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MATHEMATICS			
PRELIMINARY EXAM PAPER 2			
Examiner	L Mudzamiri	Marks	150
Moderator	C van de Venter	Time	3 Hours
Date handed out	18/09/2024	Due date	18/09/2024

NAME & CLASS:

INSTRUCTIONS:

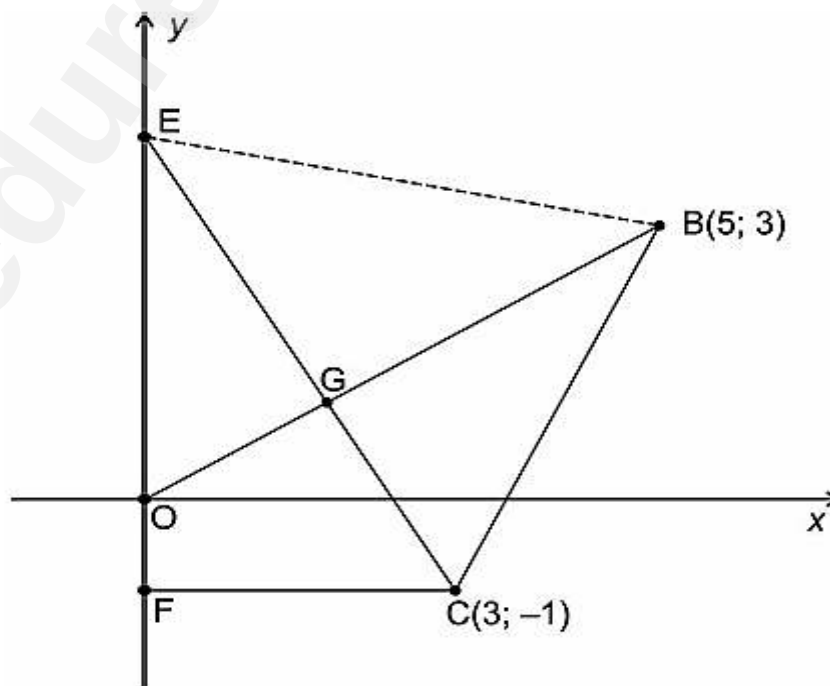
1. Write your name, surname, and class on this cover page.
2. This question paper consists of **13 questions** and **22 pages**.
3. Answer all the questions in the spaces provided on the question paper.
4. You may use an approved, non-programmable and non-graphical calculator, unless otherwise stated. Round off to 2 decimal places unless the context requires rounding up or down.
5. All the necessary working details must be clearly shown.
6. Write legibly and present your work neatly.
7. The **information sheet** is on pages **21** and **22** and you're allowed to detach it.

Question 1

[16]

In the diagram below:

- E, O and F lie on the y-axis
- The coordinates of B(5; 3) and C(3; -1) are given
- EC intersects OB at G
- FC is parallel to the x-axis



a) Calculate the gradient of OB.

(1)

b) Determine the coordinates of E if EC is perpendicular to OB.

(3)

c) Determine the length of straight line EB.

(2)

d) Calculate the coordinates of point G.

(5)

e) Consider $\triangle EFC$.

1) Calculate the area of $\triangle EFC$.

(2)

2) Hence, or otherwise, calculate the area of quadrilateral OGCF.

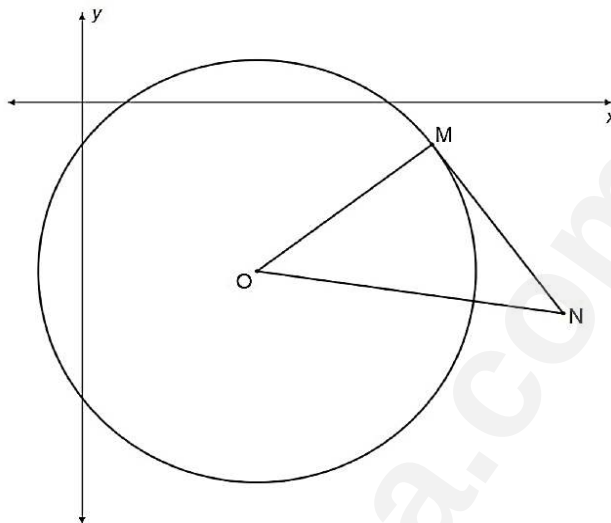
(3)

Question 2

[10]

In the diagram below, circle centre O is drawn in the Cartesian plane.

