



NATIONAL SENIOR CERTIFICATE EXAMINATION  
NOVEMBER 2015

**MATHEMATICS: PAPER II**

EXAMINATION NUMBER

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Time: 3 hours

150 marks

**PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY**

1. This question paper consists of 27 pages and an Information Sheet of 2 pages (i – ii). Please check that your paper is complete.
2. Read the questions carefully.
3. **Answer ALL the questions on the question paper and hand this in at the end of the examination. Remember to write your examination number on the space provided.**
4. Number your answers exactly as the questions are numbered.
5. Diagrams are not necessarily drawn to scale.
6. You may use an approved non-programmable and non-graphical calculator, unless otherwise stated.
7. Ensure that your calculator is in **DEGREE** mode.
8. Round off your answers to one decimal digit where necessary, unless otherwise stated.
9. All the necessary working details must be clearly shown.
10. It is in your own interest to write legibly and to present your work neatly.

**FOR OFFICE USE ONLY: MARKER TO ENTER MARKS**

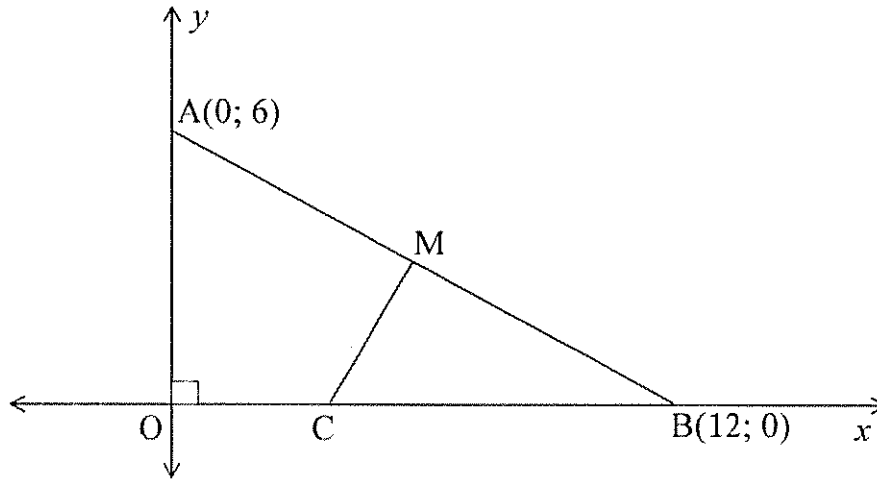
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	TOTAL
13	7	14	3	14	6	10	8	7	20	19	21	8	/150

**SECTION A**

**QUESTION 1**

In the diagram below:

- AB is drawn with A(0; 6) and B(12; 0).
- M is the midpoint of AB.
- AMCO is a cyclic quadrilateral.



(a) Determine the coordinates of point M.

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(2)

(b) Write down, giving reasons, the size of  $\widehat{CMA}$  and hence determine the equation of line MC.

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(5)

(c) (1) Show that the area of  $\Delta MCB$  is  $11,25 \text{ units}^2$ .

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(4)

(2) Determine the area of  $AMCO$ .

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(2)  
[13]

