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ST STITHIANS GIRLS' COLLEGE

Departments of Mathematics

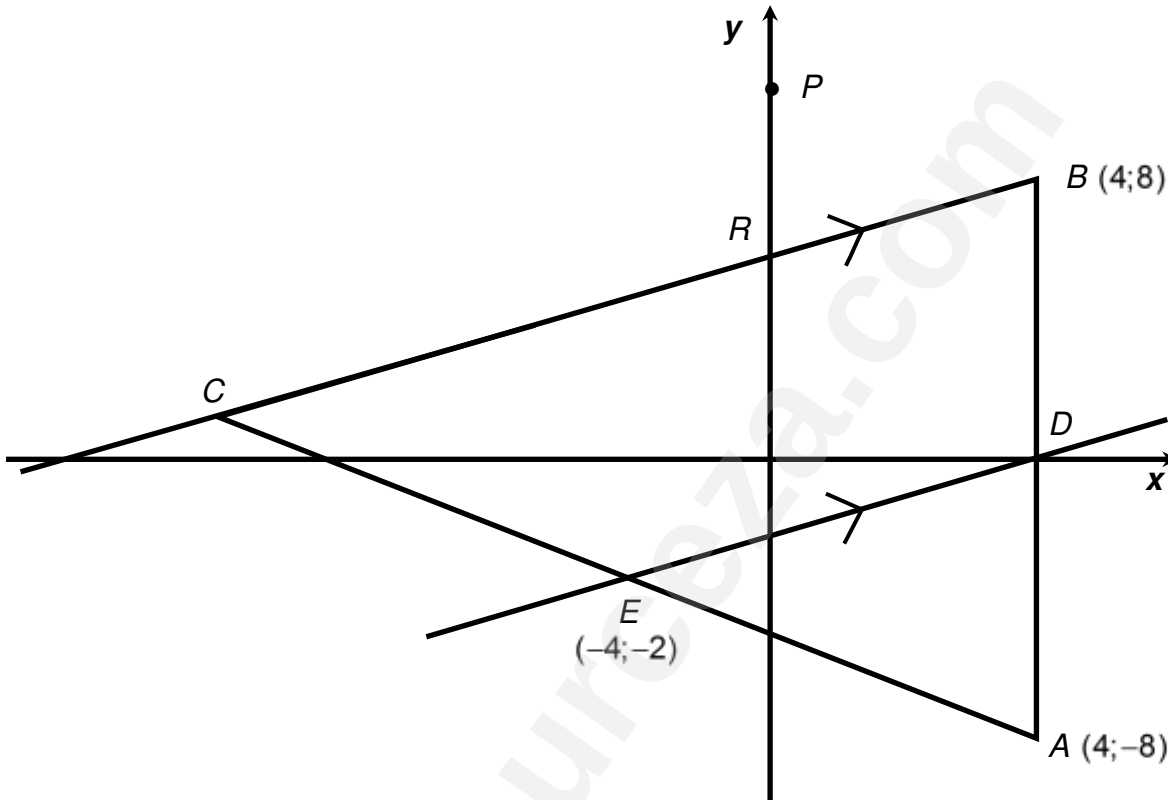
GRADE 12	
PRELIMINARY EXAMINATION – PAPER 2	
DATE: September 2020	TIME: 3 hours
TOTAL MARKS: 150	
EXAMINER: Girls' College	MODERATOR: Boys' College

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY:

1. This question paper consists of 13 questions and 24 pages.
2. A separate information (formula) sheet will be provided to you.
3. Answer ALL the questions and clearly show the calculations you have used to determine 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 specified otherwise.
6. If necessary, round off answers to TWO decimal places, unless stated otherwise.
7. Please note that diagrams are not drawn to scale.
8. It is in your own interest to write legibly and to present your work neatly.
9. PLEASE FILL IN YOUR NAME AND CIRCLE YOUR TEACHER'S NAME ON THE BACK PAGE.

Question 1:

In the diagram below, $\triangle ABC$ is shown with coordinates of $A(4; -8)$ and $B(4; 8)$ given. AB intersects the x -axis at D and AC intersects the line DE at $E(-4; -2)$. BC intersects the y -axis at R . P is a point on the y -axis. $DE \parallel BC$.