- MN is a tangent to the circle at M.
- N is a point outside the circle with coordinates $N(11; -5)$.



a) Write down the size of $\widehat{OMN}$ stating your reason. (2)

b) If the equation of the circle is $x^2 - 8x + (y + 4)^2 = 9$:

1) Determine the coordinates of O. (2)

2) Determine the length of OM. (2)

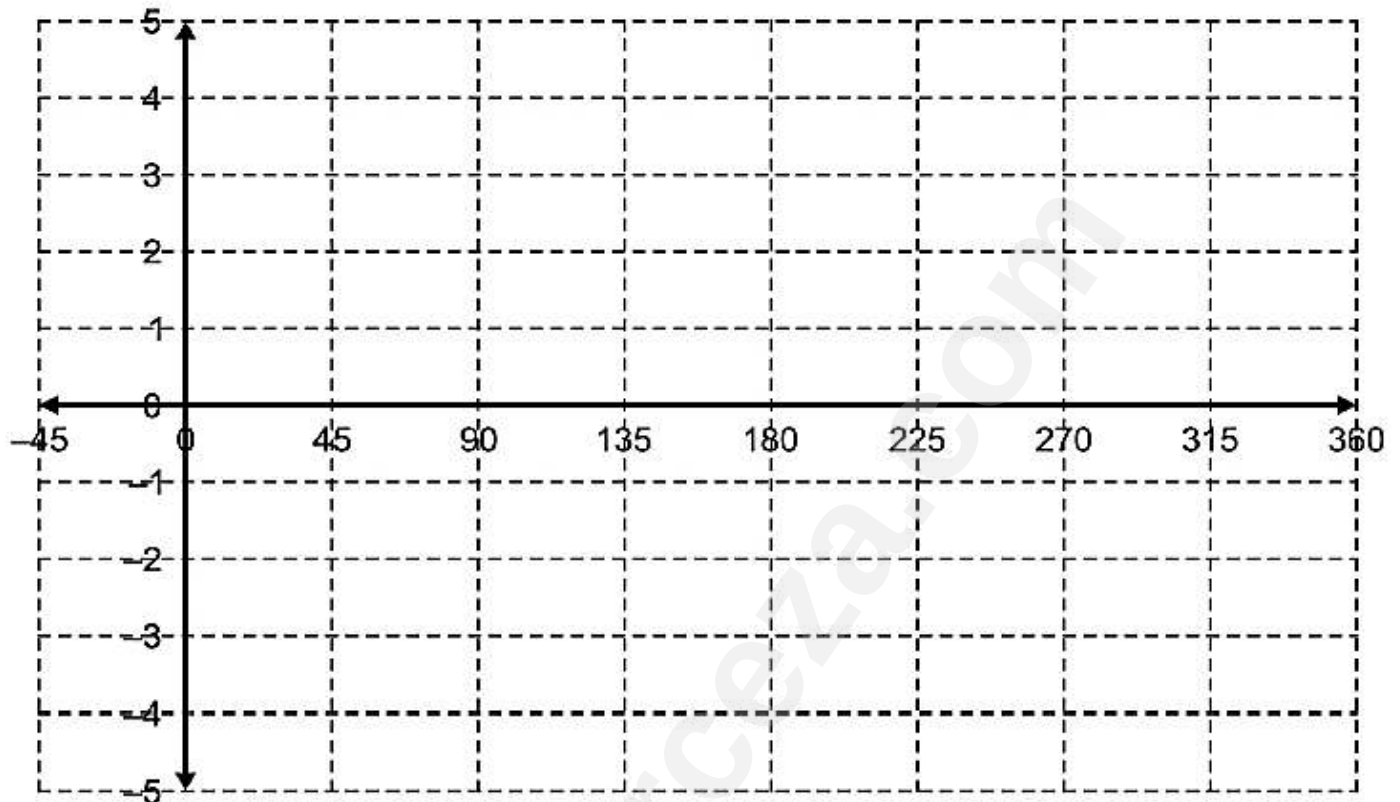
c) Calculate the length of MN. (4)

Question 3

[24]

Given that: $f(x) = 3 \sin(x - 45^\circ)$ and $g(x) = 2$.

- a) Sketch the graphs of $f(x)$ and $g(x)$ on the set of axes below for $x \in [-45^\circ; 360^\circ]$. (6)



- b) Determine **algebraically** correct to one decimal place, the values of $x \in [-45^\circ; 360^\circ]$ satisfying:

$$f(x) = g(x).$$

(4)

- c) For what values of $x \in [-45^\circ; 360^\circ]$ is $f(x) > g(x)$. (2)

d) Given that: $\frac{\cos 2\theta + 1}{\cos \theta} + 2 \tan \theta \cdot \sin \theta = \frac{A}{\cos \theta}$; where A is a constant.

1) Determine the value of A.