**QUESTION 2**

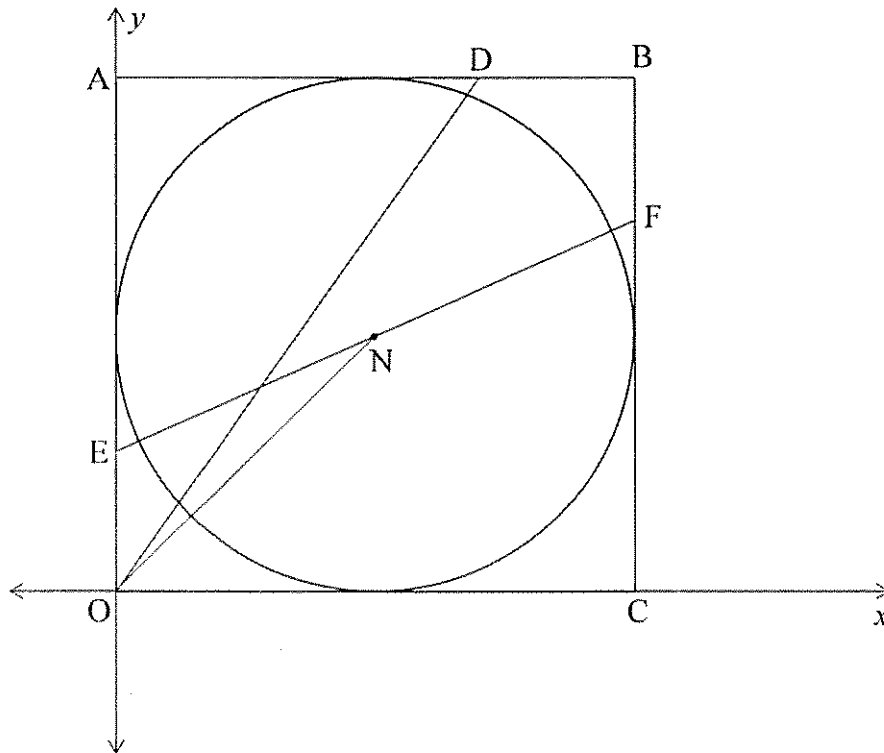
In the diagram below, circle centre N is drawn.

The equation of OD is  $7y = 10x$ .

The equation of ON is  $y = x$ .

The equation of EF is  $y = \frac{1}{2}x + 4$ .

OABC is a square that touches the circle at four points on the circumference.



- (a) Show that N (8; 8).

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(3)

- (b) Write down the coordinates of B.

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(1)

(c) Determine the length of DB.

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(3)

[7]

**QUESTION 3**

(a) Simplify the following expression as far as possible.

(1) 
$$\frac{\sin(180^\circ - \theta) \cdot \cos(90^\circ - \theta) - 1}{\cos(-\theta)}$$

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(4)

(2) Hence determine for which value(s) of  $\theta \in [0^\circ; 360^\circ]$ ,  $\sqrt{\frac{\sin(180^\circ - \theta) \cdot \cos(90^\circ - \theta) - 1}{\cos(-\theta)}}$  will be real.

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(2)

(b) Prove the following identity:

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

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(3)

(2) Hence; determine the general solution to:

$$\tan \theta \sin \theta + \cos \theta = \frac{3}{\sin \theta}$$

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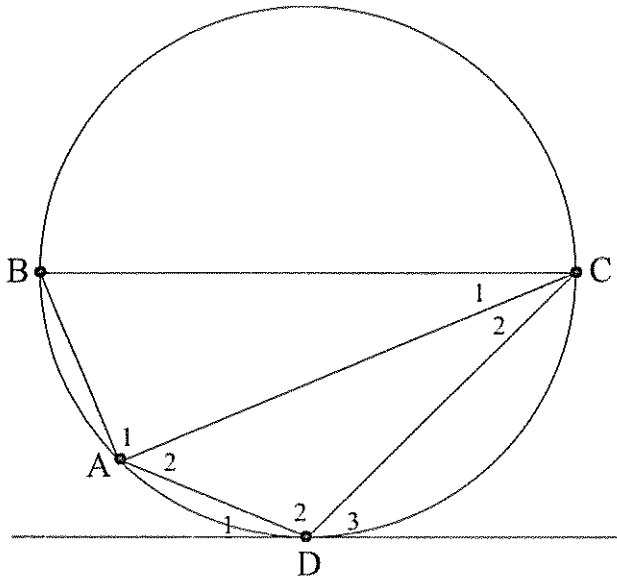
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(5)  
[14]

**QUESTION 4**

In the diagram below:

- Points A, B, C and D lie on the circle.
- A tangent is drawn at point D with a chord drawn from A to C.



Prove that  $\hat{C}_2 + \hat{D}_3 = \hat{B}$ .