- (a) Write down the coordinates of D. (1)

- (b) Determine the gradient of line DE. (2)

(c) Determine the equation of line BC.

(3)

(d) Calculate $\hat{P}RB$.

(3)

(e) Determine the equation of the circle with centre at B and passing through point R . (3)

(f) Determine the equation of the tangent at R .

(2)

- (g) Determine the midpoint of DE. (2)

- (h) Determine the point Q such that BDQE is a parallelogram. (3)

- (i) Calculate the length of DE in simplest surd form. (2)

- (j) (1) Write down the ratio AD: AB in its simplest form. (2)

- (2) Hence, or otherwise, calculate the length of BC, with reasons. (3)

[26]

Question 2:

In the current COVID-19 pandemic, a significant proportion of cases shed SARS-Coronavirus-2 (SARS-CoV-2) with their faeces. To determine if SARS-CoV-2 RNA was present in sewage during the emergence of COVID-19 in the Netherlands, sewage samples were tested for the nucleocapsid gene (N3). Below is a table of the data recorded of the number of cases per 100 000 people and the presence of the Gene (N3) per ml in the sewerage system. (This data was taken from the early days of the outbreak.)

Number of cases per 100 000 people (x)	Gene (N3) per ml of Sewerage (N)
2	9
3	23
4	90
8	132
6	486
7	486
10	775
22	357
38	711
57	1643
64	3250
67	2929
67	2286
93	839

- (a) Determine the correlation coefficient, r , for the set of data, and describe the relationship between N and x that this value represents.
(Round off to 3 decimal places) (3)

- (b) Determine the equation of the least squares regression line for N in terms of x in the form $N = A + Bx$. (Round off to 3 decimal places). (2)

- (c) Predict the expected concentration of the N3 Gene when the area has 150 cases per 100 000 people. Comment on the reliability of your answer. (2)

[7]

Question 3:

The table below indicates the COVID-19 deaths by age in South Africa up until the 24th June 2020. Answer the questions below.

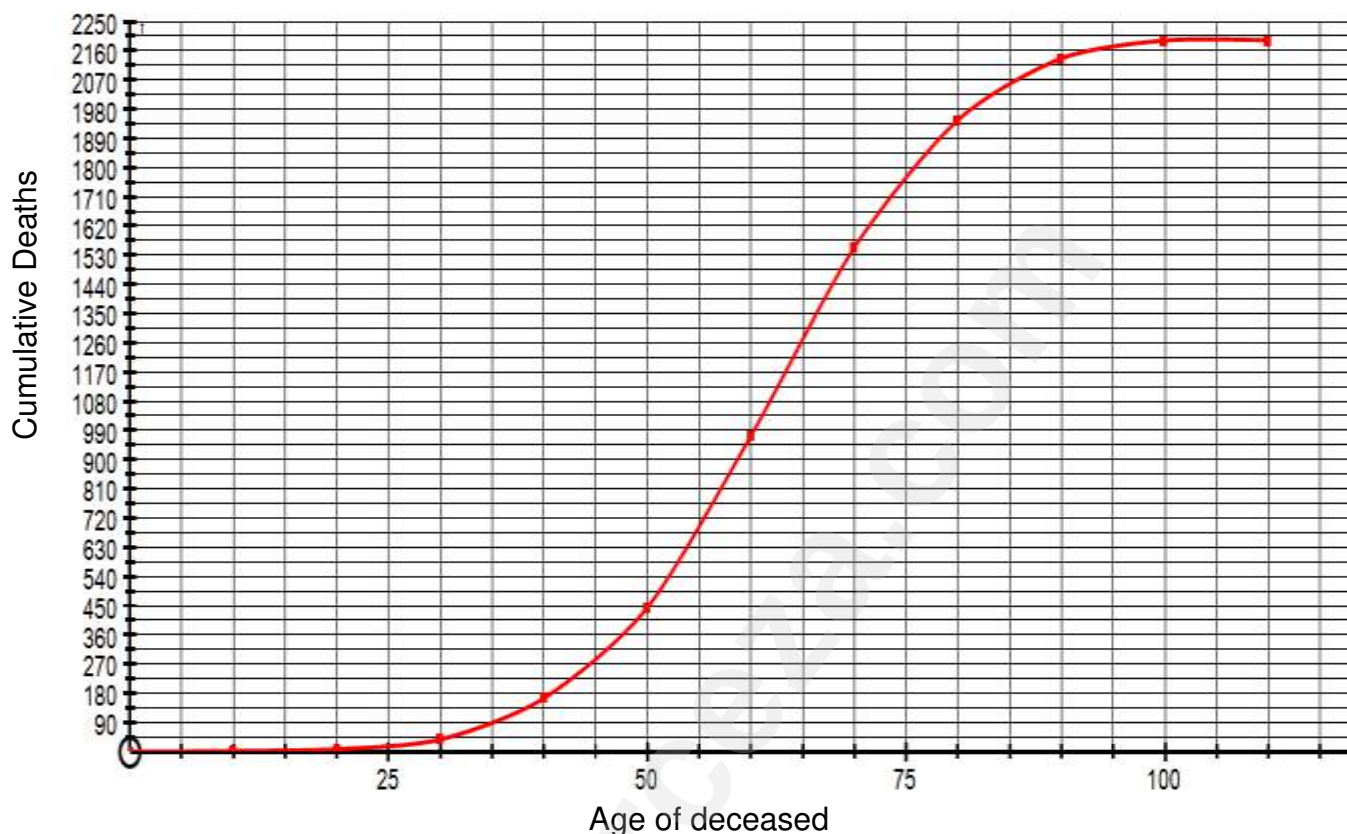
Age of deceased	Number of deaths	
0-9	3	
10-19	5	
20-29	30	
30-39	127	
40-49	280	
50-59	529	
60-69	581	
70-79	392	
80-89	190	
90-99	55	
100- 109	1	
Total Deaths	2193	