(4)

2) Determine all values of θ for which the following expression is undefined:

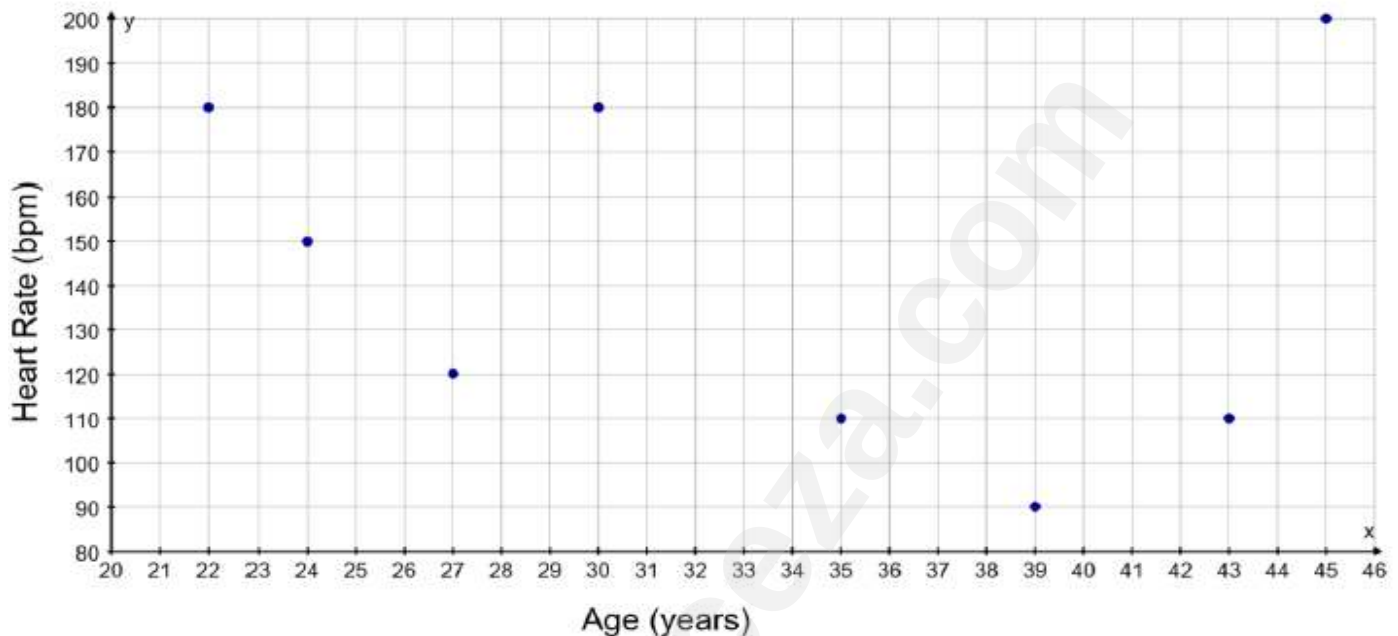
$$\frac{\cos 2\theta + 1}{\cos \theta} + 2 \tan \theta \cdot \sin \theta$$

(3)

e) If $5 \cos \beta = 4$ and $\beta \in [90^\circ; 360^\circ]$, determine the value of $3 \sin 2\beta$ without using a calculator. (5)

- a) The scatter graph below shows the age of eight individuals and their maximum heart rate in beats per minute (bpm) after a particular exercise programme.

SCATTER GRAPH: AGE/MAXIMUM HEART RATE

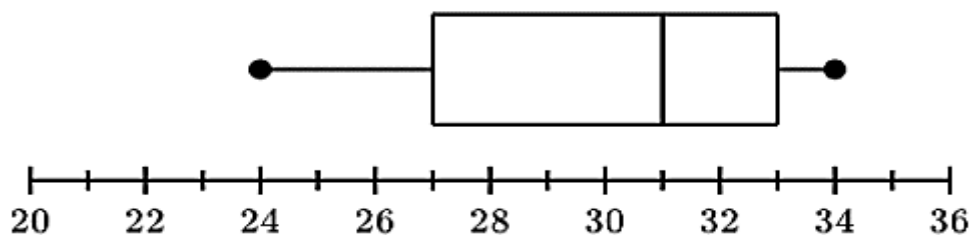


- 1) Use your calculator to determine the equation for the line of best fit in the form: $y = A + Bx$. Write down your answer correct to 3 decimal places. (3)

- 2) Use your equation to predict the maximum heart rate of a typical 55-year-old individual. (2)

- 3) Give two reasons why the prediction in question 4a2) above may not be reliable. (2)

- b) The box and whisker plot below represents the times in seconds taken by a group of 60 students to run 200 metres.