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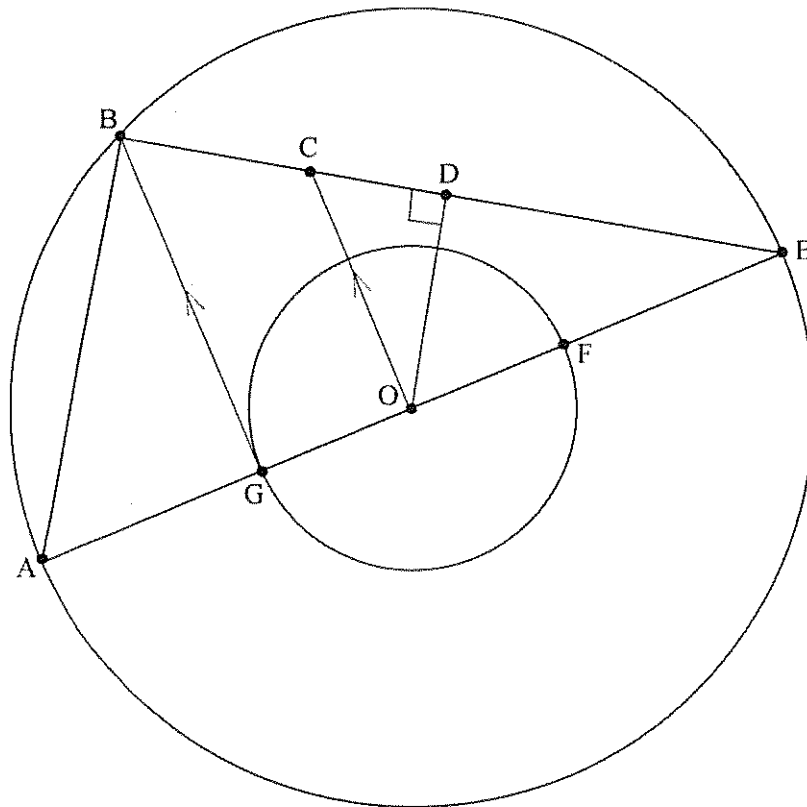
(3)  
[3]





(b) In the diagram below, O is the centre of two concentric circles.

- AE is a diameter of the larger circle and is 20 units long.
- GF is a diameter of the smaller circle and is 8 units long.
- Chord AB has a length of 12 units.
- OD is perpendicular to BE.
- OC // GB.



(1) Determine, giving reasons, the length of BE.

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(2)

(2) Determine, giving reasons,  $\frac{BC}{CE}$ .

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(2)

(3) Hence, or otherwise, determine, giving reasons, the length of CD.

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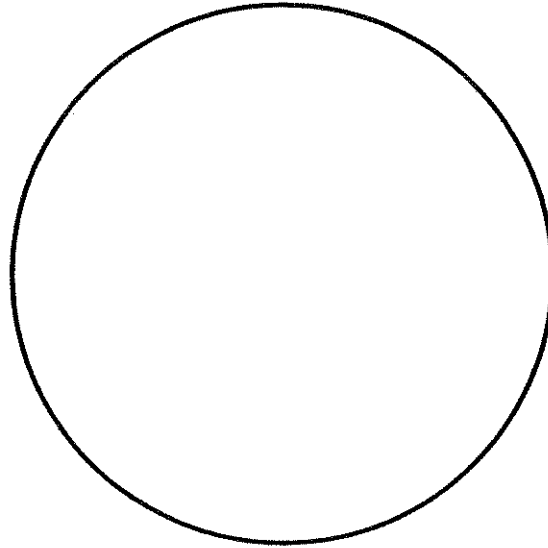
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(4)  
[14]

**QUESTION 6**

- (a) In the circle below, draw any two chords (not diameters), AB and CD intersecting at E, a point inside the circle.



(1)

- (b) Prove that  $\triangle AEC \sim \triangle DEB$ .

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(3)

- (c) Prove that  $AE \cdot EB = CE \cdot ED$ .

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(2)  
[6]

**QUESTION 7**

(a) Study the table below and answer the questions that follow.

$x$	1,3	2,1	4,2	5	6,8	9
$y$	3,2	6,4	14,8	18	25,2	34

(1) Calculate the line of best fit.

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(3)

(2) Comment on your answer in (1) by first calculating the correlation co-efficient.

