored 0 marks.

Question 6



6.1 **Write down the period of g.**

The definition of the period of a trigonometric graph was done in grade 10 and in grade11. Learners do not know their definitions.

6.2 **Calculate the:**

6.2.1 **value of k**

To find the value of k, learners had to substitute 60° in either of the two equations.

Most learners did not do that.

6.2.2 **the coordinates of B.**

Learners were supposed to subtract 60° from 180° and make the answer negative. They then had to check their answer by substituting that number in either of the two equations to see if they get the same answer as that of the value of k.

6.3 **Write down the range of $2g(x)$.**

The range of a trigonometric graph is done in grade 10 and 11. It is clear that most learners are not studying their definitions. To get the range of $2g(x)$, we times the range of $g(x)$ by 2.

Question 6.1 – 6.3 are level 1 and 2 questions.

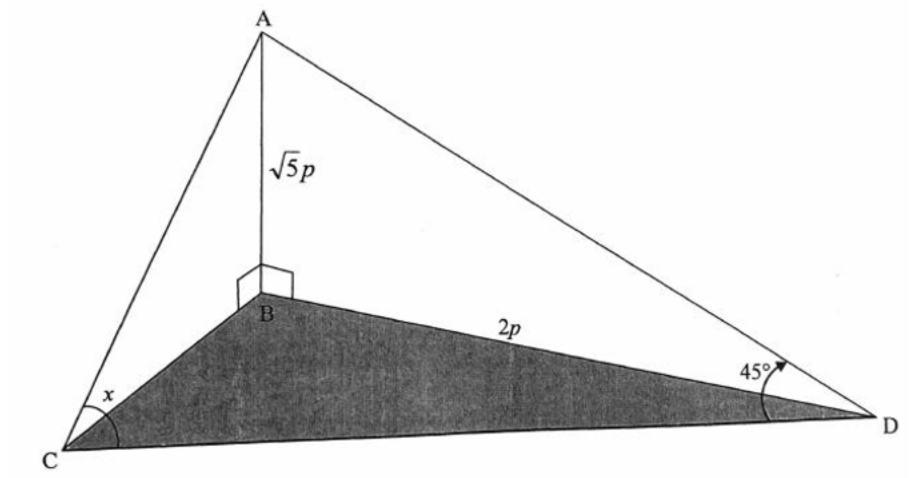
6.4 **For which value of x will $g(x+5) - f(x+5) \leq 0$, $x \in [-90° ; 0°]$**

Most learners did not know that $g(x+5)$ means that the graph of g shifts 5 to the left. So $g(x+5) \leq f(x+5)$ would be the same as $g(x) \leq f(x)$ shifted 5 units to the left.

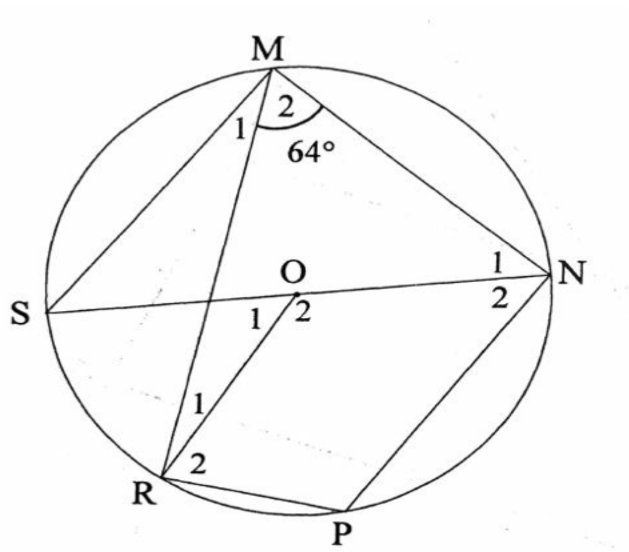
6.5 **Determine the values of p for which $\sin x \cdot \cos x = p$ will have exactly two real roots in the interval $x \in [-180° ; 180°]$**

Definitely a higher order question, not aimed at learners struggling to pass mathematics.

Our top performing learners in the province had to multiply both sides of the equation by 2 and then use their double angles. They also had to remember that for a trigonometric graph to be cut by a horizontal line twice only, the horizontal line must touch the sin $2x$ graph at its turning points, i.e., when the y values = 1 or – 1.

Question 7

7.1) **Determine the length of AD in terms of p.** Δ ABD is a right-angled triangle, so to calculate AD, the learners had to use Pythagoras. 7.2) **Show that the length of CD = $\frac{3p(\sin x + \cos x)}{\sqrt{2}.\sin x}$** In order to use the sin rule, we first had to calculate the size of $\hat{A}$ in terms of x. The sin rule can be applied if we have two angles and a side. 7.3) **If it is further given that p = 10 and x = 110°, calculate the area of Δ ADC.** Most learners do not know that we can only use the area rule if we have SAS. In order to calculate the area of Δ ADC, one method is to first calculate the length of AD and the length of CD. There are other methods also. 89.9% of learners scored 0 marks.

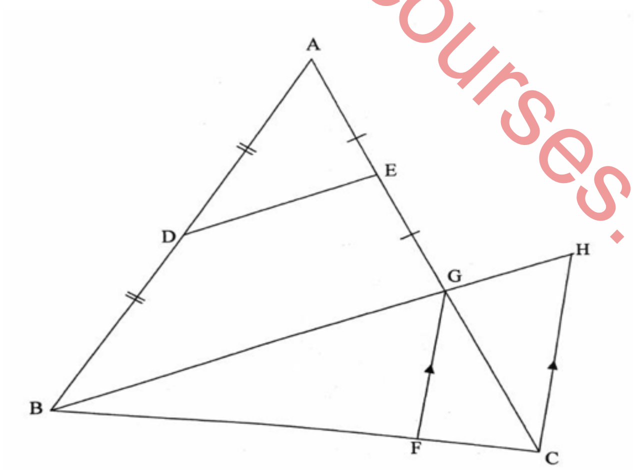
Question 8



8.1) Basic gr 11 geometry – level 1 work

Teachers should rather focus on level 1 and level 2 work only and all the theorems, instead of trying to teach level 3 and level 4 geometry to learners. With enough practice, learners can master level 1 and level 2 type of questions.

Question 8.2



8.2.1 **Give a reason why DE // BH.**

The midpoint theorem and the converse of the midpoint theorem is done in grade 10 and again in grade 12 in conjunction with the proportionality theorem.

Learners are not studying their theory and that is why they could not answer this question.

This is a level 1 question.

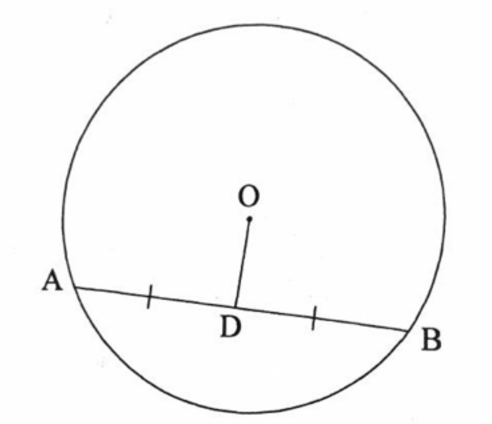
8.2.2) **If it is further given that $\frac{FC}{BF} = \frac{1}{4}$, DE = $3x - 1$ and GH = $x + 1$, calculate, giving reasons, the value of x.**

This is a higher order question that combines the midpoint theorem and the proportionality theorem. Many learners attempted this question and a lot of them actually got marks for this question. Only 70.8% of learners scored 0 marks.

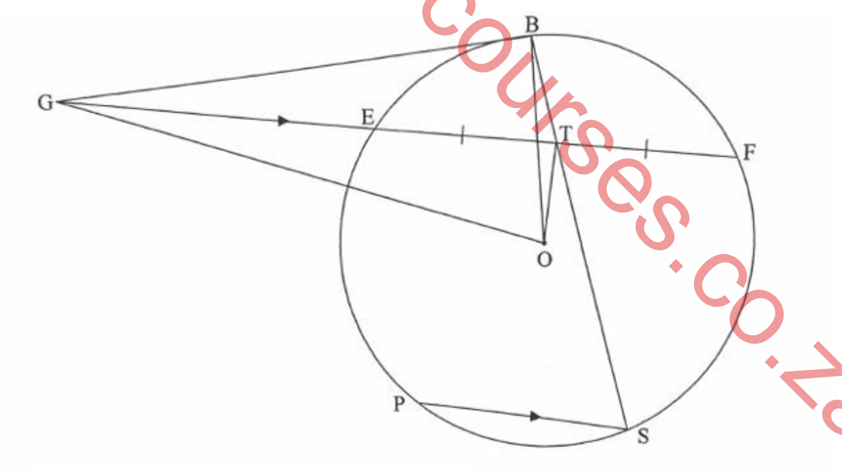
Some learners said that DE = 2 BG instead of BG = 2DE.

Those who said that DE = BG got $x = -5$. Learners should remember that when working the length of a line, the answer cannot have a negative value.

Question 9



9.1) Prove the theorem that states that the line from the centre of a circle that bisects a chord is perpendicular to the chord, i.e. OD $\perp$ AB.
Many learners did not study this theorem for the exams. Only 2.63% of learners in the sample scored full marks. The construction must be made and the arguments/statements must follow logically with the necessary acceptable reasons according to examination guidelines. A few learners confused the congruent symbol with the similarity symbol.



9.2) **Prove, giving reasons, that:**

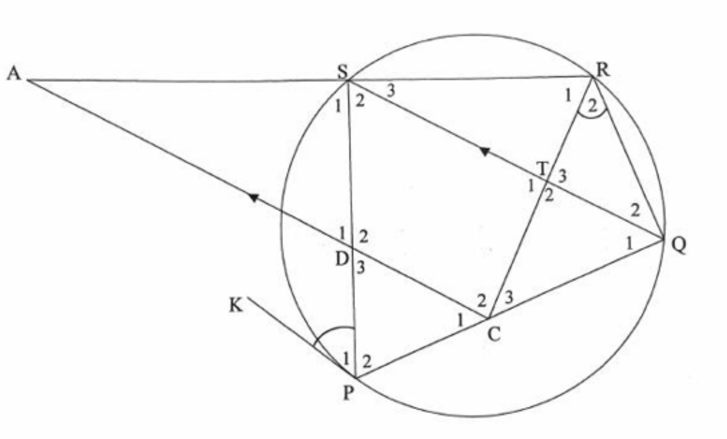
9.2.1) **OTBG is a cyclic quadrilateral.**

This was our 4th question that we have identified as being unfair.
Most learners struggled to see that $O\hat{T}G$ and $O\hat{B}G$ are both = 90°. The line OB seems to be obstructing the view of $O\hat{T}G$. As is evident from our summary, 86,1% of learners in our sample scored 0 marks for this question.

9.2.2) $\mathbf{G\hat{O}B = \hat{S}}$

Even for this question, to see that $B\hat{T}G$ was the same as $B\hat{O}G$, was really difficult for most learners. Again, the line OB seems to be obstructing $B\hat{T}G$.
Though this was a higher order question, 91.4% of learners in our sample scored 0 marks.
We also noticed that many learners did not finish this question. They ran out of time and only attempted question 9.2.1.

Question 10



Prove, giving reasons, that:

10.1) $\hat{S}_1 = \hat{T}_2$

This was the last question attempted by many learners. A higher order question.
Learners had to use3 theorems: tan chord theorem, exterior angle of a cyclic quadrilateral and the exterior angle of a triangle. 85.5% of learners scored 0 marks.

10.2) $\frac{AD}{AR} = \frac{AS}{AC}$

Learners who had time to do this question, struggled because they had to identify the two triangles that they need to prove similar. Because they had to identify the triangles themselves, the question became a higher order question. 86.8% of learners scored 0 marks.

10.3) **AC × SD = AR × TC**

Indeed, a very good difficult higher order question.
Learners had to use their answer in 10.2 along with the correct ratio of the proportionality theorem in Δ ACR and combine the two answers to get the correct answer.
From our sample, 97.7% of learners scored 0 marks and 0,26% scored full marks.
Again, we noticed that many learners ran out of time because of the error in the paper.
I am sure that had learners had more time, some of them would have attempted question 10.2 and 10.3.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Learners should be given a checklist of all topics they need to know for their grade 12 final examination. This list should have all the topics and 3 columns, one to tick for June examination, one to tick for trial examination and a final column for their end of year examination. Below is an example with just a few topics:

Topic	June	Sept	Nov
Statement in words of the similarity theorem and the prove of it			
Statement in words of the proportionality theorem and the			

prove of it			
Statement of the midpoint theorem and the converse of the midpoint theorem			
All grade 11 theorems: Line from centre of a circle that bisects a chord is ⊥ to the chord And it's converse Angle at the centre is twice the angle at the circumference Opposite angles of a cyclic quadrilateral are supplementary Tan – chord theorem			
Converse statements of all the theorems			
Level 1 and 2 riders			
Level 3 and 4 riders in terms of x			
Proving that a quadrilateral is a cyclic quadrilateral			
Proving that a line is a tangent to a circle at a specific point			
CAST diagram and reduction formulae			
Co – ratios and special angles			
Negative angles and general solution			
Trig graphs and sin, cos and area rule			
Compound angles and identities			

We have found during marking that many learners are not studying their definitions, theory and theorems. One reason could be because there is no order in their notebooks.
Learners are always looking for the shortest way (time frame) to prepare for exams. Rushing into past papers does not seem to be a solution.
Learners should also be given a page with all the acceptable reasons [examination guidelines] in geometry and teachers must be encouraged to use those acceptable reasons only, and not use any shortened version in class or in a test/exam/memo.
Learners should also get a summary of the cognitive levels, what it measures and the percentage that each level represents in a test or in an examination.
Level 1 = Knowledge = 20%
Level 2 = Routine procedure = 35%
Level 3 = Complex procedure = 30%
Level 4 = Problem solving = 15%
These 3 pages must be pasted in their maths P 1 book and in their maths P 2 book.
That means that all learners should be given two 3 quire hard cover books. One for P 1 and another for P 2. The first two pages in each book must be used as a content page and all pages should be numbered. e.g. If a learner is looking for proving grade 12 trigonometric identities, the learners must be able to find the topic in their maths P 2 book in less than 7 seconds.
Learners should only use these two books, that should include all the theory and proofs, to prepare them for their final examination. They should use different colour pens and increase the font size of very important theory notes and put a border around it. This is what top performing learners are doing!!! Learners should have two more 3 quire books, one for their P 1 exam papers and the 2nd one for their P 2 exam papers. These two books should also have a contents page. e.g., November 2019 P 1, pages 23 – 29.