- 1) Calculate the number of students who ran between 31 and 33 seconds? (2)

- 2) Using: $Q_1 - 1.5 \times IQR$, determine whether 24 seconds would be an outlier or not. (2)

- 3) The time for the fastest student was recorded incorrectly. It was 25 seconds.
How would this affect the median? (1)

Question 5

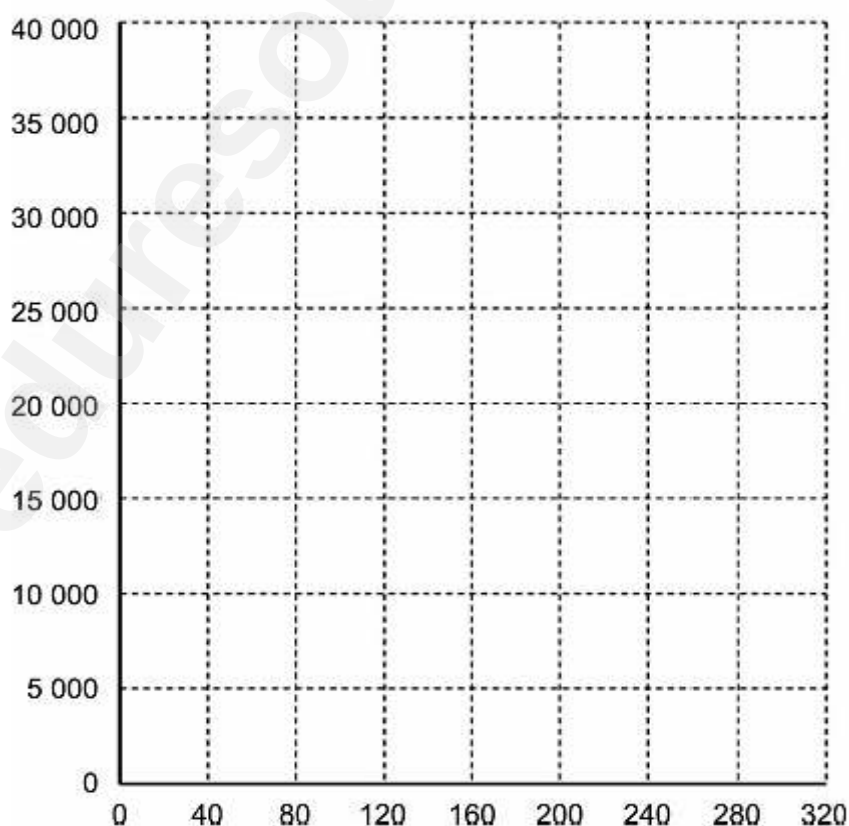
[16]

The table below summarises the amount of water consumed by individuals.

Number of litres used	Frequency	Midpoint	Cumulative Frequency
$0 < x \leq 40$	2 000	20	2 000
$40 < x \leq 80$	3 000	60	5 000
$80 < x \leq 120$	7 000	100	12 000
$120 < x \leq 160$	13 000	140	25 000
$160 < x \leq 200$	6 500	180	31 500
$200 < x \leq 240$	2 500	220	34 000
$240 < x \leq 280$	1 000	260	35 000

- a) Determine the estimated mean number of litres used by an individual. (2)

- b) Draw a cumulative frequency graph that represents the information in the table above. (4)



- c) Determine the median number of litres used by an individual. Show on your graph where you read this value. (2)

- d) How many individuals use more than 220 litres of water? Show on your graph where you would read this value. (2)

- e) At the time of the survey the maximum number of litres permitted per individual was 280 litres. If this restriction was reduced to 240 litres per individual, what would happen to:

- 1) The median? (Give a reason for your answer.) (2)