- (a) Determine the estimated mean age of the deceased population. (3)

- (b) Determine the standard deviation of the data. (2)

- (c) Give the full interval of possible ages within one standard deviation of the mean. (3)

- (d) Given the Ogive below of the data in the table on page 6. Answer the following questions:



Using the Ogive, answer the following questions:

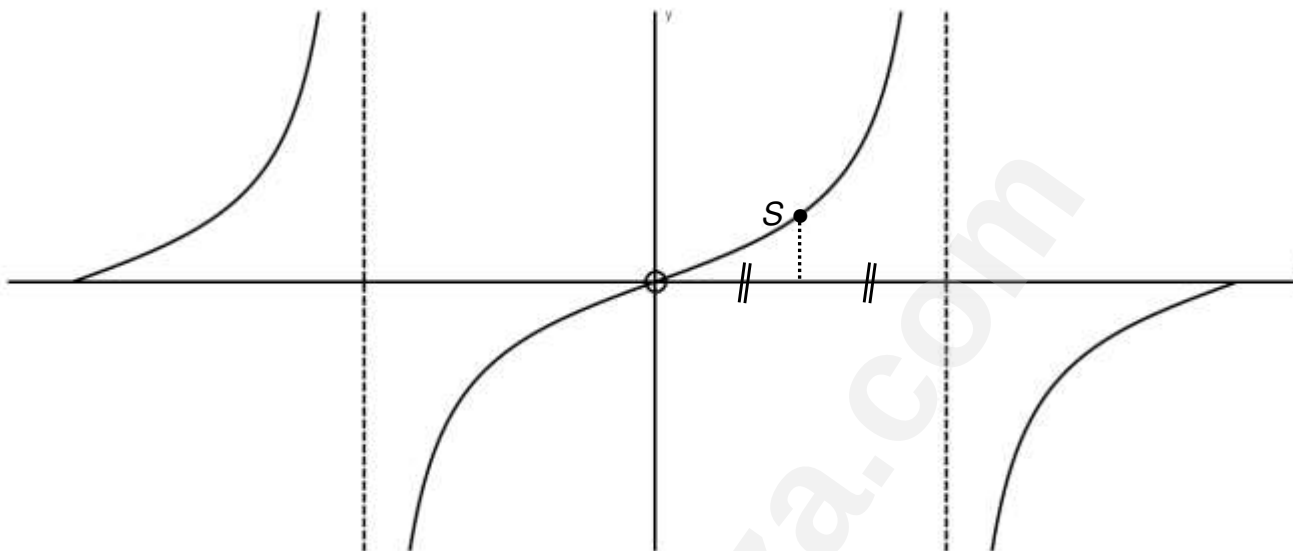
- (1) Determine the median value of the age on your Ogive. Indicate with the letter *A* where you read it on the graph. (2)

- (2) Determine the interquartile range from the Ogive. (3)

[13]

Question 4:

The function $f(x) = \tan 2x$ is sketched for $x \in [-90^\circ; 90^\circ]$.