It is the teacher's responsibility to help/guide learners with their time management in preparation for examinations. Learners are children, they do not have the mental maturity as adults yet. Some of them have no guidance at home.

Teachers are encouraged to be punctual for classes, to be well prepared for all lessons and assessments and try their very best to be in school every day. Teachers must act as positive role models to their learners and they should endeavour to learn new ideas in making mathematics fun.

It is very important to do planning for teaching and assessment in advance – 1 term in advance, preferably. This planning will benefit both the teacher and the learners.
The chief markers report gets send to all schools every year. Teachers should insist on getting a copy and keep it their maths files together with the marking guidelines.
Attending of workshops by underperforming schools should be compulsory. The workshops can be held via teams and notes can also be distributed on the maths WhatsApp group " Educ Related news". There are at least 150 mathematics teachers on that group.

All workshops offered by subject advisors could be done in 3 categories:
Category number 1: Learners who obtain more than 70%.
Category number 2: Learners who get marks between 40% and 70%.
Category number 3: Learners who get marks less than 40%.
If at a particular school there are 42 mathematics learners and they all are failing, then that maths teacher should ask anyone of his mathematics colleagues or his subject advisor for guidance and support. Surely, this teacher cannot be doing level 3 and level 4 work with his learners.
On the other hand, if at a particular school there are learners who get consistently more than 80%, then that teacher's approach will be very different from the above-mentioned teacher.

All schools should introduce compulsory lessons for grade 12 learners every Friday during term 1. This will help us to complete the syllabus comfortably and revise for trials.

Subject advisors must continue to keep workshops for teachers that have not done geometry at school or that is not confident in teaching geometry. We find at the marking centre that teachers do not want to mark the geometry. If they are teaching geometry to grade 12's at school, then it should not be difficult to mark geometry.

(d)	Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

In question 1.1.1 many learners wrote: mean = $\frac{115}{10}$ = 15.5 and not just the answer.
Answer only, if it is correct will be awarded 2 marks, but answer only, if it is incorrect, will lose 2 marks. The first mark was for the 115 and the 2nd mark was for the answer. This is the method we are encouraging teachers to follow.
Many learners have input the numbers twice in their calculators to ensure they get the same answer for the mean and for the standard deviation.
We also want to encourage the learners to read their questions carefully. For bivariate data, the mean of the x values or the mean of the y values can be asked. They must not always assume that it is the mean of the x values that is being asked.
In question 1.3 we recommend that learners write down the value of *a* and the value of *b* and then the equation of the least squares regression line. Learners can also be reminded that the equation is given on the formula sheet.
In question 1.4, by reading the question properly, learners should know whether the predicted value is for the x value or the y value of the regression equation.

In question 2.2 the learners were asked to write down the modal class. Many learners did not know how to answer this question. The modal class is simply the interval with the highest frequency. By looking at the dots of the cumulative frequency, we can see that the biggest jump is between 20 and 25.

In question 3.1 many of the very weak learners are using $\frac{\Delta x}{\Delta y}$ or they switch one of the x values.
Please remind learners to label the coordinates as $(x_1;\ y_1)$ and $(x_2; y_2)$. This will certainly eliminate the careless mistakes that they are making. Please also remind your very weak learners that the formulae are given.
In question 3.1.2, learners are calculating the angle of inclination and they leave the answer as an acute angle or they are leaving it as a negative angle. Please remind learners that if the angle is obtuse on the diagram, then to make their acute angle obtuse, they have to subtract if from 180°.
In question 3.2 the learners were asked to determine the equation of CD. Since the line is sloping downwards, the gradient must be negative. Many learners made a mistake in calculating the gradient of AB. But what is encouraging is the fact that they know that when lines are parallel, the gradients must be the same.
In question 3.3.1, some learners calculated the coordinates of F and P, then the y calculated the lengths of PC, CF and PF, then they used the cos rule to calculate the size of $\mathrm{D\hat{C}A}$.
In question 3.3.2, teachers are encouraged to read the chief marker's report along with the marking guidelines and note the different alternate solutions to calculate the area of POSC.

In question 4.2.1, some learners calculated the length of MN or the length of MP or the length of NP in order to get the length of the radius. The formula for the equation of a circle with centre (a;b) is given on the formula sheet. In question 4.2.2, learners were asked to determine the equation of the tangent at N. Many learners calculated the gradient of the radius and used that gradient to determine the equation of the tangent at point N. For doing that, they were awarded 2 marks out of 5. Learners must be reminded that the radius is always perpendicular and that if lines are perpendicular, then the product of the gradients = -1. Question 4.3 and 4.4 were higher order questions. Teachers can remind learners what a secant is and that a secant cuts a circle twice. In question 4.4.2 we integrated calculus with analytical geometry. To determine the minimum length of AB, we could have used one of 4 different methods: There were four ways how they could have done it. Option 1: Use $t = \frac{-b}{2a}$ Option 2: found the derivative of $2t^2 + 4t + 9$ and make it = 0 Option 3: They could have completed the square Option 4: minimum value = $\frac{-\Delta}{4a}$
In question 5.3, knowledge of quadratic equations should have guaranteed that the weaker learners get at least 1 mark. When we have cos x = -2 sin x, we always divide by cos x on both sides in order to get 1 = -2 tan x. Then if we divide by -2 on both sides we get Tan x = $\frac{-1}{2}$, then solve the equation. In question 5.4, when proving an identity, we encourage learners to start with one side and simplify it until we get to the other side. We do not encourage learners to simplify both sides until LHS = RHS. Learners are reminded to use their formula sheet when proving identities.
In question 6.1 – 6.3, we encourage teachers to give the definition of the period, amplitude and range of a trigonometric graph to learners and explain when the period, amplitude and range changes. In question 6.4, learners must be told that f(x + 5°) means that the graph of f(x) has shifted 5° degrees to the left. If we know where g(x) ≤ f(x), then g(x + 5°) ≤ f(x + 5°) simply means the points of intersection will move 5° to the left. In question 6.5, sin x. cos x = p has exactly two roots, means that a horizontal line drawn to sin 2x = 2p must cut the graph of sin 2x only twice, i.e., at the turning points of sin 2x.

In question 7.1, we observe that many learners have used Pythagoras incorrectly. Many learners wrote AB = $\sqrt{5}\,p\ +$ 2p, that is not Pythagoras. Pythagoras states that in a right-angled triangle, the square on the hypotenuse = sum of the squares of the other two sides. In question 7.2, learners calculated that $\hat{A}$ = 135 – x , but when they attempted to use the sin rule, they left out the sin, i.e. $\frac{CD}{135°-x} = \frac{AD}{x}$. In question 7.3 many learners used the wrong formula for area Δ ADC = $\frac{1}{2}.c\ .\ a\ .\cos\hat{D}$ All the sin, cos and area formula are given on the formula sheet, please encourage learners to make use of the formula sheet.
Question 8.1 was answered relative well. Just a few learners gave the incorrect reason. Question 8.2.1 was not answered well. It would appear that learners have not done the midpoint theorem or they have forgotten about it. In question 8.2.2, many learners said that BG = 3x – 1, used the proportionality theorem correctly and ended up with x = – 5. When working out the length of a line, your answer can never be negative.
In question 9.1, many learners did not study this theorem. Please encourage learners to study all their theorems. It is supposed to be easy marks. In question 9.2.1, many learners got the reason wrong for $O\hat{T}G = 90°$. The correct reason according to the examination guidelines is: Line from centre that bisects a chord is ⊥ chord. Though we accepted $O\hat{B}G = 90°$ (diameter ⊥ tangent) ,we would prefer it if learners wrote Radius ⊥ tangent. When saying that $B\hat{T}G\ =\ \hat{S}$ (corresp ∠'s, GT // PS), learners must include the parallel lines. When a teacher writes an answer on the board or in his/her memorandum, the parallel lines must be there.
In question 10.1, learners had to use3 theorems: tan chord theorem, exterior angle of a cyclic quadrilateral and the exterior angle of a triangle. These 3 marks were all independent marks and it could have been stated in any order. In question 10.2 we encourage teachers when using the reason, prop theorem, they have to include the parallel line. Question 10.3 was indeed, a very good difficult higher order question. Learners had to use their answer in 10.2 along with the correct ratio of the proportionality theorem in Δ ACR and combine the two answers to get the correct answer.

Common tests should be set for under performing schools. These tests should include an answer book, similar to the ones used for trials and the end of year examinations. It is the responsibility of teachers to motivate and encourage their learners. This they can do in many ways. E.g. Be punctual, be well prepared, to give meaningful lessons, to encourage learners to make wise and good choices every day, to be goal orientated, to make sacrifices daily and to choose good friends that will add value to their lives. Simply put, to do well at the end of the year, learners need to stay focused and work diligently every single day. Teachers should be eager to develop themselves by interacting with fellow teachers. Subject advisors and teacher development should put together an organized team of teachers who can bring about new and innovative ideas in teaching of mathematics and invite teachers to district workshops. It should be compulsory for all teachers to be fully equipped with GeoGebra and the graph program. Teachers can submit tests, where they have used either GeoGebra or graph, to a subject advisor or an appointed cluster leader for guidance/moderation.

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS P2

NOVEMBER 2022

MARKS: 150

TIME: 3 hours

This question paper consists of 13 pages and 1 information sheet.

* M A T H E 2 *

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 10 questions.

2. Answer ALL the questions in the SPECIAL ANSWER BOOK provided.

3. Clearly show ALL calculations, diagrams, graphs, etc. which 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, round off answers correct to TWO decimal places, unless stated otherwise.

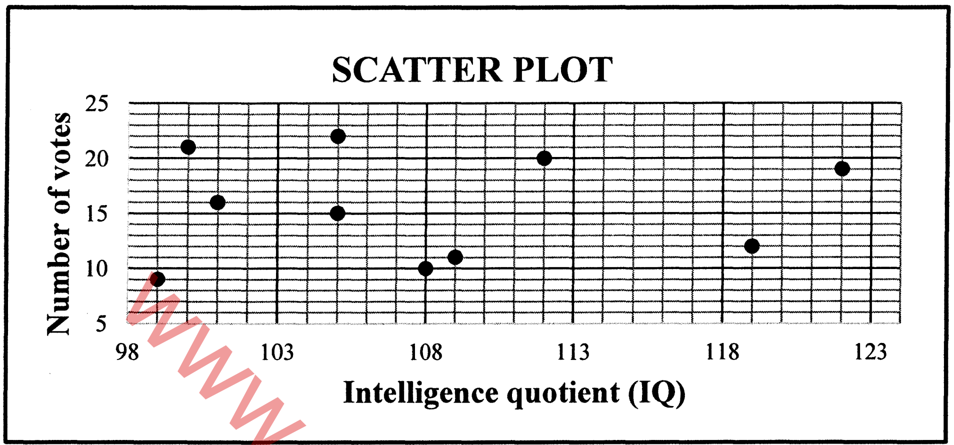
7. Diagrams are NOT necessarily drawn to scale.

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

9. Write neatly and legibly.

QUESTION 1

The matric class of a certain high school had to vote for the chairperson of the RCL (representative council of learners). The scatter plot below shows the IQ (intelligence quotient) of the 10 learners who received the most votes and the number of votes that they received.



Before the election, the popularity of each of these ten learners was established and a popularity score (out of a 100) was assigned to each. The popularity scores and the number of votes of the same 10 learners who received the most votes are shown in the table below.