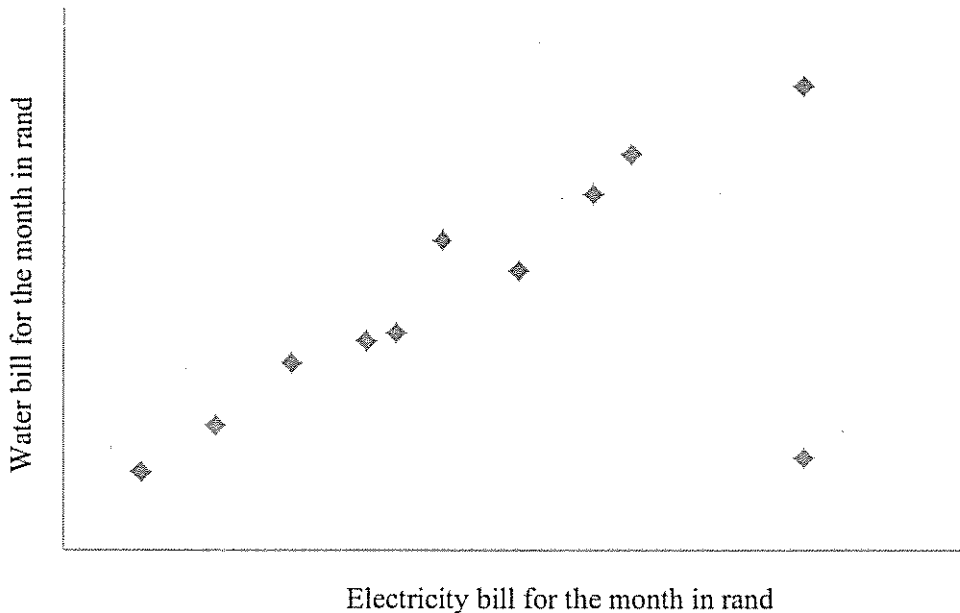
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(2)

(b) The scatter plot below is a graphical representation of the relationship between a household's monthly electricity bill and their monthly water bill within the same suburb. *Electricity bills between R100 and R1 000 were used in the study.*



(1) Label the outlier on the diagram above with the letter T.

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(1)

- (2) Comment on the relationship between a household's monthly electricity bill and monthly water bill.

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(1)

- (3) If the outlier was removed from the data above, how would this affect the correlation coefficient?

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(1)

- (4) The equation for the line of best fit is  $y = A + Bx$  (including the outlier). If the outlier was excluded, what would happen to the value of B?

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(1)

- (5) If a household has a monthly electricity bill of **R3 000**, can you estimate the amount that will appear on the water bill for the month by using the equation above? (Explain your answer.)

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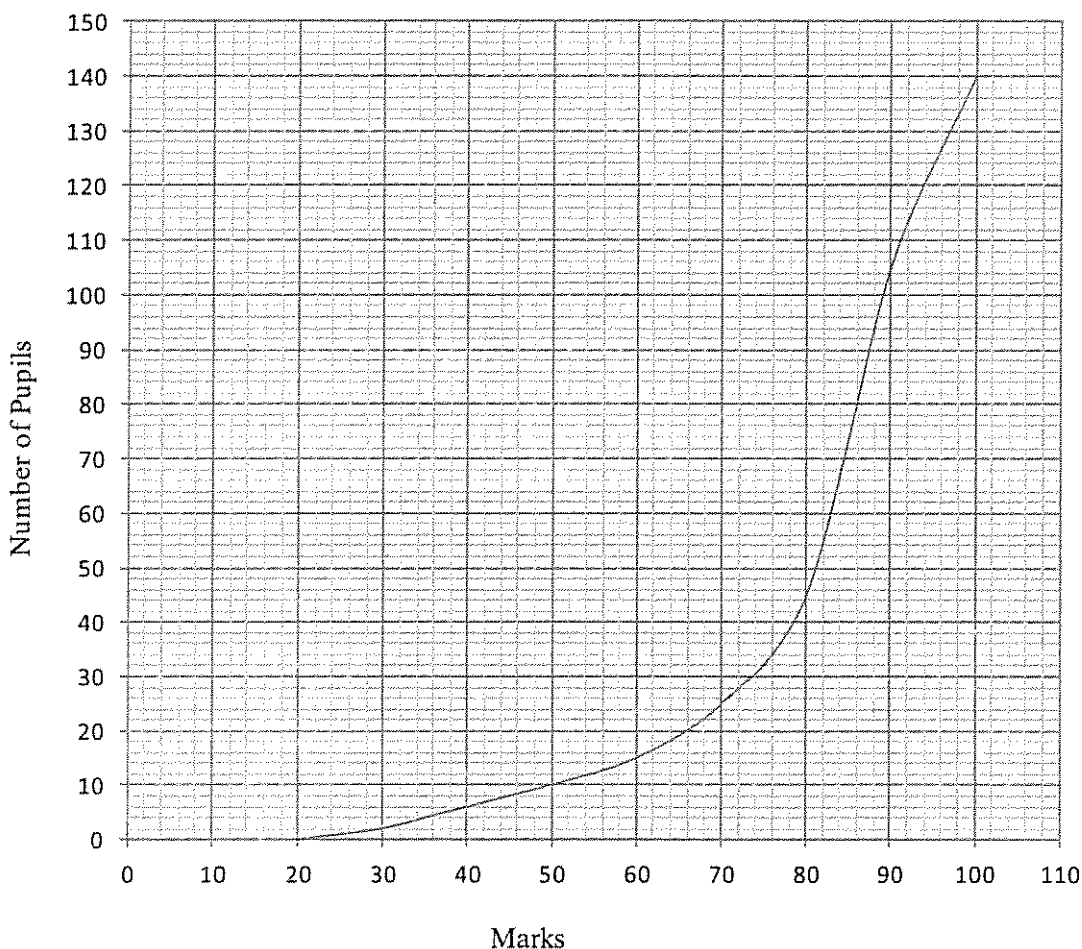
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(1)