- (a) Write down the equation of the asymptote to the right of the y-axis. (1)

- (b) Give the co-ordinates of the point S. (2)

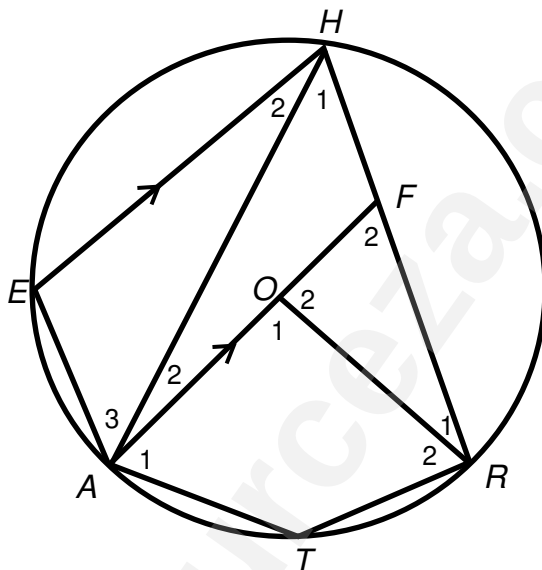
- (c) If $g = \frac{\sin x - 2\sin^3 x}{2\sin^2 x \cdot \cos x}$, show that $g = \frac{1}{f(x)}$. (5)

- (d) Hence, state the values of $x \in [-90^\circ; 90^\circ]$ where g is undefined. (2)

[10]

Question 5:

In the diagram, O is the centre of the circle $HEATR$. AOF is parallel to EH .
 $\hat{F}_2 = 78^\circ$ and $\hat{R}_1 = 22^\circ$.



Calculate, with reasons, the size of:

- $$(a) \quad \hat{O}_1 \quad (2)$$

- $$(b) \quad \hat{H}_1 \quad (2)$$

- $$(c) \quad \hat{T} \quad (2)$$

- $$(d) \quad \hat{H}_2 \quad (2)$$

[8]

Question 6:

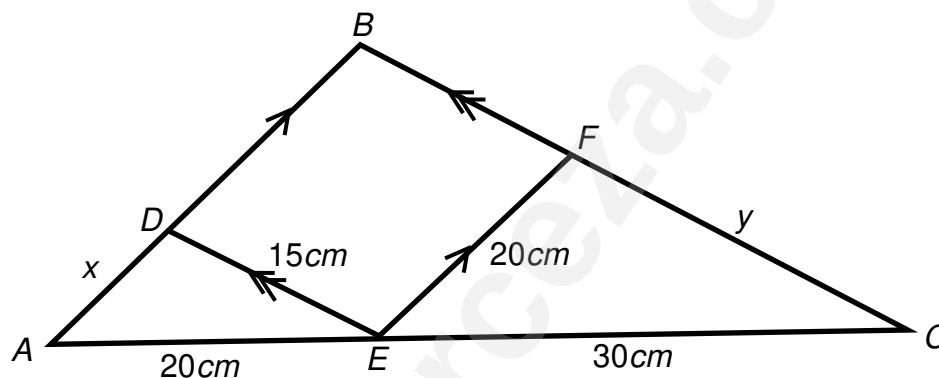
- (a) Complete the theorem that states: A line drawn parallel to one side of a triangle cuts the other 2 sides ... (1)

- (b) Given $\triangle ABC$ with D a point on AB such that $DE \parallel BC$ and F is a point such that $AB \parallel EF$.

Given:

$DE = 15\text{cm}$, $EF = 20\text{cm}$, $EC = 30\text{cm}$ and $AE = 20\text{cm}$.

$AD = x$ and $FC = y$.