Popularity score (x)	32	89	35	82	50	59	81	40	79	65
Number of votes (y)	9	22	10	21	11	15	20	12	19	16

1.1 Calculate the:

1.1.1 Mean number of votes that these 10 learners received (2)

1.1.2 Standard deviation of the number of votes that these 10 learners received (1)

1.2 The learners who received fewer votes than one standard deviation below the mean were not invited for an interview. How many learners were invited? (2)

1.3 Determine the equation of the least squares regression line for the data given in the table. (3)

1.4 Predict the number of votes that a learner with a popularity score of 72 will receive. (2)

1.5 Using the scatter plot and table above, provide a reason why:

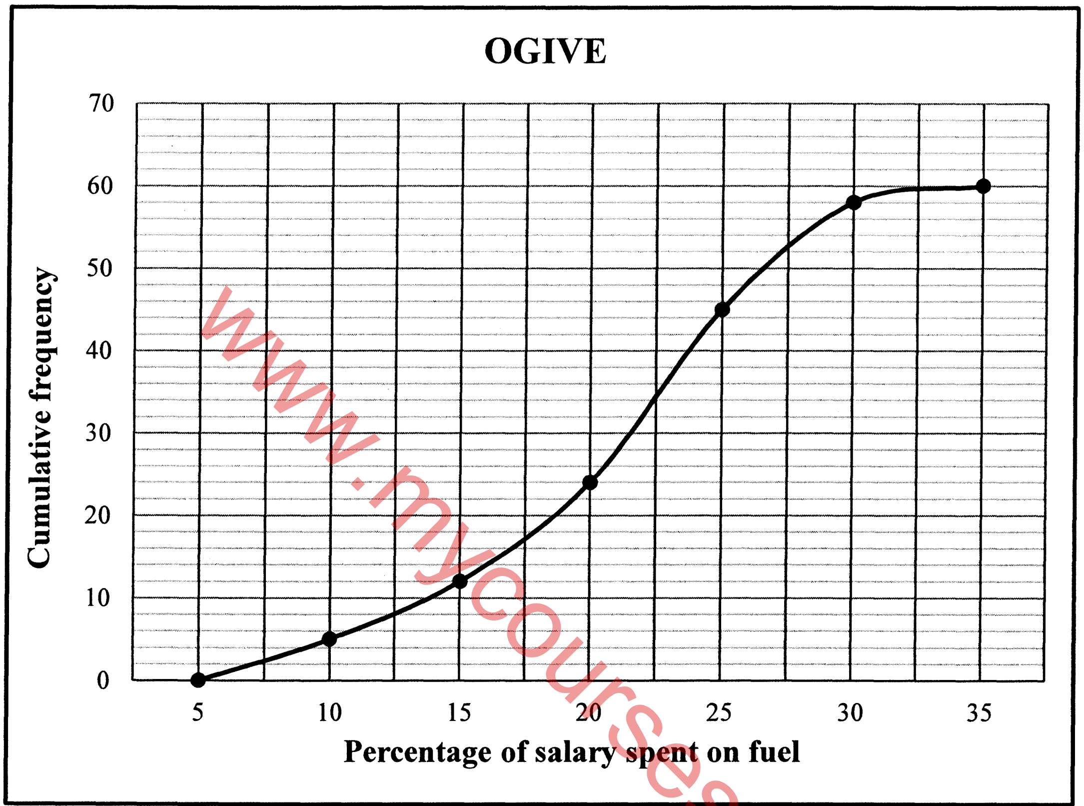
1.5.1 IQ is not a good indicator of the number of votes that a learner could receive (1)

1.5.2 The prediction in QUESTION 1.4 is reliable (1)

[12]

QUESTION 2

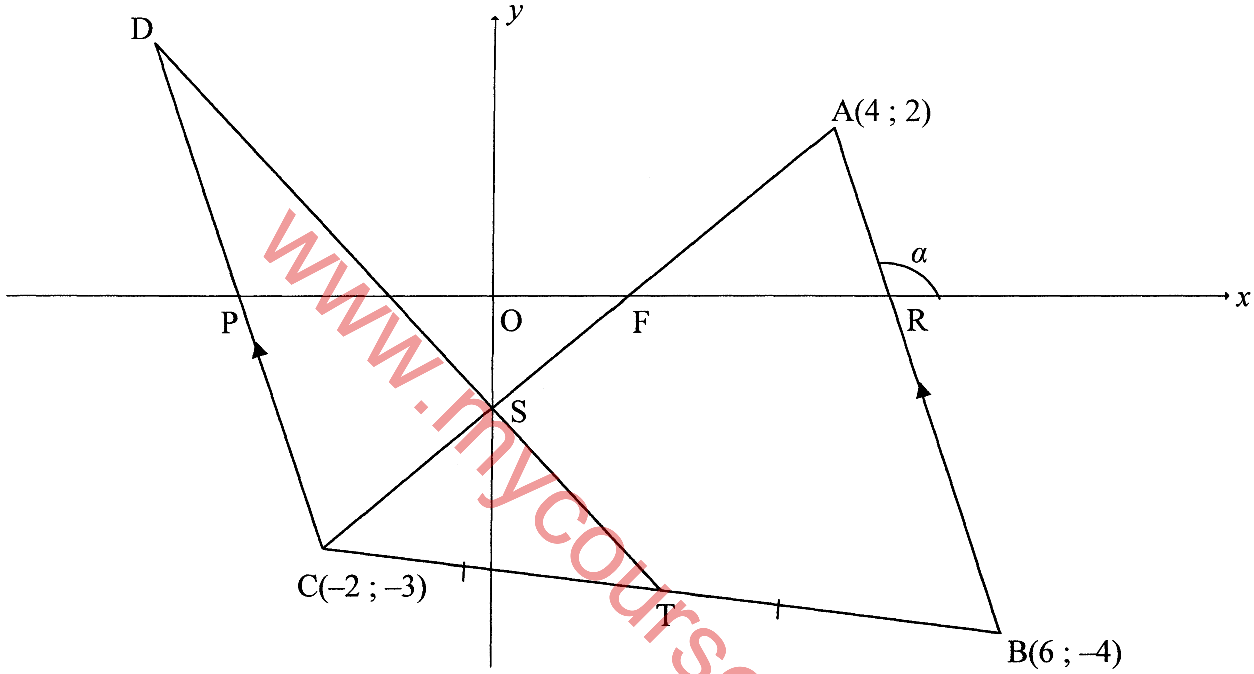
A company conducted research among all its employees on what percentage of their monthly salary was spent on fuel in a particular month. The data is represented in the ogive (cumulative frequency graph) below.



2.1	How many people are employed at this company?	(1)
2.2	Write down the modal class of the data.	(1)
2.3	How many employees spent more than 22,5% of their monthly salary on fuel?	(2)
2.4	An employee spent R2 400 of his salary on fuel in that particular month. Determine the monthly salary of this employee if he spends 7% of his salary on fuel.	(2)
2.5	The monthly salaries of these employees remains constant and the number of litres of fuel used in each month also remains constant. If the fuel price increases from R21,43 per litre to R22,79 per litre at the beginning of the next month, how will the above ogive change?	(2)
		[8]

QUESTION 3

In the diagram, A(4 ; 2), B(6 ; –4) and C(–2 ; –3) are vertices of ΔABC. T is the midpoint of CB. The equation of line AC is $5x-6y=8$. The angle of inclination of AB is α. ΔDCT is drawn such that CD || BA. The lines AC and DT intersect at S, the y-intercept of AC. P, F and R are the x-intercepts of DC, AC and AB respectively.



3.1 Calculate the:

3.1.1 Gradient of AB (2)

3.1.2 Size of α (2)

3.1.3 Coordinates of T (2)

3.1.4 Coordinates of S (2)

3.2 Determine the equation of CD in the form $y = mx + c$. (3)

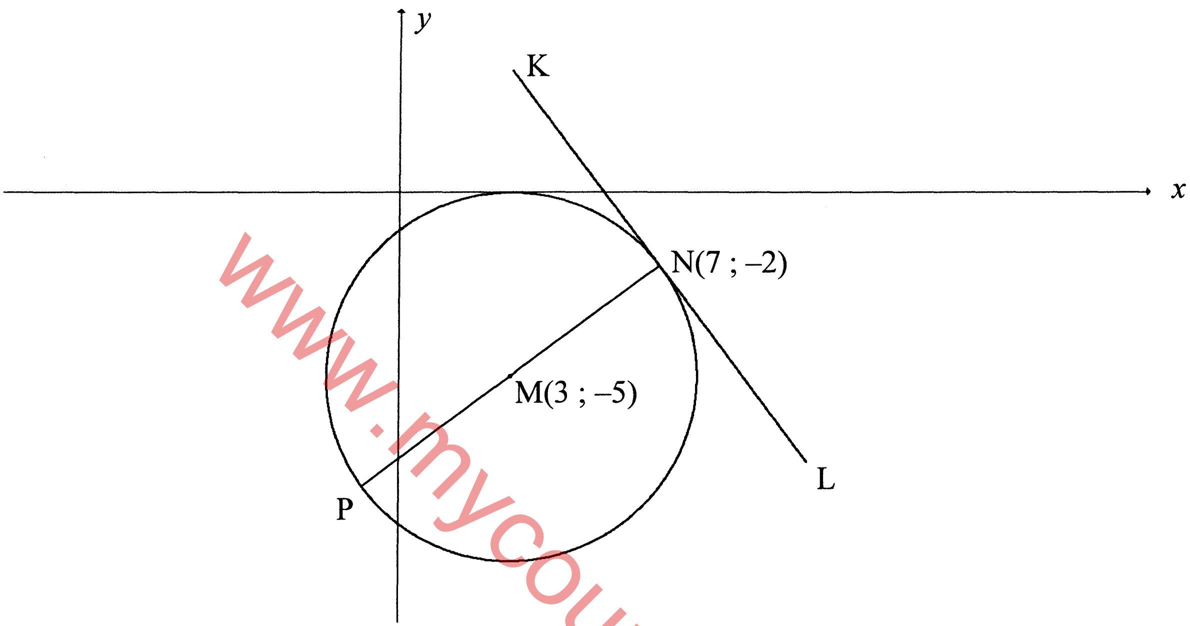
3.3 Calculate the:

3.3.1 Size of $D\hat{C}A$ (4)

3.3.2 Area of POSC (5)
[20]

QUESTION 4

In the diagram, M(3 ; –5) is the centre of the circle having PN as its diameter. KL is a tangent to the circle at N(7 ; –2).



4.1 Calculate the coordinates of P. (2)

4.2 Determine the equation of:

4.2.1 The circle in the form $(x-a)^2+(y-b)^2=r^2$ (3)

4.2.2 KL in the form $y=mx+c$ (5)

4.3 For which values of k will $y=-\frac{4}{3}x+k$ be a secant to the circle? (4)

4.4 Points A(t ; t) and B are not shown on the diagram.

From point A, another tangent is drawn to touch the circle with centre M at B.

4.4.1 Show that the length of tangent AB is given by $\sqrt{2t^2+4t+9}$. (2)

4.4.2 Determine the minimum length of AB. (4)

[20]

QUESTION 5

5.1 Given that $\sqrt{13}\sin x + 3 = 0$, where $x \in (0° ; 90°)$.

Without using a calculator, determine the value of:

5.1.1 $\sin(360° + x)$ (2)

5.1.2 $\tan x$ (3)

5.1.3 $\cos(180° + x)$ (2)

5.2 Determine the value of the following expression, **without using a calculator**:

$$\frac{\cos(90° + \theta)}{\sin(\theta - 180°) + 3\sin(-\theta)}$$ (5)

5.3 Determine the general solution of the following equation:

$(\cos x + 2\sin x)(3\sin 2x - 1) = 0$ (6)

5.4 Given the identity: $\cos(x + y).\cos(x - y) = 1 - \sin^2 x - \sin^2 y$

5.4.1 Prove the identity. (4)

5.4.2 Hence, determine the value of $1 - \sin^2 45° - \sin^2 15°$, **without using a calculator**. (3)

5.5 Consider the trigonometric expression: $16\sin x.\cos^3 x - 8\sin x.\cos x$

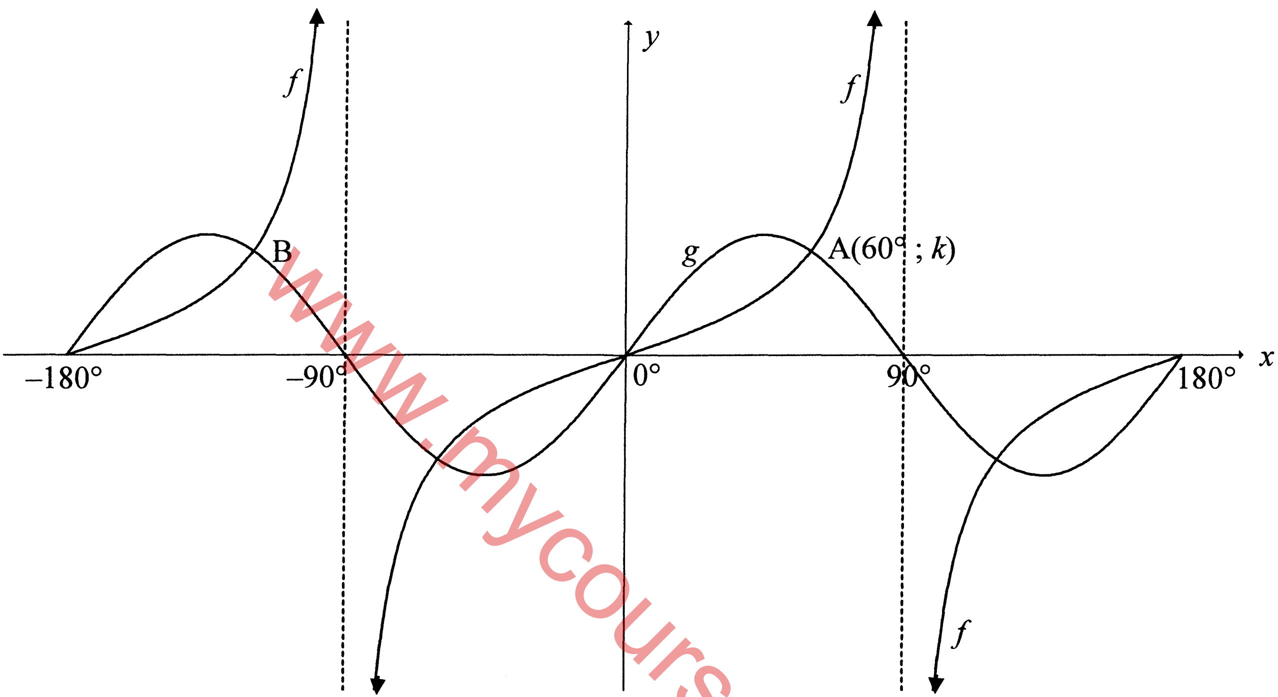
5.5.1 Rewrite the expression as a single trigonometric ratio. (4)

5.5.2 For which value of x in the interval $x \in [0° ; 90°]$ will $16\sin x.\cos^3 x - 8\sin x.\cos x$ have its minimum value? (1)

[30]

QUESTION 6

In the diagram below, the graphs of $f(x) = \tan x$ and $g(x) = 2\sin 2x$ are drawn for the interval $x \in [-180°\,;180°]$ A$(60°\,;k)$ and B are two points of intersection of f and g.