[10]

**QUESTION 8**

The diagram below is an ogive for the mark distribution of a certain grade.



(a) On the same grid as the ogive, sketch the histogram for the mark distribution of the grade. Assume 8 equal class intervals. (5)

(b) Describe the skewness of the mark distribution. (1)

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(c) State whether the statement is TRUE or FALSE. Explain. (2)

The median is closer to the upper quartile than the lower quartile. (8)

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**75 marks**

**SECTION B**

**QUESTION 9**

(a) What statement can be deduced from **all** of the following statements?

$$\hat{A} + \hat{B} + \hat{C} = 180^\circ.$$

$$\hat{D} + \hat{E} + \hat{F} = 180^\circ.$$

$$\hat{A} = \hat{E}.$$

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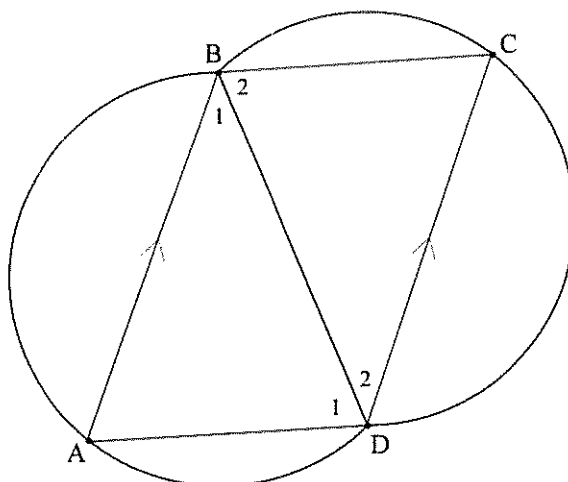


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(1)

(b) In the diagram below:

- Two major segments of circles are drawn with BD a common chord.
- Both circles have equal diameters.
- Chord AB is parallel to chord CD.



Prove that ABCD is a parallelogram.

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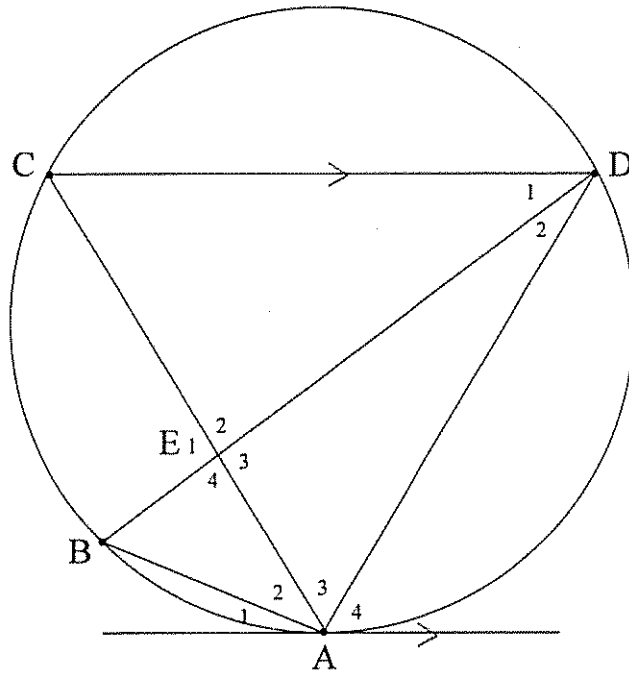
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(6)  
[7]



**QUESTION 10**

- (a) In the diagram below, the tangent at point A is parallel to chord CD. C; D; A and B lie on the circumference of the circle.