- Determine, giving reasons, the values of x and y . (5)

Question 7:

- (a) Simplify to one trigonometric ratio:

$$\frac{2\cos(90^\circ + \theta)\sin 216^\circ \cos 396^\circ}{\sin 72^\circ} \quad (5)$$

- (b) Prove the following identity:

$$\frac{\sin \theta + \sin 2\theta}{1 + \cos \theta + \cos 2\theta} = \tan \theta \quad (4)$$

- (b) Given $\sin A = 2p$ and $\cos A = p$, and $0^\circ < A < 90^\circ$. With the aid of a sketch and without the use of a calculator, determine:

(1) the value of $\tan A$.

(2)

(2) the value of p .

(3)

[14]

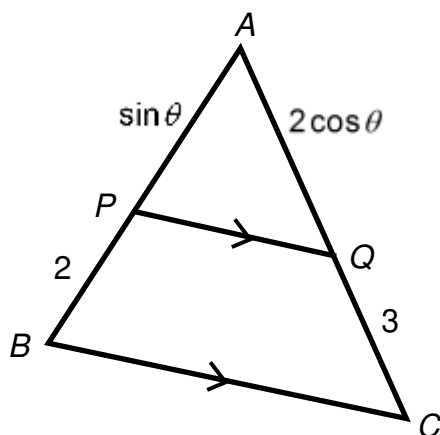
Question 8:

In the triangle below, $PQ \parallel BC$.

$$AP = \sin \theta, PB = 2, AQ = 2 \cos \theta, QC = 3$$

Determine the values of θ for which the diagram is valid, where $\theta \in [0^\circ; 360^\circ]$

(6)



[6]

Question 9:

In the sketch below,

DA and DB are tangents to the circle ABF at A and B .

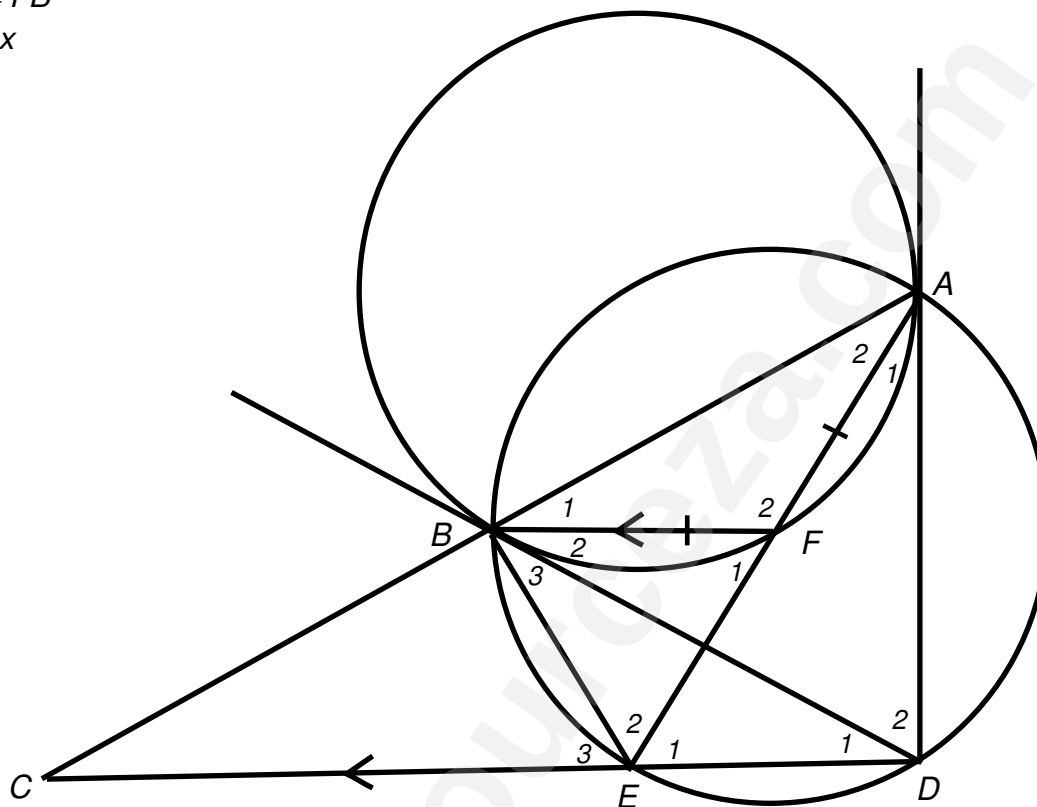
AB produced meets the line DC at C .