6.1 Write down the period of g. (1)

6.2 Calculate the:

6.2.1 Value of k (1)

6.2.2 Coordinates of B (1)

6.3 Write down the range of $2g(x)$. (2)

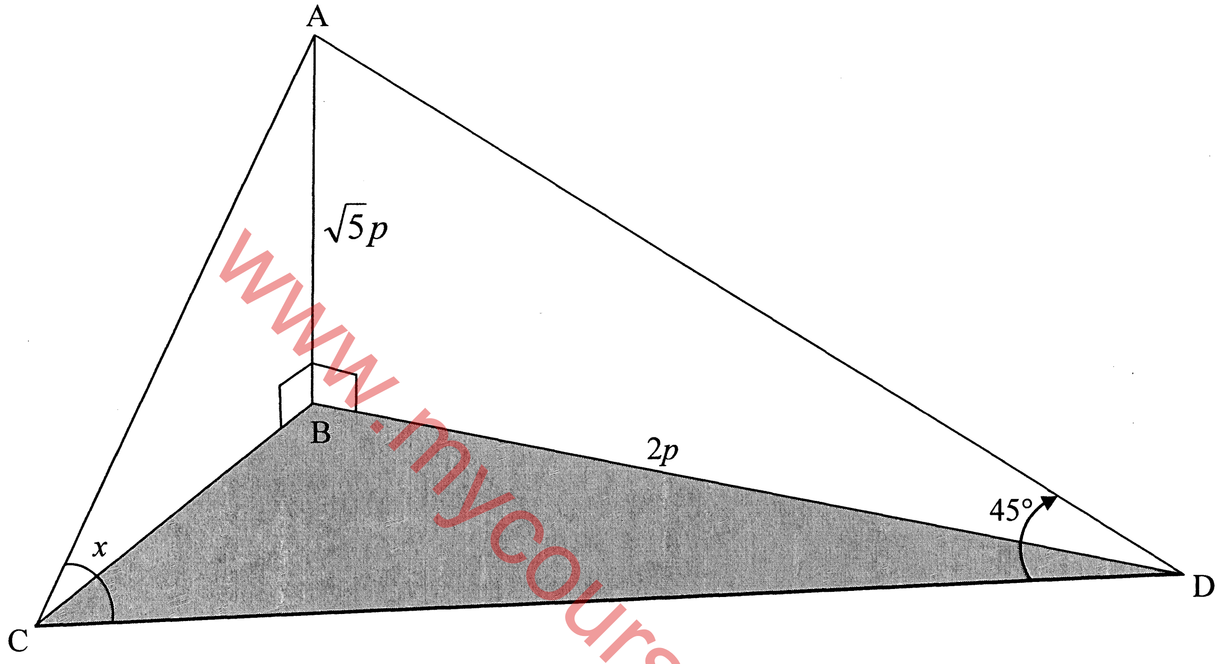
6.4 For which values of x will $g(x+5°) - f(x+5°) \leq 0$ in the interval $x \in [-90°\,;0°]$? (2)

6.5 Determine the values of p for which $\sin x . \cos x = p$ will have exactly two real roots in the interval $x \in [-180°\,;180°]$. (3)

[10]

QUESTION 7

AB is a vertical flagpole that is $\sqrt{5}p$ metres long. AC and AD are two cables anchoring the flagpole. B, C and D are in the same horizontal plane.
$BD = 2p$ metres, $A\hat{C}D = x$ and $A\hat{D}C = 45°$.



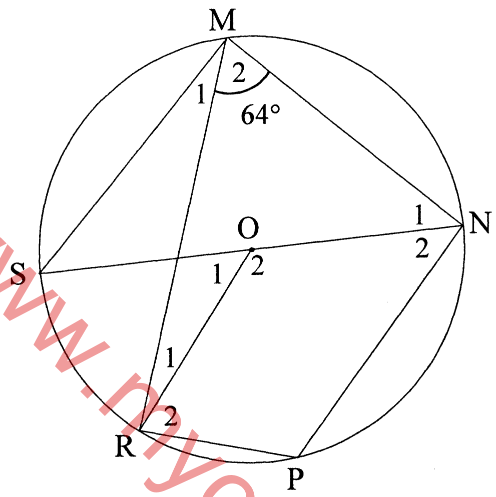
7.1 Determine the length of AD in terms of p. (2)

7.2 Show that the length of $CD = \dfrac{3p(\sin x + \cos x)}{\sqrt{2}\sin x}$. (5)

7.3 If it is further given that $p = 10$ and $x = 110°$, calculate the area of ΔADC. (3)
[10]

QUESTION 8

8.1 In the diagram, O is the centre of the circle. MNPR is a cyclic quadrilateral and SN is a diameter of the circle. Chord MS and radius OR are drawn. $\hat{M}_2 = 64°$.



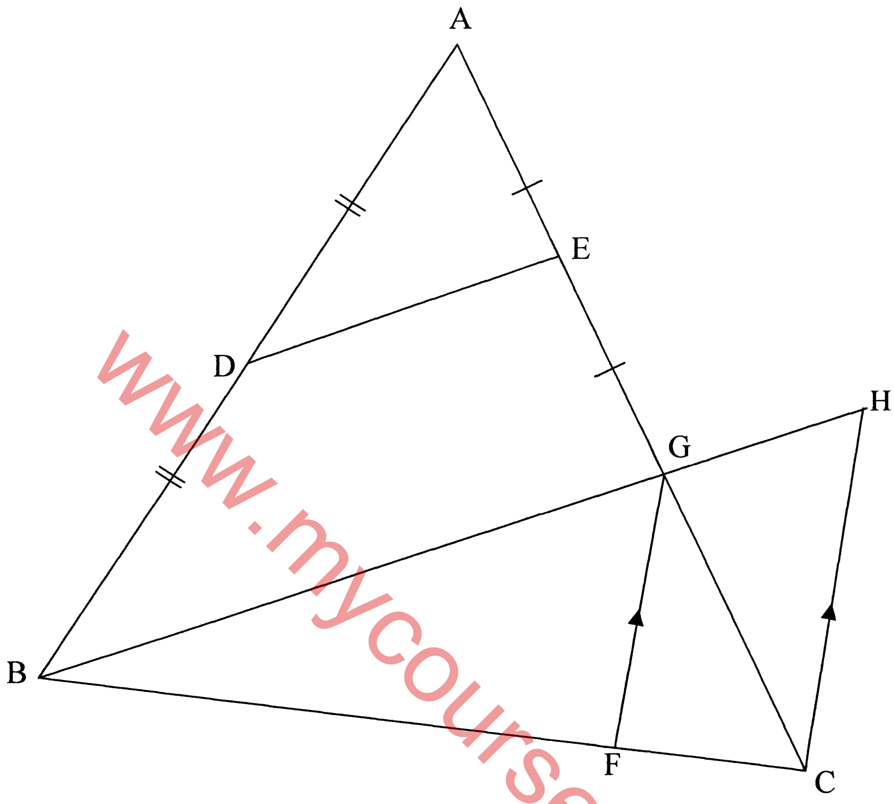
Determine, giving reasons, the size of the following angles:

8.1.1 $\hat{P}$ (2)

8.1.2 $\hat{M}_1$ (2)

8.1.3 $\hat{O}_1$ (2)

8.2 In the diagram, ΔABG is drawn. D and E are midpoints of AB and AG respectively. AG and BG are produced to C and H respectively. F is a point on BC such that $FG \parallel CH$.



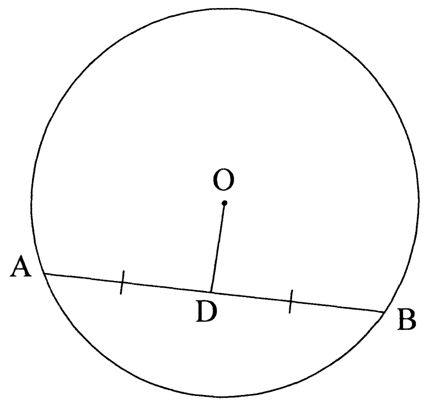
8.2.1 Give a reason why $DE \parallel BH$. (1)

8.2.2 If it is further given that $\frac{FC}{BF} = \frac{1}{4}$, $DE = 3x - 1$ and $GH = x + 1$, calculate, giving reasons, the value of x. (6)

[13]

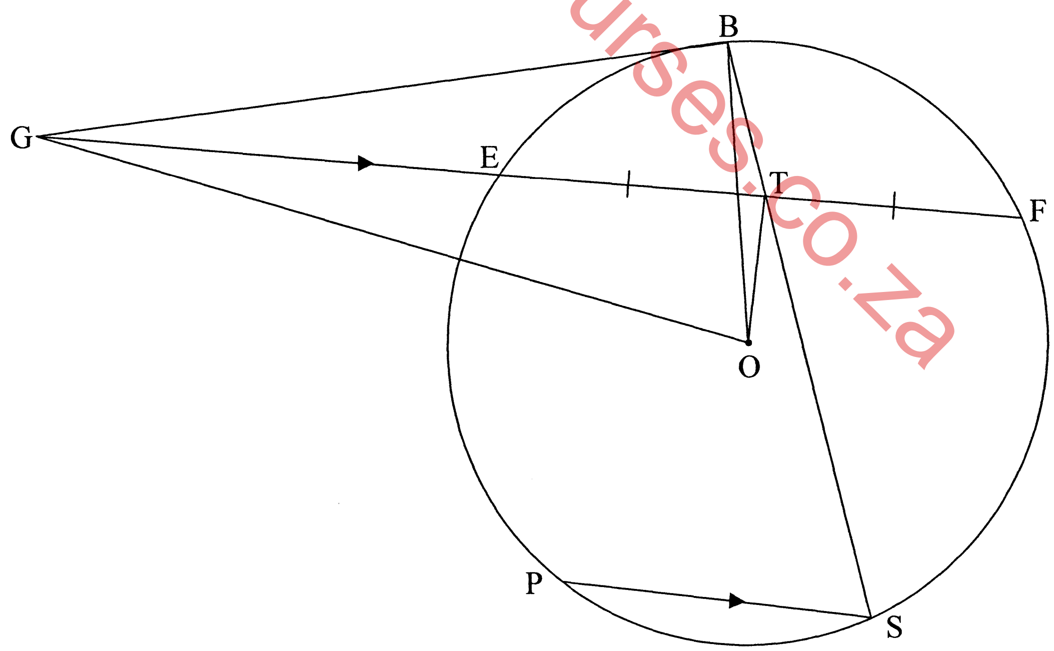
QUESTION 9

9.1 In the diagram, O is the centre of a circle. OD bisects chord AB.



Prove the theorem that states that the line from the centre of a circle that bisects a chord is perpendicular to the chord, i.e. $OD \perp AB$. (5)

9.2 In the diagram, E, B, F, S and P are points on the circle centred at O. GB is a tangent to the circle at B. FE is produced to meet the tangent at G. OT is drawn such that T is the midpoint of EF. GO and BO are drawn. BS is drawn through T. PS || GF.