If  $\widehat{B} = 55^\circ$  and  $\widehat{A}_1 = 18^\circ$ , then calculate the size of  $\widehat{E}_2$ , giving reasons for your statements.

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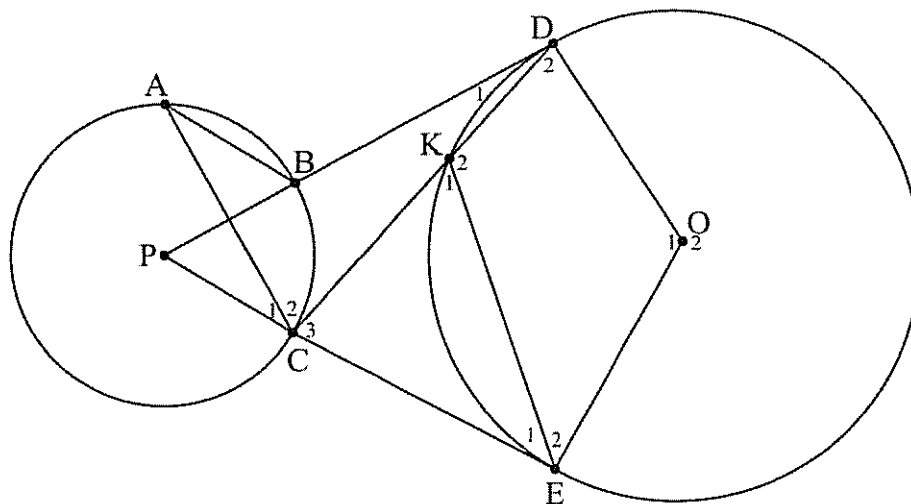
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(6)

- (b) In the diagram below, circles with centres P and O are drawn.
- Tangents PD and PE to circle O cut the circle P at B and C respectively.
  - A is a point on the major arc BC.
  - DC cuts circle O at K.



(1) Prove that  $\hat{O}_1 + 2\hat{A} = 180^\circ$ .

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(8)

(2) Prove that  $\hat{C}_3 + \hat{E}_1 = 90^\circ + \hat{A}$ .

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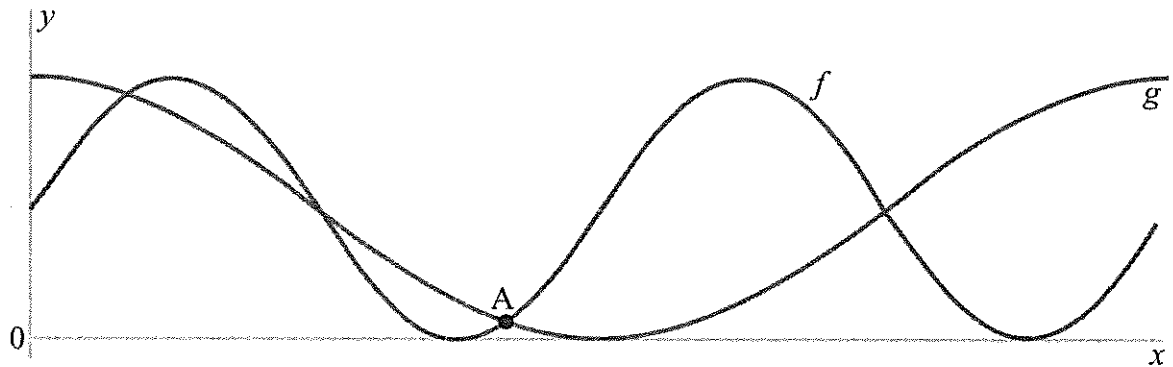
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(6)  
[20]

**QUESTION 11**

(a) The diagram below is a sketch of  $f(x)$  and  $g(x)$ :

- $f(x) = 2 \sin 2x + 2$
  - $g(x) = 2 \cos x + 2$
- $x \in [0^\circ ; 360^\circ]$



Calculate the coordinates of point A. (Show your working.)