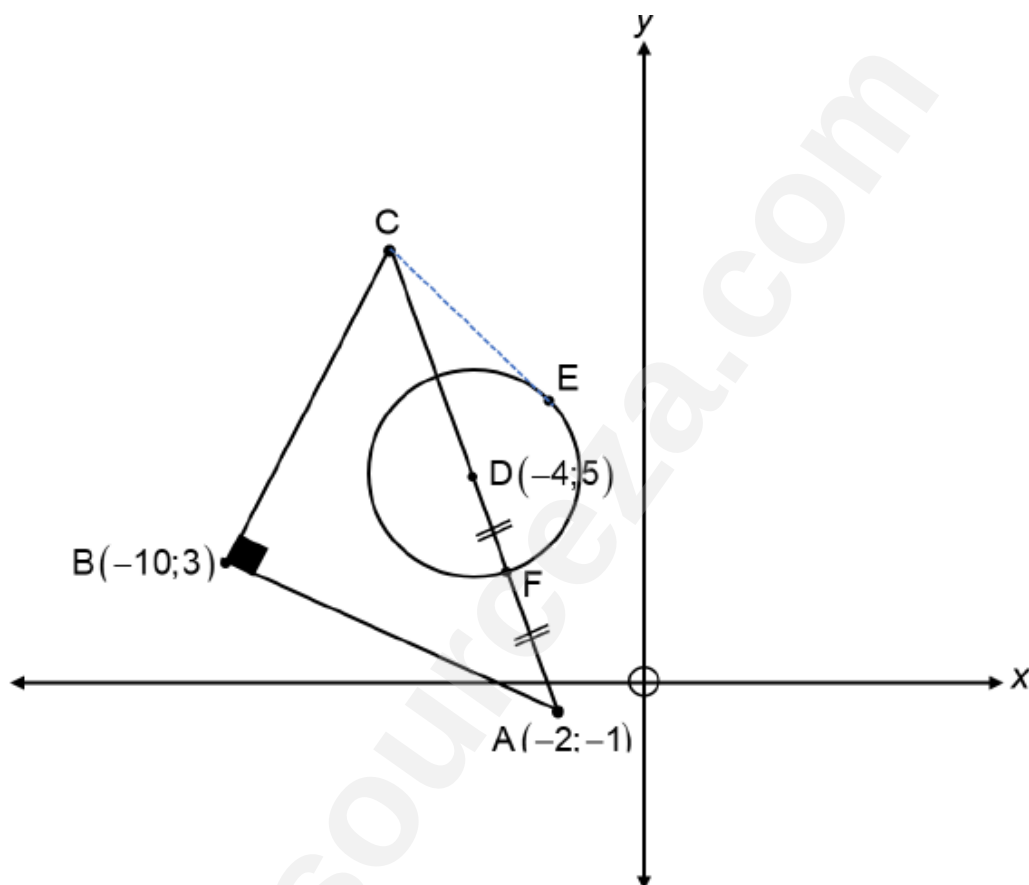
- 2) The standard deviation? (Give a reason for your answer.) (2)

- 3) The skewness of the data? (Give a reason for your answer.) (2)

Question 6

In the diagram below, $\triangle ABC$ is drawn with $A(-2; -1)$ and $B(-10; 3)$.

- $D(-4; 5)$ is the centre of the circle.
- ADC cuts the circle at F with $AF = FD$.
- E is a point on the circle such CE is a tangent to the circle at E .
- $BC \perp AB$.



a) Determine the equation of the circle with centre D .

(5)

b) Determine the coordinates of C.

(7)

c) Determine the length of the tangent CE, if it is given that the coordinates of C(−6; 11).

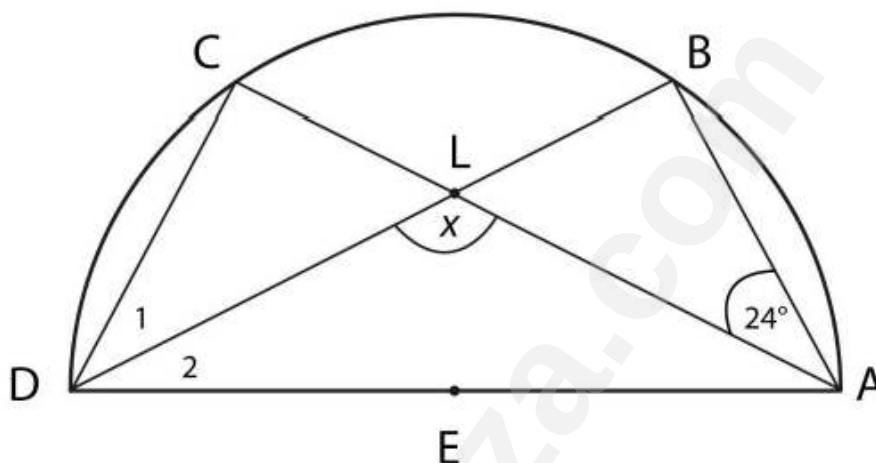
(4)

Question 7

[7]

In the diagram below, C and B lie on the semi-circle with centre E.

- AD is a diameter of the semi-circle.
- AC and BD intersect at L.
- $\widehat{CAB} = 24^\circ$
- $\widehat{DLA} = x$



a) Determine x stating reason/s.

(3)

Statement	Reason/s

b) Determine the size of $\widehat{D_1}$ stating reason/s.

(2)

Statement	Reason/s

c) If straight lines CE and BE are drawn, determine $\widehat{CEB}$.

(2)