Prove, giving reasons, that:

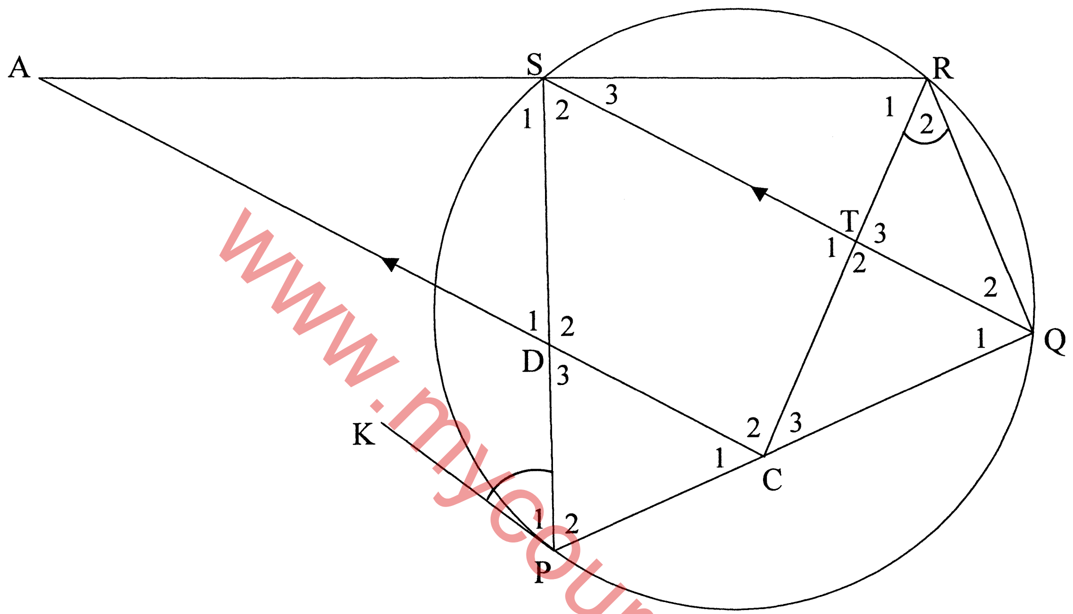
9.2.1 OTBG is a cyclic quadrilateral (5)

9.2.2 $G\hat{O}B = \hat{S}$ (4)

[14]

QUESTION 10

In the diagram, PQRS is a cyclic quadrilateral. KP is a tangent to the circle at P. C and D are points on chords PQ and PS respectively and CD produced meets RS produced at A. CA || QS. RC is drawn. $\hat{P}_1 = \hat{R}_2$.



Prove, giving reasons, that:

10.1 $\hat{S}_1 = \hat{T}_2$ (4)

10.2 $\frac{AD}{AR} = \frac{AS}{AC}$ (5)

10.3 $AC \times SD = AR \times TC$ (4)
[13]

TOTAL: 150

INFORMATION SHEET

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

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

$T_n = a + (n-1)d$ $\quad S_n = \frac{n}{2}[2a + (n-1)d]$

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

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

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

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

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

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

$In\ \Delta ABC:\ \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

$a^2 = b^2 + c^2 - 2bc.\cos A$

$area\ \Delta ABC = \frac{1}{2} ab.\sin C$

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

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

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

$\sin 2\alpha = 2\sin\alpha.\cos\alpha$

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

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

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

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE/
NASIONALE
SENIOR SERTIFIKAAT

GRADE 12/*GRAAD 12*

MATHEMATICS P2/*WISKUNDE V2*

NOVEMBER 2022

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2022 -11- 16
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

These marking guidelines consist of 24 pages.
Hierdie nasienriglyne bestaan uit 24 bladsye.

Approved by Umalusi External Moderator
16/11/2002

NOTE:

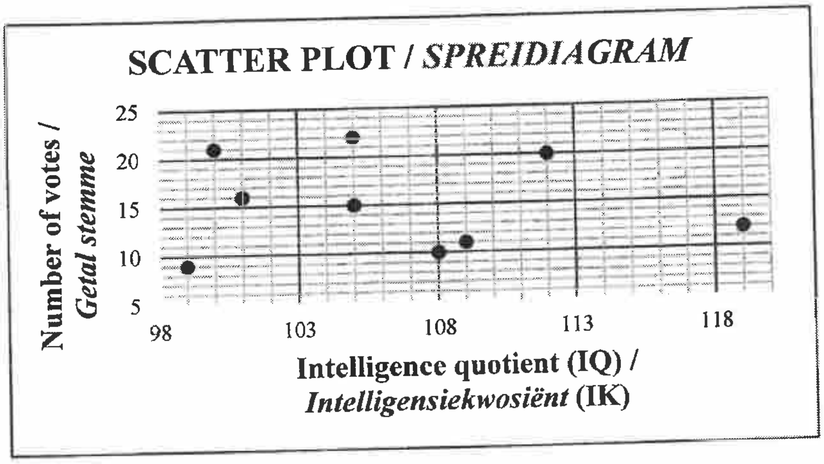
- **If a candidate answers a question TWICE, only mark the FIRST attempt.**
- **If a candidate has crossed out an attempt of a question and not redone the question, mark the crossed out version.**
- **Consistent accuracy applies in ALL aspects of the marking memorandum. Stop marking at the second calculation error.**
- **Assuming answers/values in order to solve a problem is NOT acceptable.**

NOTA:

- ***As 'n kandidaat 'n vraag TWEE KEER beantwoord, merk slegs die EERSTE poging.***
- ***As 'n kandidaat 'n antwoord van 'n vraag doodtrek en nie oordoen nie, merk die doodgetrekte poging.***
- ***Volgehoue akkuraatheid word in ALLE aspekte van die memorandum toegepas. Hou op nasien by die tweede berekeningsfout.***
- ***Aanvaar van antwoorde/waardes om 'n probleem op te los, word NIE toegelaat nie.***

GEOMETRY/*MEETKUNDE*	
S	**A mark for a correct statement** **(A statement mark is independent of a reason)**
	'n Punt vir 'n korrekte bewering ***('n Punt vir 'n bewering is onafhanklik van die rede)***
R	**A mark for the correct reason** **(A reason mark may only be awarded if the statement is correct)**
	'n Punt vir 'n korrekte rede ***('n Punt word slegs vir die rede toegeken as die bewering korrek is)***
S/R	**Award a mark if statement AND reason are both correct**
	Ken 'n punt toe as die bewering EN rede beide korrek is

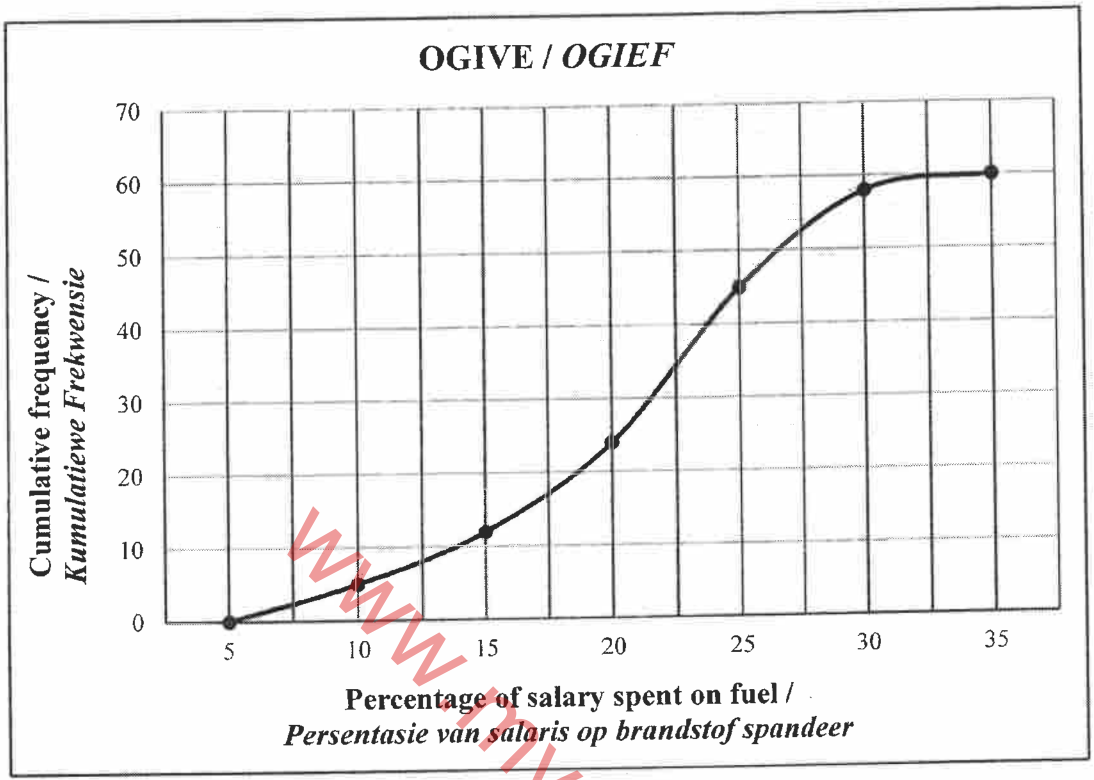
QUESTION/*VRAAG* 1



Popularity score (x) ***Gewildheidspunt* (x)**	32	89	35	82	50	59	81	40	79	65
Number of votes (y) ***Getal stemme* (y)**	9	22	10	21	11	15	20	12	19	16

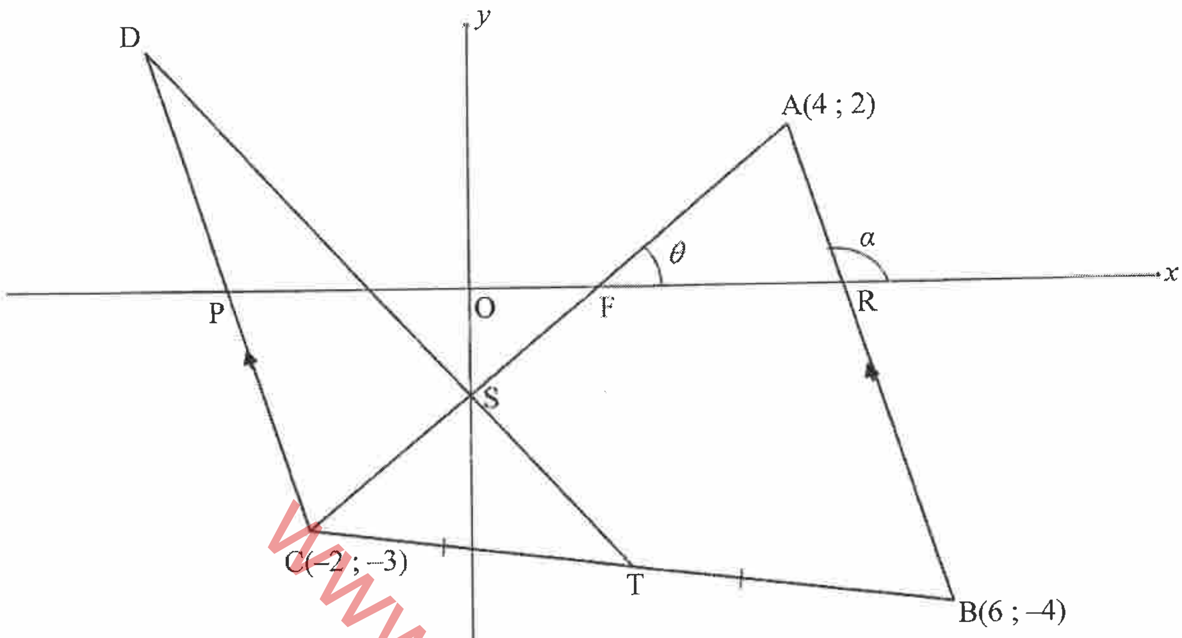
1.1.1	$\bar{y} = \frac{155}{10}$ $= 15,5$ ANSWER ONLY: Full marks	✓155 ✓answer (2)
1.1.2	SD = 4,59	✓ answer (1)
1.2	$\bar{y} - \text{SD}$ $= 15,5 - 4,59$ $= 10,91$ $\therefore\ 10 - 2 = 8$ learners	✓ value of $\bar{y} - \text{SD}$ ✓ answer (2)
1.3	$a = 1,7709\ldots$ $b = 0,2243\ldots$ $\hat{y} = 1,77 + 0,22x$	✓ a ✓ b ✓ equation (3)
1.4	$\hat{y} = 1,77 + 0,22(72)$ $= 17,61$ ≈ 18 votes **OR/*OF*** $\hat{y} = 17,92 \approx 18$ votes	✓ substitution ✓ answer (2) ✓✓ answer (2)
1.5.1	Points are all scattered therefore low correlation and unrealistic prediction./*Punte is versprei daarom 'n lae korrelasie en onrealistiese voorspelling.*	✓ R (1)
1.5.2	$r = 0,98$/correlation very strong/*korrelasie baie sterk* $\therefore$ a reliable prediction/*'n betroubare voorspelling*	✓ S (1)
		[12]

QUESTION/*VRAAG* 2



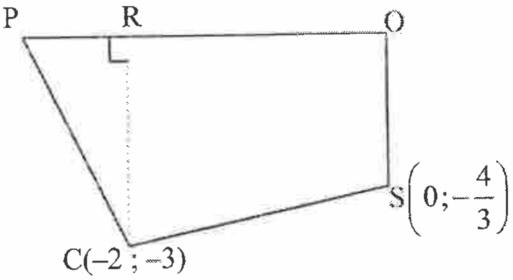
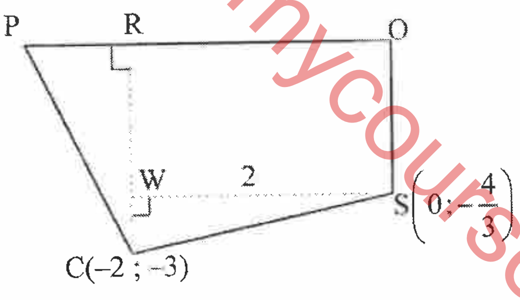
2.1	60 employees	✓ answer (A)	(1)
2.2	$20 < x \leq 25$	✓ answer	(1)
2.3	$60 - 34$ $= 26$ employees ANSWER ONLY: Full marks	✓ 34 ✓ answer	(2)
2.4	$\text{Salary} = \frac{100}{7} \times 2400$ $\text{Salary} = \text{R}34\ 285{,}71$ ANSWER ONLY: Full marks	✓ method ✓ answer	(2)
2.5	∴ Ogive/Cumulative frequency graph will shift to the right/will become steeper. ∴ *Ogief/Kumulatiewe frekwensie grafiek sal na regs skuif/sal steiler wees.*	✓✓ answer	(2)
			[8]