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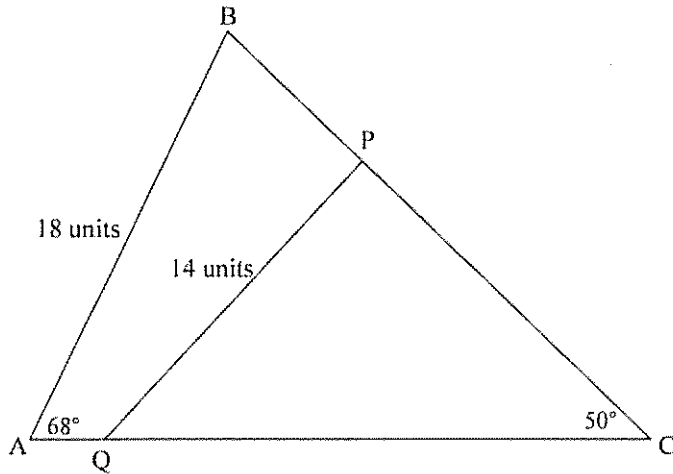
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(7)

- (b) In the diagram below, an acute-angled triangle ABC is drawn:
- A line PQ is drawn, where P lies on the line BC and Q lies on the line AC.
  - The length of PQ is 14 units and the length of AB is 18 units.
  - $\hat{A} = 68^\circ$  and  $\hat{C} = 50^\circ$ .



If the ratio of BP : PC is 2 : 3 determine the size of  $\hat{PQC}$ .

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(6)

- (c) Prove that  

$$\frac{\cos(A - 45^\circ)}{\cos(A + 45^\circ)} = \frac{1 + \sin 2A}{\cos 2A}.$$

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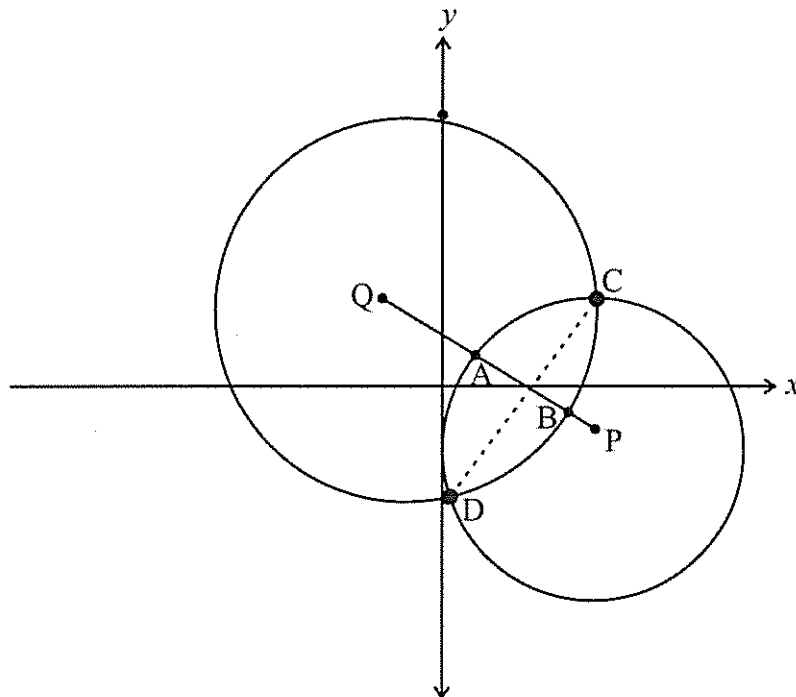
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(6)  
 [19]

**QUESTION 12**

In the diagram below, P and Q are the centres of circles having equations:

$(x - 7)^2 + (y + 2)^2 = 49$  and  $x^2 + y^2 + 10x - 6y = 30$ .



- (a) Determine the radius of the circle having centre Q.

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(4)

- (b) Calculate the length of PQ.