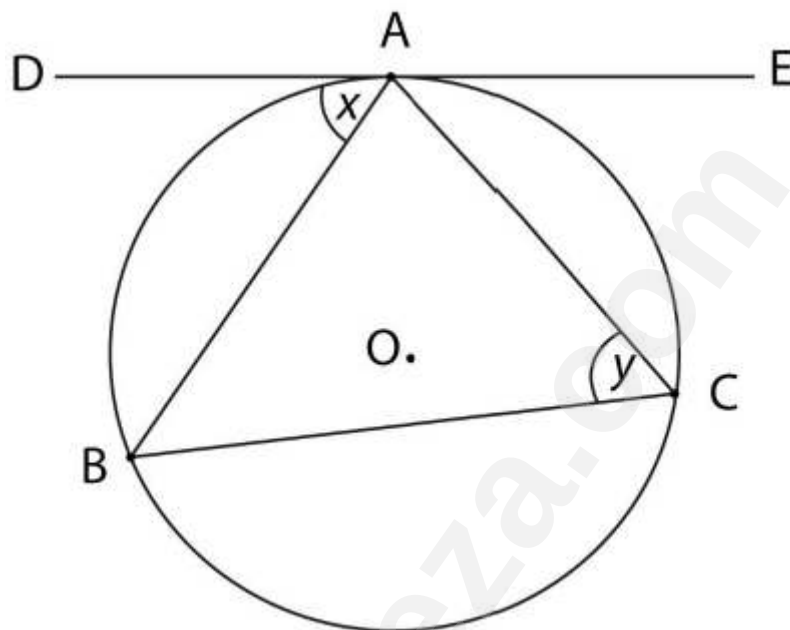
Statement	Reason/s

Question 8

[12]

a) In the diagram below, A, B and C lie on the circle with centre O.

- A, B and C are joined to form $\triangle ABC$.
- DE is a tangent to the circle at point A.



Prove by **constructing on the diagram above** the theorem which states that 'The acute angle between a tangent and a chord is equal to the angle in the alternate segment.'

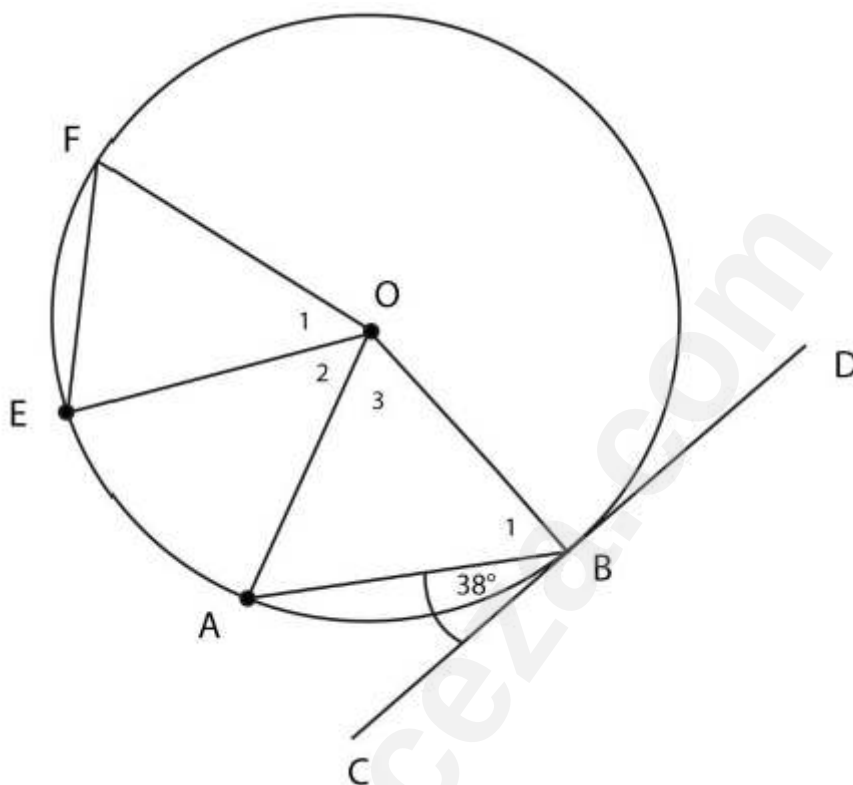
(6)

(Hint: Prove that $x = y$).

Statement	Reason/s

b) In the diagram below, F, E, A and B are points on the circle with centre O.

- CD is a tangent to the circle at B.
- $\widehat{ABC} = 38^\circ$



1) Determine $\widehat{A}$

(3)

Statement	Reason/s

2) If $EF = AB$, determine $\widehat{O_1}$

(3)

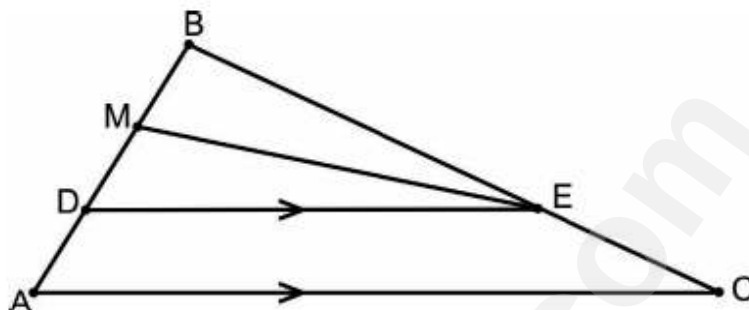
Statement	Reason/s

Question 9

[10]

In the diagram below, $\triangle ABC$ is drawn with D and E points on AB and CB respectively.