QUESTION/*VRAAG* 3



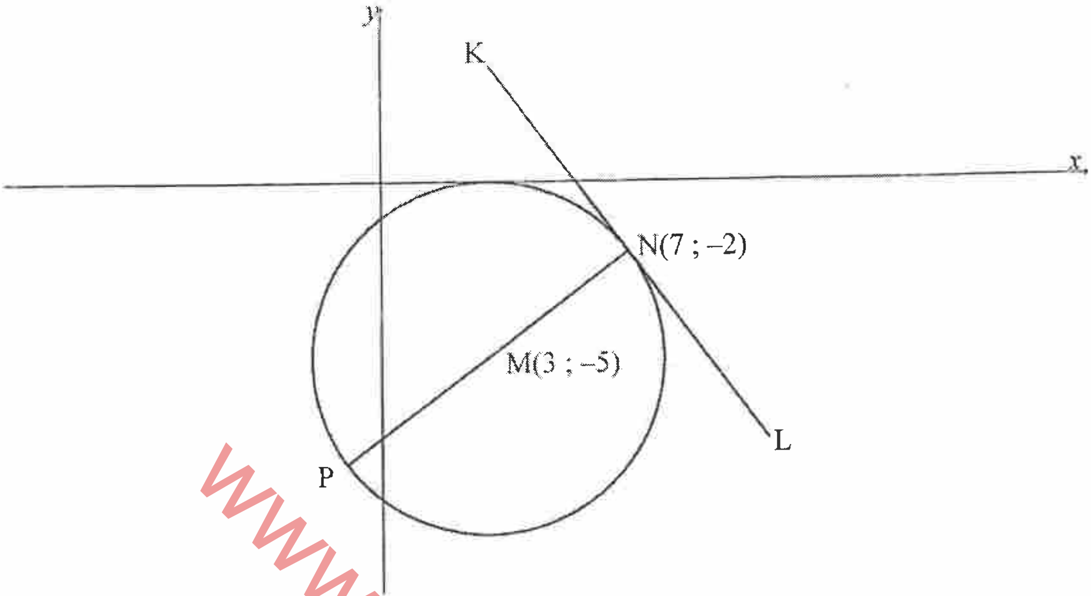
3.1.1	$m_{AB}=\frac{2-(-4)}{4-6}$ **OR** $m_{AB}=\frac{-4-2}{6-4}$ $m_{AB}=-3$ ANSWER ONLY: Full marks	✓ substitution ✓ answer (2)
3.1.2	$\tan\alpha=m_{AB}=-3$ $\alpha=108{,}43°$ ANSWER ONLY: Full marks	✓ $\tan\alpha=m_{AB}=-3$ ✓ answer (2)
3.1.3	$T\left(\frac{x_1+x_2}{2};\frac{y_1+y_2}{2}\right)$ $T\left(\frac{-2+6}{2};\frac{-3-4}{2}\right)$ $T\left(2;\frac{-7}{2}\right)$	✓ $x_T=2$ ✓ $y_T=\frac{-7}{2}$ (2)
3.1.4	$5(0)-6y=8$ $y=-\frac{4}{3}$ $S\left(0;\frac{-4}{3}\right)$	✓ $x_S=0$ ✓ $y_S=\frac{-4}{3}$ (2)
3.2	$m_{CD}=m_{AB}=-3$ $-3=-3(-2)+c$ OR $y-(-3)=-3(x-(-2))$ $c=-9$ $y=-3x-9$ $y=-3x-9$	✓ gradient ✓ substitution of C(–2 ; –3) ✓ equation (3)

3.3.1	$5x-6y=8$ $y=\frac{5}{6}x-\frac{8}{6}$ $\tan\theta=m_{AC}=\frac{5}{6}$ $\theta=39{,}81°$ $\hat{A}=108{,}43°-39{,}81°$ $=68{,}62°$ $D\hat{C}A=68{,}62°$ [alt ∠s ; DC‖AB]	✓ $\tan\theta=m_{AC}=\frac{5}{6}$ ✓ $\theta=39{,}81°$ ✓ $\hat{A}=68{,}62°$ ✓ answer (4)
3.3.2	$P(-3;0)$ and $F(1{,}6\ ;0)$ Area POSC = Area ΔFPC – Area ΔOFS $=\frac{1}{2}(4{,}6)(3)-\frac{1}{2}(1{,}6)\left(\frac{4}{3}\right)$ $=6{,}9-1{,}07$ $=5{,}83$ units^2	✓ $P(-3;0)$ ✓ method ✓ $\frac{1}{2}(4{,}6)(3)$ ✓ $\frac{1}{2}(1{,}6)\left(\frac{4}{3}\right)$ ✓ answer (5)
	OR/*OF* $P(-3;0)$ $FC=\sqrt{\left(-2-\frac{8}{5}\right)^2+(-3-0)^2}=\frac{3\sqrt{61}}{5}$ Area $\Delta PFC=\frac{1}{2}(PF)(FC)\sin O\hat{F}S$ $=\frac{1}{2}\left(\frac{23}{5}\right)\left(\frac{3\sqrt{61}}{5}\right)\sin 39{,}81°$ $=6{,}90$ Area $\Delta OFS=\frac{1}{2}\left(\frac{8}{5}\right)\left(\frac{4}{3}\right)$ $=1{,}07$ Area POSC $=6{,}90-1{,}07$ $=5{,}83$ units^2	✓ $P(-3;0)$ ✓ $\frac{1}{2}\left(\frac{23}{5}\right)\left(\frac{3\sqrt{61}}{5}\right)\sin 39{,}81°$ ✓ $\frac{1}{2}\left(\frac{8}{5}\right)\left(\frac{4}{3}\right)$ ✓ method ✓ answer (5)
	OR/*OF*	

		
	$P(-3;0)$ Area of POSC = Area of OSCR + Area of ΔPRC $=\frac{1}{2}\left(\frac{4}{3}+3\right)\times 2+\frac{1}{2}(1\times 3)$ $=\frac{35}{6}$ $=5,83\text{ units}^2$	✓ $P(-3;0)$ ✓ method ✓ $\frac{1}{2}\left(\frac{4}{3}+3\right)\times 2$ ✓ $\frac{1}{2}(1\times 3)$ ✓ answer (5)
	OR/*OF*	
		
	$P(-3;0)$ Area POSC = Area ROSW + Area ΔPRC + Area ΔWSC $=\left(\frac{4}{3}\right)(2)+\frac{1}{2}(1)(3)+\frac{1}{2}(2)\left(\frac{5}{3}\right)$ $=\frac{35}{6}$ $=5,83\text{units}^2$	✓ $P(-3;0)$ ✓ method ✓ $\frac{1}{2}(1)(3)$ ✓ $\left(\frac{4}{3}\right)(2)+\frac{1}{2}(2)\left(\frac{5}{3}\right)$ ✓ answer (5)
	OR/*OF*	

	$P(-3;0)$ Area of $\Delta PSC = \frac{1}{2}(PC)(CS)\sin D\hat{C}A$ $= \frac{1}{2}\left(\sqrt{10}\right)\left(\frac{\sqrt{61}}{3}\right)\sin 68,62°$ $= 3,833..$ Area of $\Delta POS = \frac{1}{2}(PO)(OS)$ $= \frac{1}{2}(3)\left(\frac{4}{3}\right)$ $= 2$ Area $POSC = 3,833\ldots + 2$ $= 5,83 \text{units}^2$	✓ $P(-3;0)$ ✓ $\frac{1}{2}\left(\sqrt{10}\right)\left(\frac{\sqrt{61}}{3}\right)\sin 68,62°$ ✓ $\frac{1}{2}(3)\left(\frac{4}{3}\right)$ ✓ method ✓ answer (5)
		[20]

UESTION/*VRAAG* 4



4.1	$P(x;y);\ N(7;-2)\ ;\ M(3;-5)$ $\frac{x+7}{2}=3 \qquad \frac{y-2}{2}=-5$ $x=-1 \qquad y=-8$ $P(-1;-8)$	✓ $x_P=-1$ ✓ $y_P=-8$ (2)
4.2.1	$r^2=(7-3)^2+(-2-(-5))^2$ **OR/*OF*** $r^2=(-1-3)^2+(-8-(-5))^2$ $r^2=25$ $(x-3)^2+(y+5)^2=25$	✓ substitution into distance formula ✓ $(x-3)^2+(y+5)^2$ ✓ $r^2=25$ (3)
4.2.2	$m_{\text{radius}}=\frac{-5-(-2)}{3-7}=\frac{3}{4}$ $m_{\text{tangent}}=-\frac{4}{3}$ [radius ⊥ tangent/*raaklyn* ⊥ *radius*] $-2=-\frac{4}{3}(7)+c$ **OR** $y-(-2)=-\frac{4}{3}(x-7)$ $c=\frac{22}{3}$ $\qquad y=-\frac{4}{3}x+\frac{22}{3}$ $y=-\frac{4}{3}x+\frac{22}{3}$	✓ substitution ✓ $m_{\text{radius}}=\frac{-3}{-4}=\frac{3}{4}$ ✓ $m_{\text{tangent}}=-\frac{4}{3}$ ✓ substitution of m and N(7 ; –2) ✓ equation (5)
4.3	$-8=-\frac{4}{3}(-1)+c$ $\therefore\ c=-\frac{28}{3}$ $-\frac{28}{3}<k<\frac{22}{3}$	✓ subst m and P ✓ value of c ✓✓ answer (4)

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4.4.1	$AB^2 = AM^2 - MB^2$ $AB^2 = \left[(t-3)^2 + (t+5)^2\right] - 5^2$ $= t^2 - 6t + 9 + t^2 + 10t + 25 - 25$ $AB = \sqrt{2t^2 + 4t + 9}$	✓ substitution into Pythagoras ✓ simplification (A) (2)
4.4.2	$t = \frac{-4}{2(2)}$ $= -1$ Minimum at $t = -1$ $AB = \sqrt{2(-1)^2 + 4(-1) + 9}$ $AB = \sqrt{7}$	✓ substitution into correct formula ✓ $t = -1$ ✓ substitution ✓ answer (4)
	OR/*OF* $4t + 4 = 0$ $t = -1$ Minimum at $t = -1$ $AB = \sqrt{2(-1)^2 + 4(-1) + 9}$ $AB = \sqrt{7}$	✓ derivative = 0 ✓ $t = -1$ ✓ substitution ✓ answer (4)
	OR/*OF* Length of $AB = \sqrt{2t^2 + 4t + 9}$ $= \sqrt{2\left(t^2 + 2t + \frac{9}{2}\right)}$ $= \sqrt{2\left[(t+1)^2 + \frac{7}{2}\right]}$ $= \sqrt{2(t+1)^2 + 7}$ Minimum at $t = -1$ $AB = \sqrt{2(-1)^2 + 4(-1) + 9}$ $AB = \sqrt{7}$	✓ completing of the square ✓ $t = -1$ ✓ substitution ✓ answer (4)
		[20]

QUESTION/*VRAAG* 5

5.1.1	$\sin(360°+x)$ $=\sin x$	✓ + ✓ $\sin x$ (2)
5.1.2	$x-\text{coordinate}=\sqrt{\left(\sqrt{13}\right)^2-(-3)^2}$ $=-2$ $\tan x=\frac{-3}{-2}$ $=\frac{3}{2}$ **OR/*OF*** $x-\text{coordinate}=\sqrt{\left(\sqrt{13}\right)^2-(3)^2}$ $=2$ $\tan x=\frac{3}{2}$	✓✓ substitution ✓ method (3) ✓✓ substitution ✓ method (3)
5.1.3	$\cos(180°+x)$ $=-\cos x$	✓ – ✓ $\cos x$ (2)
5.2	$\frac{\cos(90°+\theta)}{\sin(\theta-180°)+3\sin(-\theta)}$ $=\frac{-\sin\theta}{\sin(-(180°-\theta))-3\sin\theta}$ $=\frac{-\sin\theta}{-\sin\theta-3\sin\theta}$ $=\frac{-\sin\theta}{-4\sin\theta}$ $=\frac{1}{4}$	✓ $-\sin\theta$ ✓ $-3\sin\theta$ ✓ $-\sin\theta$ ✓ simplification ✓ answer (5)