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(3)

(c) Show that the equation of PQ is  $5x + 12y = 11$ .

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(4)

(d) Determine the coordinates of A.

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(5)

(e) Determine the equation of chord CD.

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(3)



(f) Prove that  $CD \perp PQ$ .

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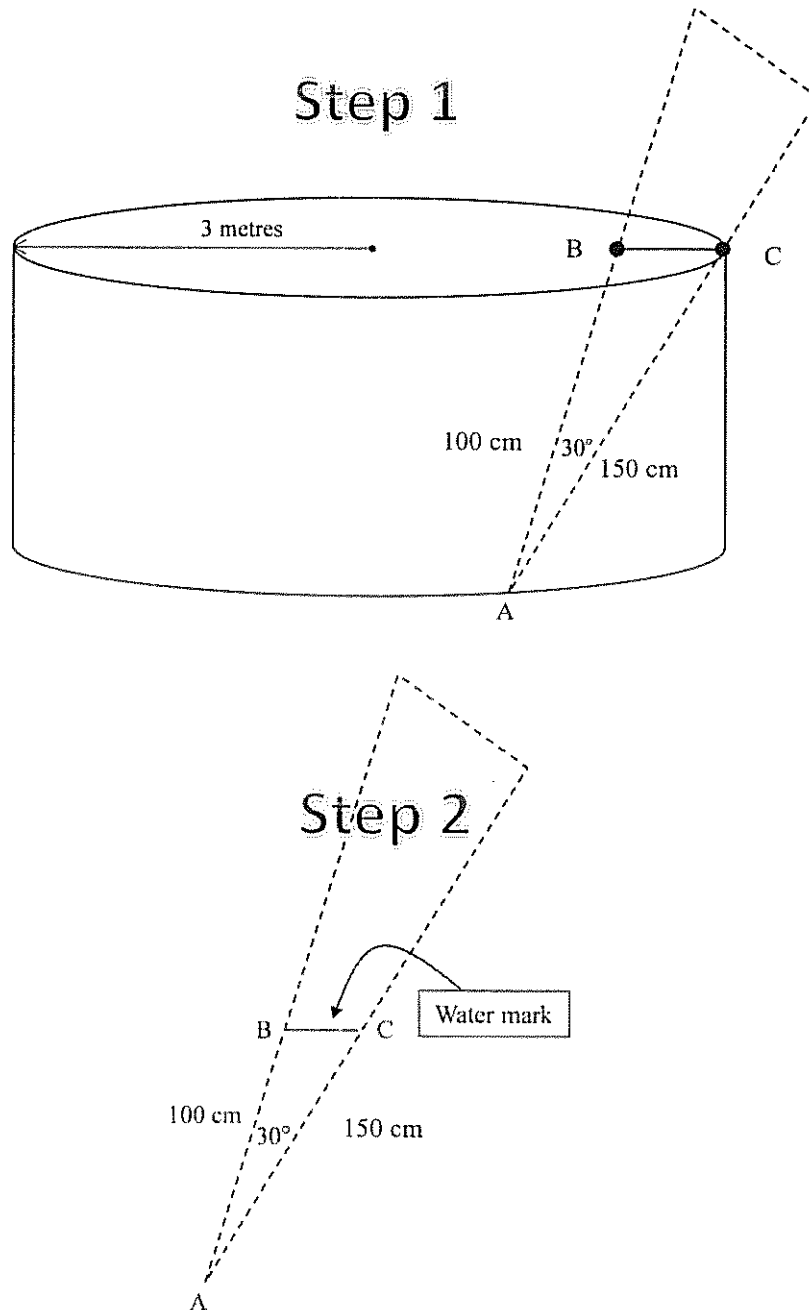
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(2)  
[21]

**QUESTION 13**

A farmer has come up with an accurate way to measure the volume of water in his water tank:

- You place the triangular wedge with  $\hat{A} = 30^\circ$  in the water tank until point A is touching the bottom of the tank. (Step 1)
- You pull the triangular wedge out of the tank and look for the water mark made on the wedge. This is indicated in Step 2 as line BC.



If the farmer's water tank has a radius of 3 metres, and he measures AB to be 100 cm and AC to be 150 cm, determine the volume of water in the water tank.

*(Only round off at the end of your calculation.)*  $v = \pi r^2 h$