- M is a point on DB.
- $DE \parallel AC$.
- $AD = DM = MB$.



- a) Calculate $\frac{EC}{BE}$ (2)

Statement	Reason/s

- b) Calculate: $\frac{\text{Area } \triangle BME}{\text{Area } \triangle BAC}$ (4)

Statement	Reason/s

- c) If the length of DE = 17 units, find the length of AC. (4)

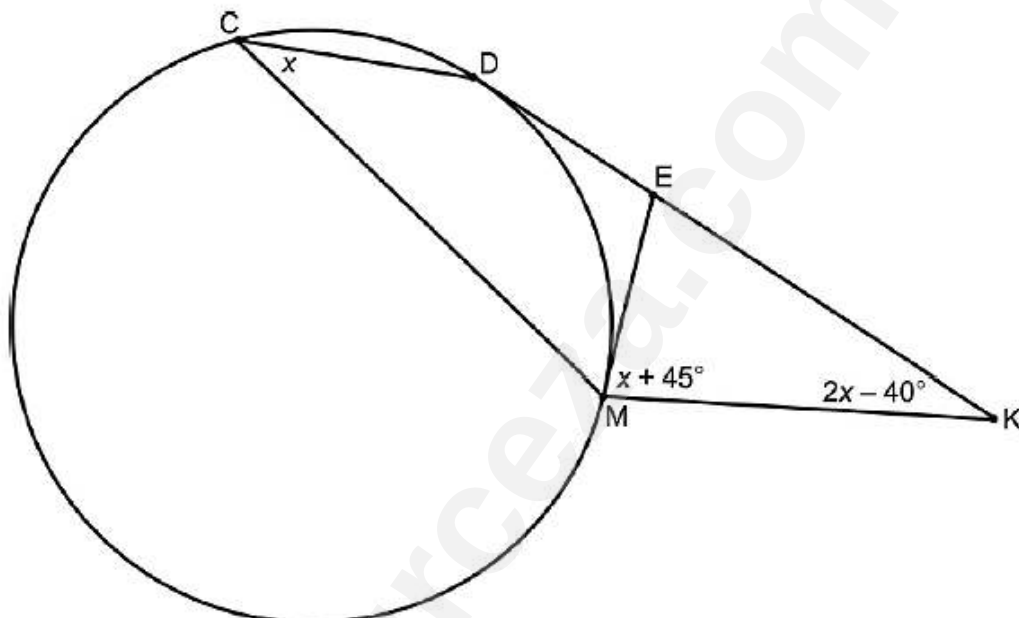
Statement	Reason/s

Question 10

[7]

In the diagram below, C, D and M are points on the circle.

- $\widehat{MCD} = x$
- KD is a tangent to the circle at D.
- E is a point on DK.
- EM is another tangent to the circle at M.
- $\widehat{KME} = x + 45^\circ$ and $\widehat{EKM} = 2x - 40^\circ$



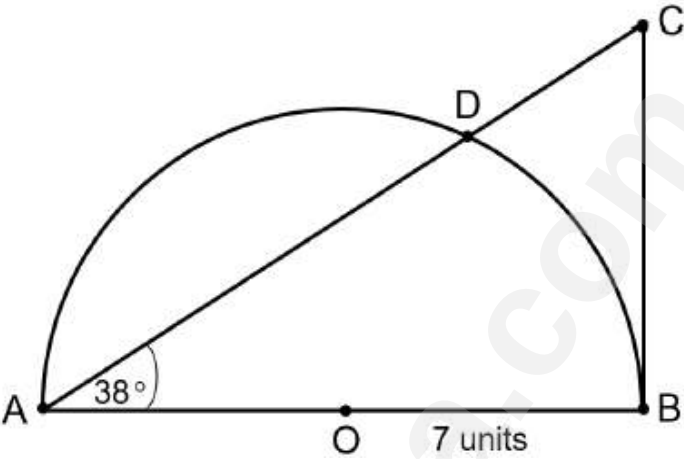
Determine the value of x .