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5.3	$(\cos x + 2\sin x)(3\sin 2x - 1) = 0$ $\cos x + 2\sin x = 0$ or $3\sin 2x - 1 = 0$ $\tan x = -\frac{1}{2}$; $\sin 2x = \frac{1}{3}$ ref $\angle = 26{,}565...°$; ref $\angle = 19{,}471...°$ $x = 153{,}43° + k.180°$; $k \in Z$; $x = 9{,}74° + k.180°$; $k \in Z$ **OR/*OF*** ; or $x = 153{,}43° + k.360°$; $k \in Z$; $x = 80{,}26° + k.180°$; $k \in Z$ or $x = 333{,}43° + k.360°$; $k \in Z$	✓ both equations ✓ $\tan x = -\frac{1}{2}$ ✓ $\sin 2x = \frac{1}{3}$ ✓ $x = 153{,}43°$ **OR** $x = 153{,}43°$ & $333{,}43°$ ✓ $x = 9{,}74°$ & $80{,}26°$ ✓ $+ k.180°$; $k \in Z$ (6)
5.4.1	LHS $= \cos(x+y).\cos(x-y)$ $= [\cos x.\cos y - \sin x.\sin y][\cos x.\cos y + \sin x.\sin y]$ $= \cos^2 x.\cos^2 y - \sin^2 x.\sin^2 y$ $= (1-\sin^2 x)(1-\sin^2 y) - \sin^2 x.\sin^2 y$ $= 1 + \sin^2 x.\sin^2 y - \sin^2 x - \sin^2 y - \sin^2 x.\sin^2 y$ $= 1 - \sin^2 x - \sin^2 y$ = RHS	✓ expansion ✓ simplification ✓ square identity ✓ product (4)
5.4.2	$1 - \sin^2 45° - \sin^2 15°$ $= \cos(45° + 15°).\cos(45° - 15°)$ $= \cos 60°.\cos 30°$ $= \left(\frac{1}{2}\right)\left(\frac{\sqrt{3}}{2}\right)$ $= \frac{\sqrt{3}}{4}$ **OR/*OF***	✓ identifying x and y ✓ substitution ✓ answer (3)

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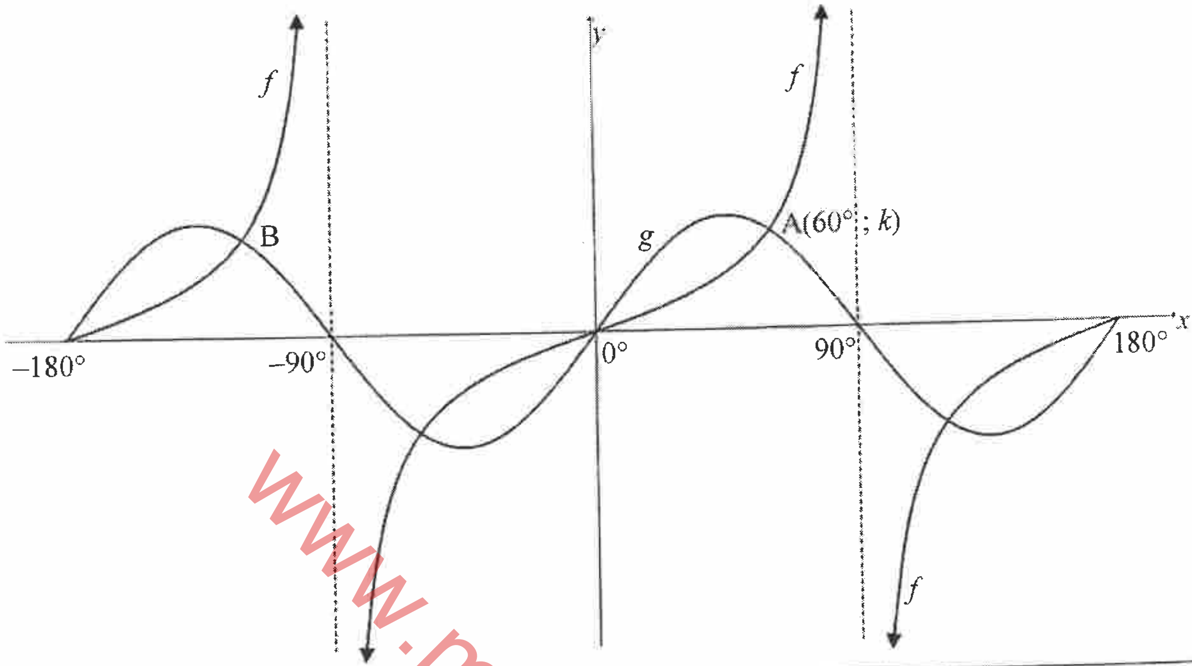
	$1-\sin^2 45°-\sin^2 15°$ $=\sin^2 15°+\cos^2 15°-\sin^2 45°-\sin^2 15°$ $=\cos^2 15°-\left(\frac{\sqrt{2}}{2}\right)^2$ $=\cos^2 15°-\frac{1}{2}$ $=\frac{2\cos^2 15°-1}{2}$ $=\frac{\cos 30°}{2}$ $=\frac{\sqrt{3}}{2}\times\frac{1}{2}$ $=\frac{\sqrt{3}}{4}$	✓ identity ✓ substitution ✓ answer (3)
	OR $1-\sin^2 45°-\sin^2 15°$ $=\cos^2 45°-\sin^2(45°-30°)$ $=\left(\frac{1}{\sqrt{2}}\right)^2-(\sin 45°\cos 30°-\cos 45°\sin 30°)^2$ $=\frac{1}{2}-\left(\frac{1}{\sqrt{2}}\times\frac{\sqrt{3}}{2}-\frac{1}{\sqrt{2}}\times\frac{1}{2}\right)^2$ $=\frac{1}{2}-\left(\frac{\sqrt{3}}{2\sqrt{2}}-\frac{1}{2\sqrt{2}}\right)^2$ $=\frac{1}{2}-\left(\frac{\sqrt{3}}{2\sqrt{2}}-\frac{1}{2\sqrt{2}}\right)^2$ $=\frac{1}{2}-\left(\frac{3}{8}-\frac{\sqrt{3}}{4}+\frac{1}{8}\right)$ $=\frac{\sqrt{3}}{4}$	✓ expansion ✓ substitution ✓ answer (3)
5.5.1	$16\sin x.\cos^3 x-8\sin x.\cos x$ $=8\sin x.\cos x(2\cos^2 x-1)$ $=4\sin 2x(\cos 2x)$ $=2\sin 4x$	✓ factorisation ✓ 4sin2x ✓ cos2x

	OR/*OF* $16\sin x.\cos^3 x - 8\sin x.\cos x$ $= 16\cos^2 x\left(\frac{1}{2}\sin 2x\right) - 8\left(\frac{1}{2}\sin 2x\right)$ $= 8\left(2\cos^2 x - 1\right)\left(\frac{1}{2}\sin 2x\right)$ $= 4\sin 2x.\cos 2x$ $= 2\sin 4x$	✓ double angle (4) ✓ factorisation ✓ $4\sin 2x$ ✓ cos2x ✓ double angle (4)
5.5.2	$16\sin x.\cos^3 x - 8\sin x.\cos x = 2\sin 4x$ Minimum at $x = 67{,}5°$	✓ answer (1)
		[30]

QUESTION/*VRAAG* 6



6.1	180°	✓ answer (1)
6.2.1	$k=\sqrt{3}=1,73$	✓ answer (1)
6.2.2	$B(-120°;\sqrt{3})$	✓ $x=-120°$ (1)
6.3	Range of g: $y\in[-2;\ 2]$ Range of $2g(x)$: $y\in[-4;\ 4]$ ANSWER ONLY: Full marks **OR/*OF*** Range of g: $-2\le y\le 2$ Range of $2g(x)$: $-4\le y\le 4$	✓ $y\in[-2;\ 2]$ ✓ answer (2) ✓ $-2\le y\le 2$ ✓ answer (2)
6.4	$x\in[-65°;\ -5°]$ **OR/*OF*** $-65°\le x\le -5°$	✓✓ $x\in[-65°;\ -5°]$ (2) ✓✓ $-65°\le x\le -5°$ (2)
6.5	$\sin x.\cos x=p$ $4\sin x.\cos x=4p$ $2\sin 2x=4p$ $4p=\pm 2$ $\therefore\ p=-\frac{1}{2}$ or $\frac{1}{2}$ ANSWER ONLY: Full marks	✓ $2\sin 2x=4p$ ✓ $4p=\pm 2$ ✓ answers (3)
		[10]

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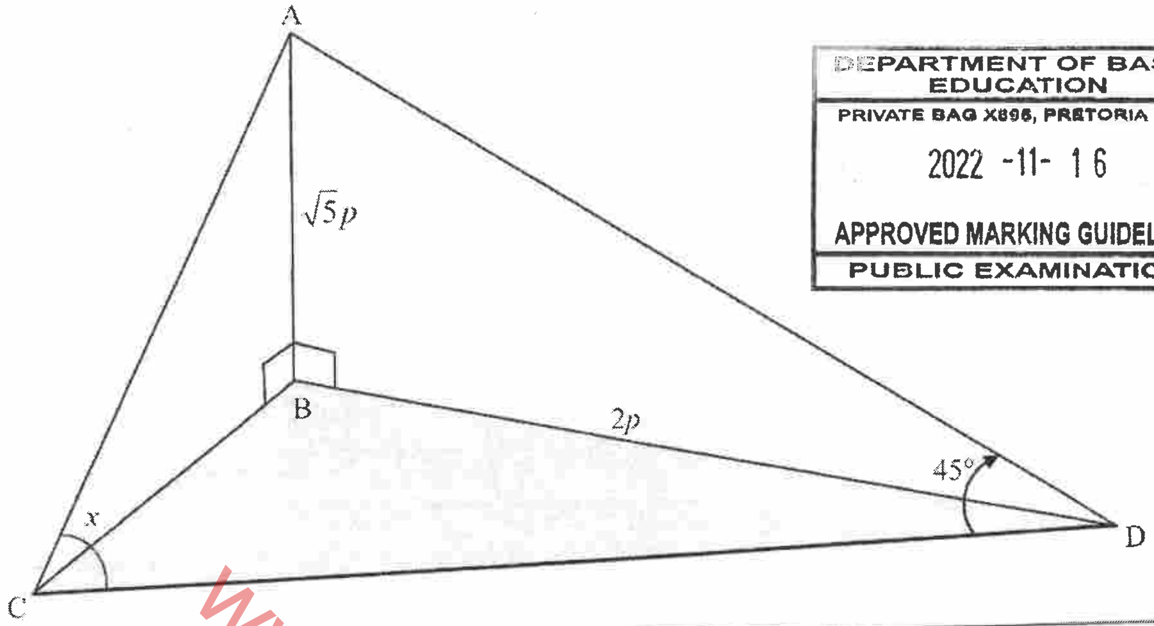
QUESTION/*VRAAG* 7

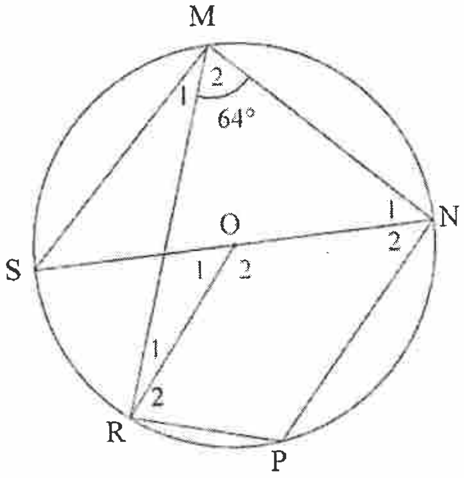


7.1	$AD^2 = AB^2 + BD^2$ $AD^2 = (\sqrt{5}p)^2 + (2p)^2$ $AD^2 = 9p^2$ $AD = 3p$	✓ substitution in Pythagoras ✓ answer (2)
7.2	$\frac{CD}{\sin(135° - x)} = \frac{3p}{\sin x}$ $CD = \frac{3p\sin(135° - x)}{\sin x}$ $CD = \frac{3p(\sin 135° \cos x - \cos 135° \sin x)}{\sin x}$ $CD = \frac{3p(\sin 45° \cos x + \cos 45° \sin x)}{\sin x}$ $CD = \frac{3p\left(\frac{\sqrt{2}}{2}\cos x + \frac{\sqrt{2}}{2}\sin x\right)}{\sin x}$ $CD = \frac{3p\left(\frac{\sqrt{2}}{2}\right)(\cos x + \sin x)}{\sin x}$ $CD = \frac{3p(\sin x + \cos x)}{\sqrt{2}\sin x}$	✓ correct use of sine rule ✓ $135° - x$ ✓ compound angle ✓ special values ✓ factorisation (5)

7.3	$\text{Area } \Delta ADC = \frac{1}{2}(AD)(CD)\sin A\hat{D}C$ $= \frac{1}{2}(3p)\left(\frac{3p(\sin x + \cos x)}{\sqrt{2}\sin x}\right)(\sin 45°)$ $= \frac{1}{2}(30)\left(\frac{30(\sin 110° + \cos 110°)}{\sqrt{2}\sin 110°}\right)\sin 45°$ $= 143{,}11\, m^2$	✓ correct use of area rule ✓ substitution in area rule ✓ answer (3)
		[10]

QUESTION/*VRAAG* 8

8.1



8.1.1	$\hat{P} = 116°$	[opp ∠s of cyclic quad/*teenoorst. ∠e van kvh*]	✓S ✓R (2)
8.1.2	$\hat{M}_1 + 64° = 90°$ $\hat{M}_1 = 26°$	[∠ in semi-circle/∠ *in halwe sirkel*]	✓R ✓S (2)
8.1.3	$\hat{O}_1 = 52°$	[∠ at centre = 2 x ∠ at circumference/*midpts.* ∠ = 2 x *omtreks.* ∠]	✓S ✓R (2)