$DC \parallel BF$

AF produced meets DC at E .

$AF = FB$

$\hat{A}_1 = x$



- (a) Determine, giving reasons, 4 other angles which are equal to x .

(4)

(b) Prove $\hat{A}BE = 3\hat{A}_1$ (3)

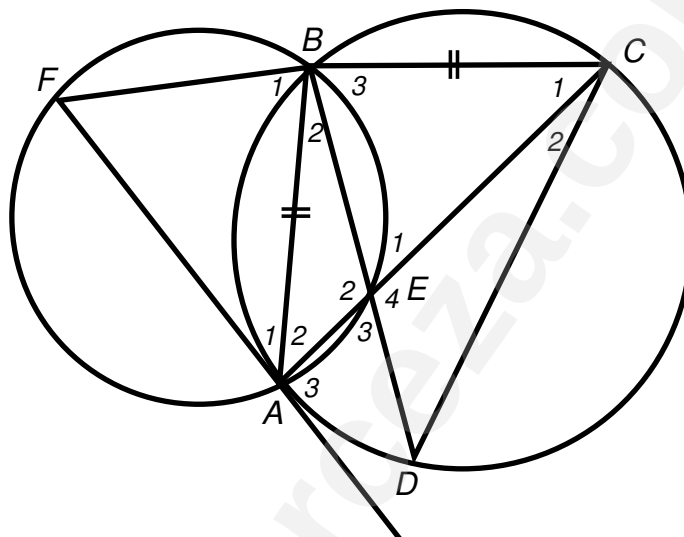
(c) Prove $AD = BC$ (3)

[10]

Question 10:

- (a) Complete the statement: "The exterior angle of a cyclic quadrilateral..." (1)

- (b) A, B, C and D are 4 points on the circumference of a circle such that $AB = BC$.
 AC and BD intersect at E .
 FA is a tangent to the circle $ABCD$.



Prove:

- (1) $\triangle BCD \sim \triangle BEC$ (4)

- (2) $\hat{C}_1 + \hat{C}_2 = \hat{F}$ (3)

[8]

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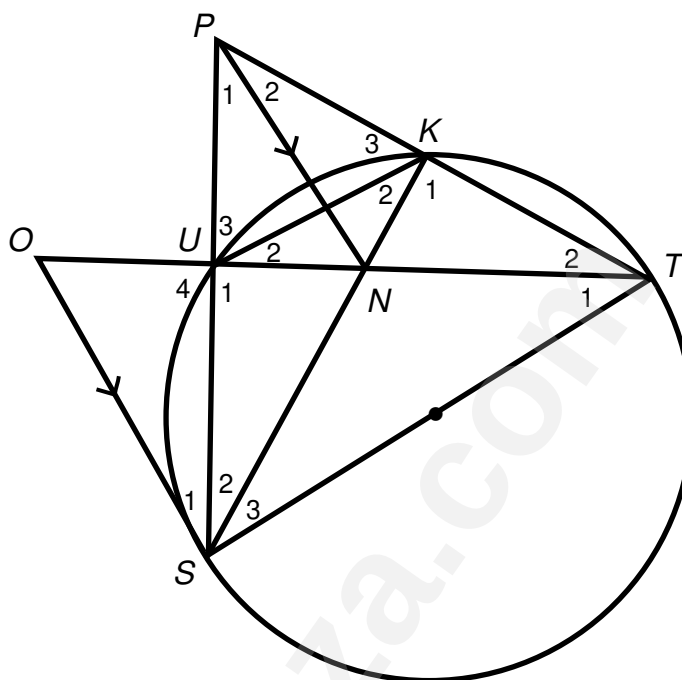
Question 11:

Refer to the diagram:

ST is a diameter of the circle.

OS // PN,

TO bisects $\hat{STP}$.



Prove that:

(a) $PUNK$ is a cyclic quadrilateral.

(5)

(b) SO is a tangent to circle $KUST$.