(7)

Statement	Reason/s

In the diagram below:

- ABD is a semi-circle with centre O.
- CB is a tangent to the semi-circle at B.
- $OB = 7$ units and $\widehat{CAB} = 38^\circ$



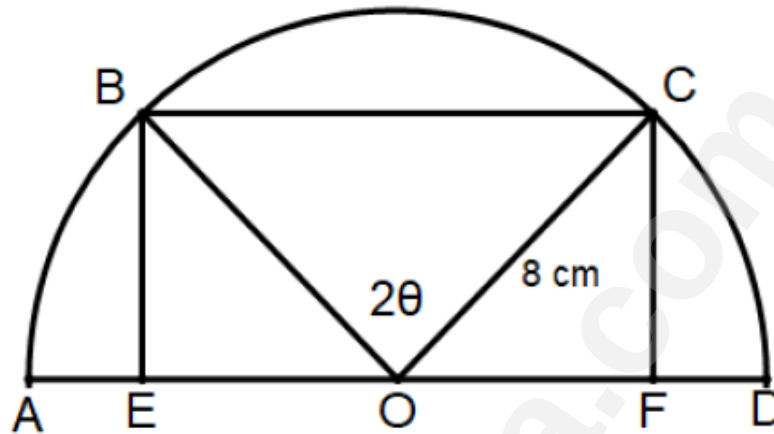
Determine the length of CD **with reasons**, correct to 1 decimal place. (7)

Statement	Reason/s

Question 12

In the diagram below:

- Rectangle EBCF is inscribed in a semicircle with centre O.
- The radius of the semicircle is 8 cm.
- $\widehat{BOC} = 2\theta$.



a) If the perimeter (P) of the rectangle EBCF is represented by P, show that:

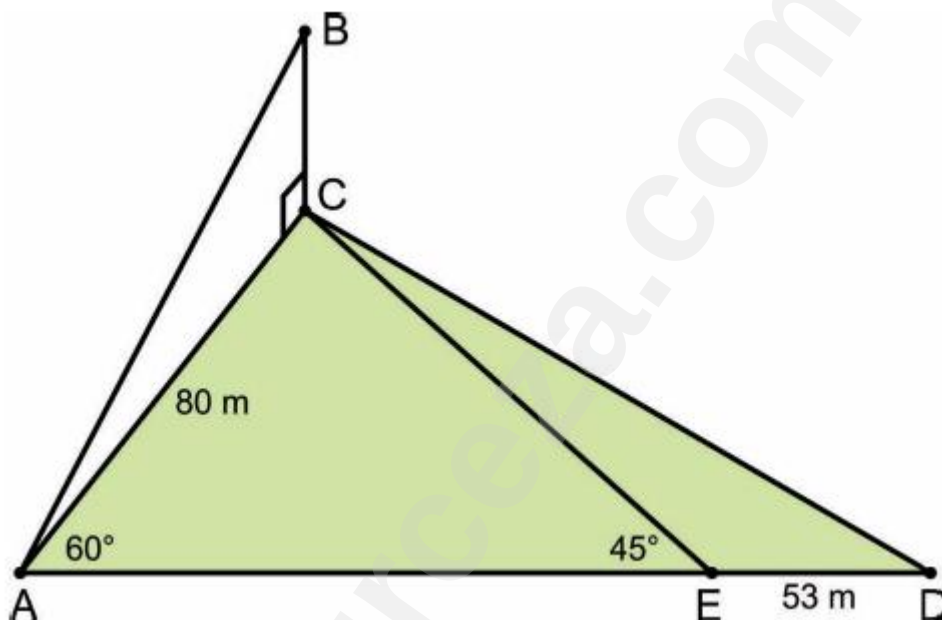
$$P = 16 \cos \theta + 32 \sin \theta.$$

(4)

b) If it is further given that $P = 16\sqrt{5} \sin(\theta + \alpha)$ and α is an acute angle, determine the value of α .

(3)

- ACD is a triangular field on a horizontal ground.
- E is a point on AD.
- BC is a vertical building.
- AC = 80 m and ED = 53 m.
- $\widehat{CAE} = 60^\circ$ and $\widehat{CEA} = 45^\circ$



Calculate the length of CD.

(6)

[illegible]

MARKS = 150

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

$$\sum_{i=1}^n 1 = n$$

$$T_n = a + (n-1)d$$

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

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

$$A = P(1 + ni)$$

$$A = P(1 + i)^n$$

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

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$y = mx + c$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

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

$$\sum_{i=1}^n i = \frac{n(n+1)}{2}$$

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

$$S_\infty = \frac{a}{1-r}; -1 < r < 1$$

$$A = P(1 - ni)$$

$$A = P(1 - i)^n$$

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

$$M \left(\frac{x_1 + x_2}{2}; \frac{y_1 + y_2}{2} \right)$$

$$y - y_1 = m(x - x_1)$$

$$m = \tan \theta$$

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

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

$$\text{area } \triangle ABC = \frac{1}{2} ab \sin C$$

$$\sin(\alpha + \beta) = \sin \alpha \cos \beta + \cos \alpha \sin \beta$$

$$\sin(\alpha - \beta) = \sin \alpha \cos \beta - \cos \alpha \sin \beta$$

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

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

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

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

$$\bar{x} = \frac{\sum fx}{n}$$

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

$$P(A) = \frac{n(A)}{n(S)}$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$\hat{y} = a + bx$$

$$b = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}$$