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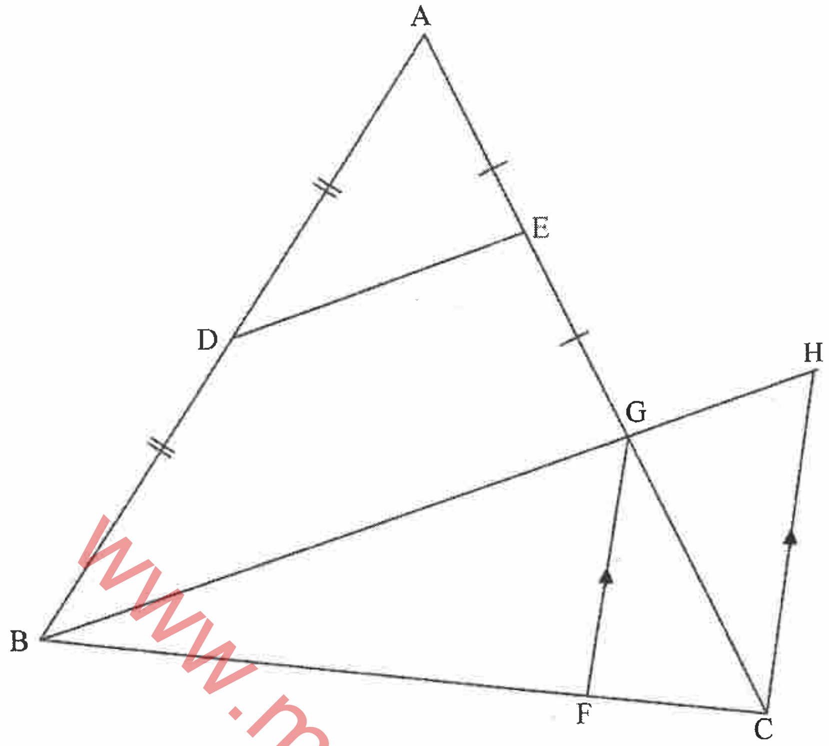
8.2



8.2.1	Midpt theorem/*Midpt. Stelling* **OR/*OF*** Converse prop intercept theorem	✓ R (1) ✓ R (1)	
8.2.2	BG = 2DE or $6x-2$ [Midpt theorem/*Midpt. stelling*] $BG = 6x-2$ $\frac{GH}{BG}=\frac{FC}{BF}$ [line ‖ one side of Δ **OR** prop theorem; FG ‖ CH / *lyn ‖ een sy v. Δ*] $\frac{x+1}{6x-2}=\frac{1}{4}$ $4x+4=6x-2$ $2x=6$ $x=3$ **OR/*OF***	✓ S ✓ R ✓ S ✓R ✓ equation into x ✓ answer (6)	

	$\frac{BF}{FC} = \frac{BG}{GH}$ [line ∥ one side of Δ **OR** prop theorem; FG ∥ CH / *lyn ∥ een sy v.* Δ] $\frac{AE}{AG} = \frac{DE}{BG}$ [ΔADE ∥∣ ΔABG] $BG = 4x + 4$ $\frac{1}{2} = \frac{3x-1}{4x+4}$ $\therefore 4x + 4 = 6x - 2$ $\therefore x = 3$	✓S ✓R ✓S ✓R ✓ equation into x ✓ answer (6)
		[13]

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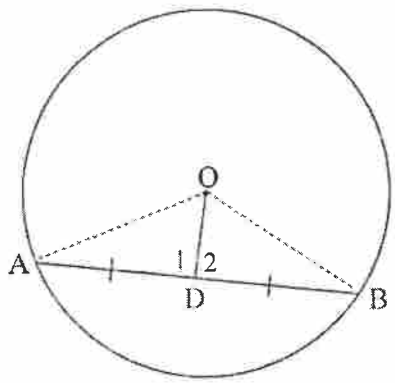
QUESTION/*VRAAG* 9

9.1



9.1.1	Construction: Draw OA and OB In ΔADO and ΔBDO OA = OB OD = OD AD = DB $\therefore \Delta ADO \equiv \Delta BDO$ ADB is a straight line $\therefore \hat{D}_1 = \hat{D}_2$ $\therefore OD \perp AB$	 [radii/*radiusse*] [common side/*gemeenskaplike sy*] [given/*gegee*] [S;S;S] $\Delta ADO \equiv \Delta BDO$ [$\angle$s on a str line/$\angle$*e op 'n reguitlyn*]	✓ construction ✓ first pair of sides ✓ other 2 pairs ✓ R ✓ R (5)
	OR/*OF* Construction: Draw OA and OB In ΔADO and ΔBDO AD = DB $\hat{A} = \hat{B}$ OA = OB $\therefore \Delta ADO \equiv \Delta BDO$ ADB is a straight line $\therefore \hat{D}_1 = \hat{D}_2$ $\therefore OD \perp AB$	 [given/*gegee*] [$\angle$s opp; $\angle$s sides /$\angle$*e teenoor gelyke sye*] [radii/*radiusse*] [S;$\angle$;S] $\Delta ADO \equiv \Delta BDO$ [$\angle$s on a str line/$\angle$*e op 'n reguitlyn*]	✓ construction ✓ first pair of sides ✓ other 2 pairs ✓ R ✓ R (5)

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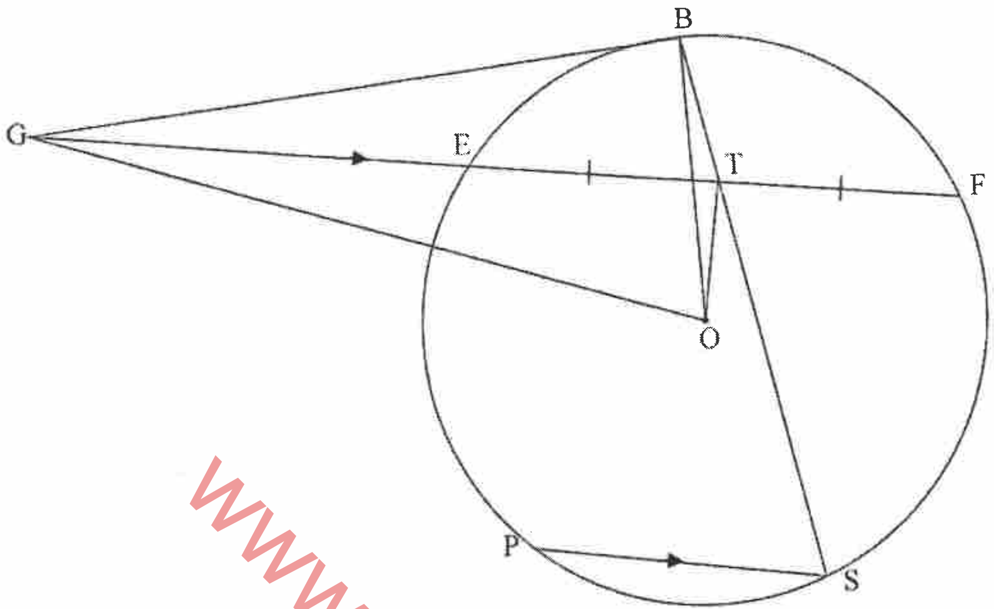
9.2



9.2.1	$O\hat{T}G = 90°$	[line from centre to midpt of chord/ *midpt. sirkel; midpt. koord*]	✓S ✓R
	$O\hat{B}G = 90°$	[tan ⊥ radius/*raaklyn* ⊥ *radius*]	✓S ✓R
	$\therefore O\hat{T}G = O\hat{B}G = 90°$		
	$\therefore$ OTBG is a cyclic quadrilateral	[line subtends equal ∠s **OR** converse ∠s in the same segment/ *lyn onderspan gelyke* ∠*e*]	✓R
			(5)
9.2.2	$\hat{S} = B\hat{T}G$	[corresp ∠s; GF || PS / *ooreenk.* ∠s; GF || PS]	✓S ✓R
	But $B\hat{T}G = G\hat{O}B$	[∠s in the same segment/∠*e in dies. sirkelsegment*]	✓S ✓R
	$G\hat{O}B = \hat{S}$		(4)
			[14]

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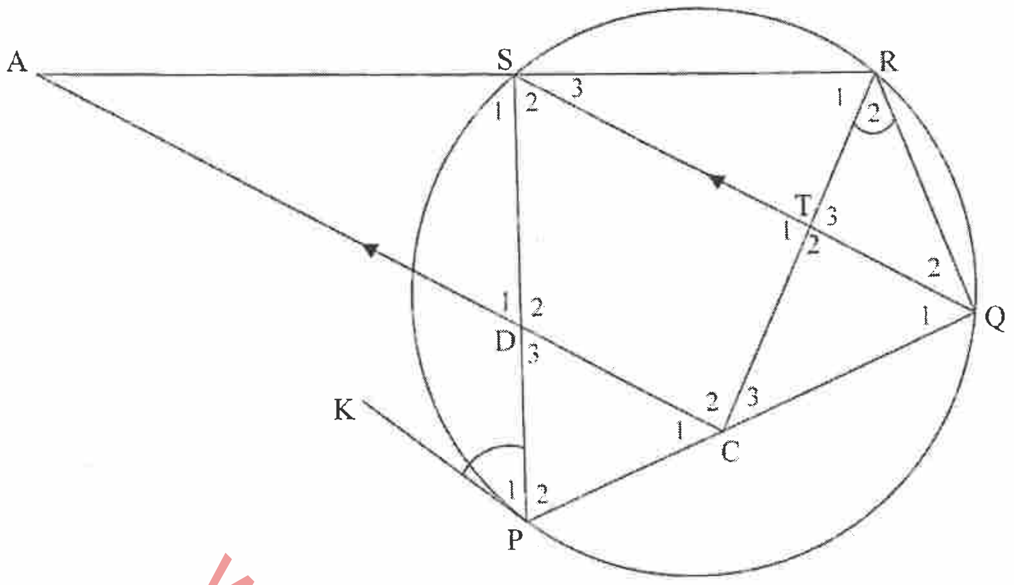
QUESTION/*VRAAG* 10



10.1	$\hat{P}_1 = \hat{Q}_1$ $\hat{S}_1 = \hat{Q}_1 + \hat{Q}_2$ $\therefore \hat{S}_1 = \hat{P}_1 + \hat{Q}_2$ $\hat{T}_2 = \hat{R}_2 + \hat{Q}_2$ but $\hat{P}_1 = \hat{R}_2$ $\hat{T}_2 = \hat{P}_1 + \hat{Q}_2$ $\therefore \hat{S}_1 = \hat{T}_2 = \hat{P}_1 + \hat{Q}_2$	[tan-chord theorem/$\angle$ *tussen raaklyn en koord*] [ext $\angle$ of cyclic quad/*buite* $\angle$ *v. kvh*] [ext $\angle$ of Δ/*buite* $\angle$ *v.* Δ] [given/*gegee*]	✓ S ✓ S / R ✓ S ✓ S (4)
10.2	In Δ ASD and ΔACR $\hat{A} = \hat{A}$ $\hat{S}_1 = \hat{T}_2$ $\hat{T}_2 = \hat{C}_2$ $\therefore \hat{S}_1 = \hat{C}_2$ $\hat{D}_1 = \hat{R}_1$ $\Delta ASD \parallel\parallel \Delta ACR$ $\therefore \frac{AD}{AR} = \frac{AS}{AC}$ **OR/*OF***	 [common $\angle$/*gemeenskaplike* $\angle$] [proven/*reeds bewys*] [alt $\angle$s; QS ∥ CA/verw. $\angle$*e*; QS ∥ CA] [sum of $\angle$s in Δ/$\angle$*e v.* Δ] [corresponding sides in proportion/ *ooreenstemmende sy in dies. verhouding*]	✓ identifying Δ's ✓ S ✓ S / R ✓ S ✓ S (5)

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	In Δ ASD and ΔACR $\hat{A} = \hat{A}$ [common $\angle$/*gemeenskaplike* $\angle$] $\hat{S}_1 = \hat{T}_2$ [proven/*gegee*] $\hat{T}_2 = \hat{C}_2$ [alt $\angle$s; QS || CA/verw. $\angle e$; QS || CA] $\therefore \hat{S}_1 = \hat{C}_2$ $\Delta ASD \mathbin{\|\|\|} \Delta ACR$ [$\angle;\angle;\angle$] $\therefore \frac{AD}{AR} = \frac{AS}{AC}$ [corresponding sides in proportion/ *ooreenstemmende sy in dies. verhouding*]	✓ identifying Δ's ✓ S ✓ S/R ✓ S ✓ R (5)
10.3	$\frac{AS}{AC} = \frac{SD}{CR}$ [$\Delta ASD \mathbin{\|\|\|} \Delta ACR$] $\therefore AS = \frac{AC \times SD}{CR}$ $\frac{AS}{AR} = \frac{CT}{CR}$ [line || one side of Δ OR prop theorem; TS || CA/*lyn || een sy v.* Δ] $\therefore AS = \frac{AR \times CT}{CR}$ $\therefore \frac{AC \times SD}{CR} = \frac{AR \times CT}{CR}$ $\therefore AC \times SD = AR \times CT$	✓ S ✓ S ✓ R ✓ equating (4)
		[13]

TOTAL/*TOTAAL*: 150

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