(5)

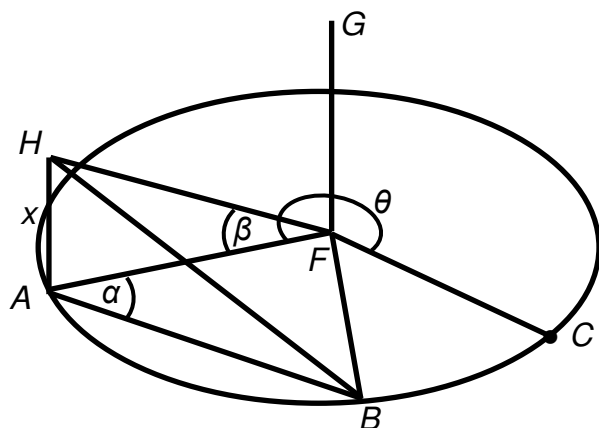
(c) $POST$ is a cyclic quadrilateral

(4)

[14]

Question 12:

Anele and Bina are playing on a merry-go-round. F is the centre of the merry-go-round and FG is the pole in the centre. Anele is leaning against pole AH which is x metres tall and Bina is standing at B . $\hat{AFH} = \beta$, $\hat{FAB} = \alpha$ and reflex angle $\hat{AFC} = \theta$.



- (a) Determine the radius of the merry-go-round in terms of x and β . (2)

- (b) Prove $AB = \frac{2x \cos \alpha}{\tan \beta}$ (4)

- (c) If $x = 0,7$ metres, $\alpha = 50^\circ$ and $\beta = 25^\circ$. Determine the length AB to 2 decimal places. (2)

- (d) A third friend Carmen gets on at point C. Bina and Carmen are 0,85 metres apart and $\theta = 247^\circ$. How far apart are Anele and Carmen? (5)

[13]

Question 13:

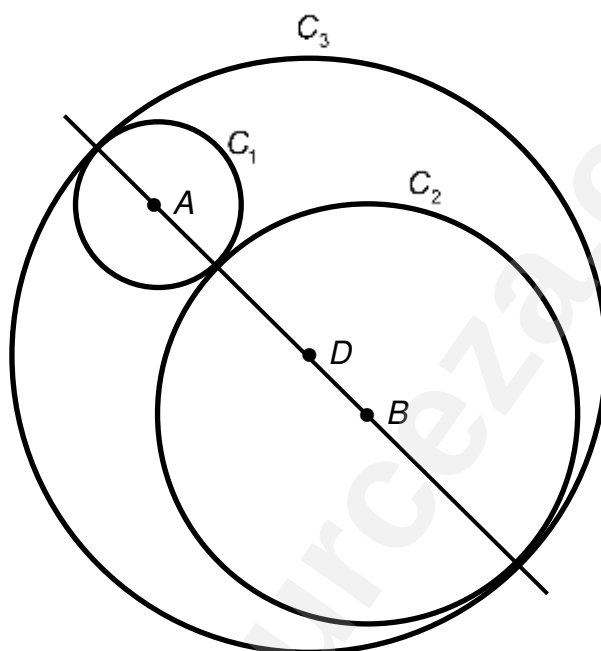
Circle C_1 has the equation $x^2 + y^2 + 6x - 10y + 9 = 0$ and its centre at A .

The centre of C_2 is $B(9; -11)$.

Circle C_1 and C_2 touch externally.

Circle C_3 , with centre D , is drawn so that C_1 , C_2 and C_3 touch internally.

The centres, A , B , and D are collinear.



- (a) Determine the centre of circle C_1 .

(3)

(b) Determine the radius of C_2 .

(4)

(c) Determine the equation of the straight line ADB .

(3)

(d) Determine the equation of C_3 .

(5)

[15]

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MARK RECORD SHEET**Name:** _____**Teacher:**Mr Nonyane ☐Mrs Marais ☐Mr Schaerer ☐Mrs Smith ☐

Question	Analytical Geometry	Euclidean Geometry & Measurement	Statistics	Trigonometry
1	/26			
2			/7	
3			/13	
4				/10
5		/8		
6		/6		
7				/14
8				/6
9		/10		
10		/8		
11		/14		
12				/13
13	/15			
TOTAL	/ 41	/ 46	/ 20	/ 43
TOTAL	/ 150		%	