



# basic education

Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 11**

**MATHEMATICS P2**

**NOVEMBER 2015**

**MARKS: 150**

**TIME: 3 hours**

**This question paper consists of 15 pages and a 24-page answer book.**

**INSTRUCTIONS AND INFORMATION**

Read the following instructions carefully before answering the questions.

1. This question paper consists of 11 questions.
2. Answer ALL the questions in the SPECIAL ANSWER BOOK provided.
3. Clearly show ALL calculations, diagrams, graphs et cetera that you used to determine the answers.
4. Answers only will NOT necessarily be awarded full marks.
5. If necessary, round off answers to TWO decimal places, unless stated otherwise.
6. Diagrams are NOT necessarily drawn to scale.
7. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
8. Write neatly and legibly.

**QUESTION 1**

The table below shows the weight (to the nearest kilogram) of each of the 27 participants in a weight-loss programme.

56	68	69	71	71	72	82	84	85
88	89	90	92	93	94	96	97	99
102	103	127	128	134	135	137	144	156

- 1.1 Calculate the range of the data. (2)
- 1.2 Write down the mode of the data. (1)
- 1.3 Determine the median of the data. (1)
- 1.4 Determine the interquartile range of the data. (3)
- 1.5 Use the number line provided in the ANSWER BOOK to draw a box and whisker diagram for the data above. (2)
- 1.6 Determine the standard deviation of the data. (2)
- 1.7 The person weighing 127 kg states that she weighs more than one standard deviation above the mean. Do you agree with this person? Motivate your answer with calculations. (3)
- [14]

**QUESTION 2**

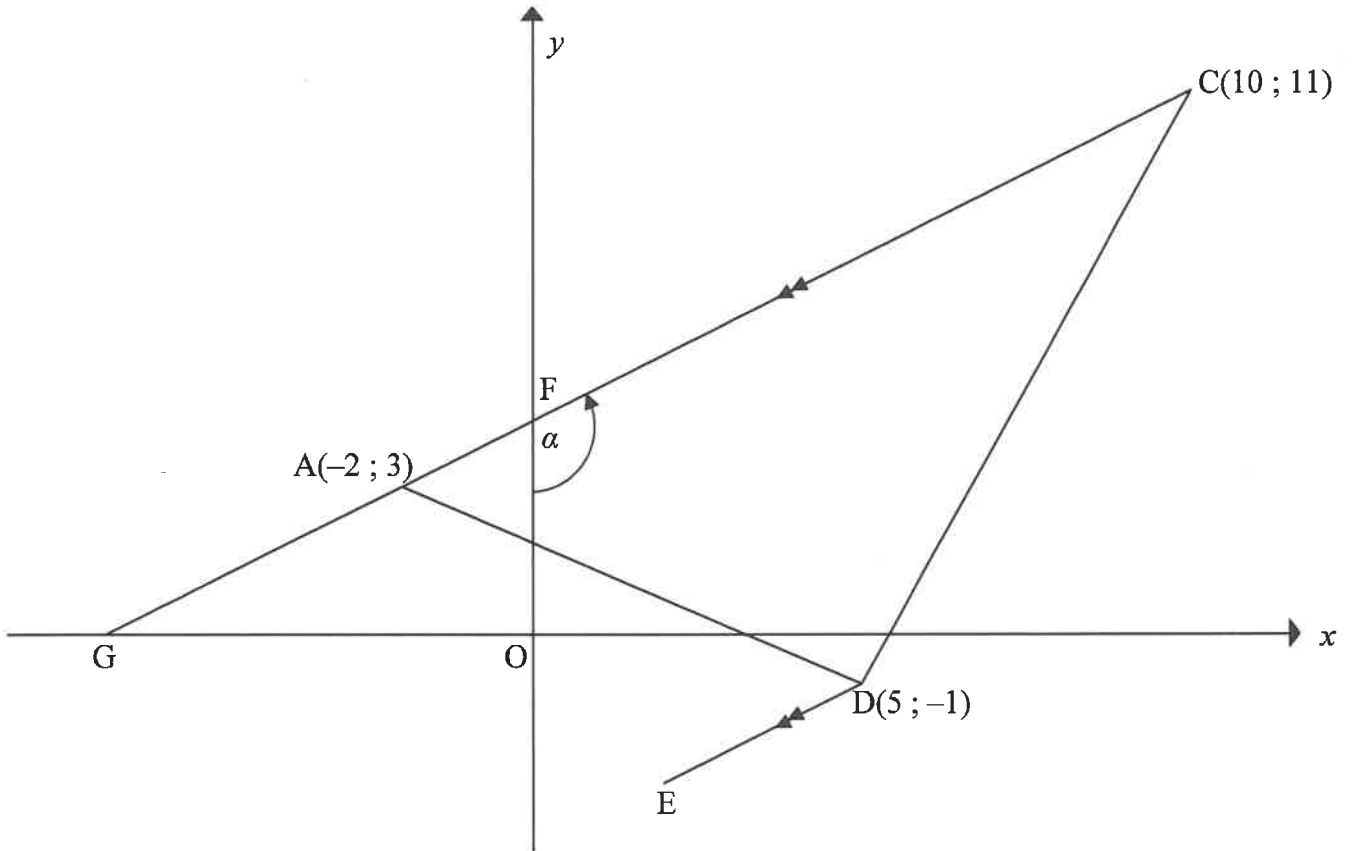
The table below shows the weight (in grams) that each of the 27 participants in the weight-loss programme lost in total over the first 4 weeks.

<b>WEIGHT LOSS OVER 4 WEEKS (IN GRAMS)</b>	<b>FREQUENCY</b>
$1\ 000 < x \leq 1\ 500$	2
$1\ 500 < x \leq 2\ 000$	3
$2\ 000 < x \leq 2\ 500$	3
$2\ 500 < x \leq 3\ 000$	4
$3\ 000 < x \leq 3\ 500$	5
$3\ 500 < x \leq 4\ 000$	7
$4\ 000 < x \leq 4\ 500$	2
$4\ 500 < x \leq 5\ 000$	1

- 2.1 Estimate the average weight loss, in grams, of the participants over the first 4 weeks. (2)
- 2.2 Draw an ogive (cumulative frequency graph) of the data on the grid provided. (4)
- 2.3 The weight-loss programme guarantees a loss of 800 g per week if a person follows the programme without cheating. Hence, determine how many of the participants had an average weight loss of 800 g or more per week over the first 4 weeks. (2)
- [8]**

**QUESTION 3**

In the diagram,  $A(-2 ; 3)$ ,  $C(10 ; 11)$  and  $D(5 ; -1)$  are the vertices of  $\triangle ACD$ .  $CA$  intersects the  $y$ -axis in  $F$  and  $CA$  produced cuts the  $x$ -axis in  $G$ . The straight line  $DE$  is drawn parallel to  $CA$ .  $\hat{CFO} = \alpha$ .

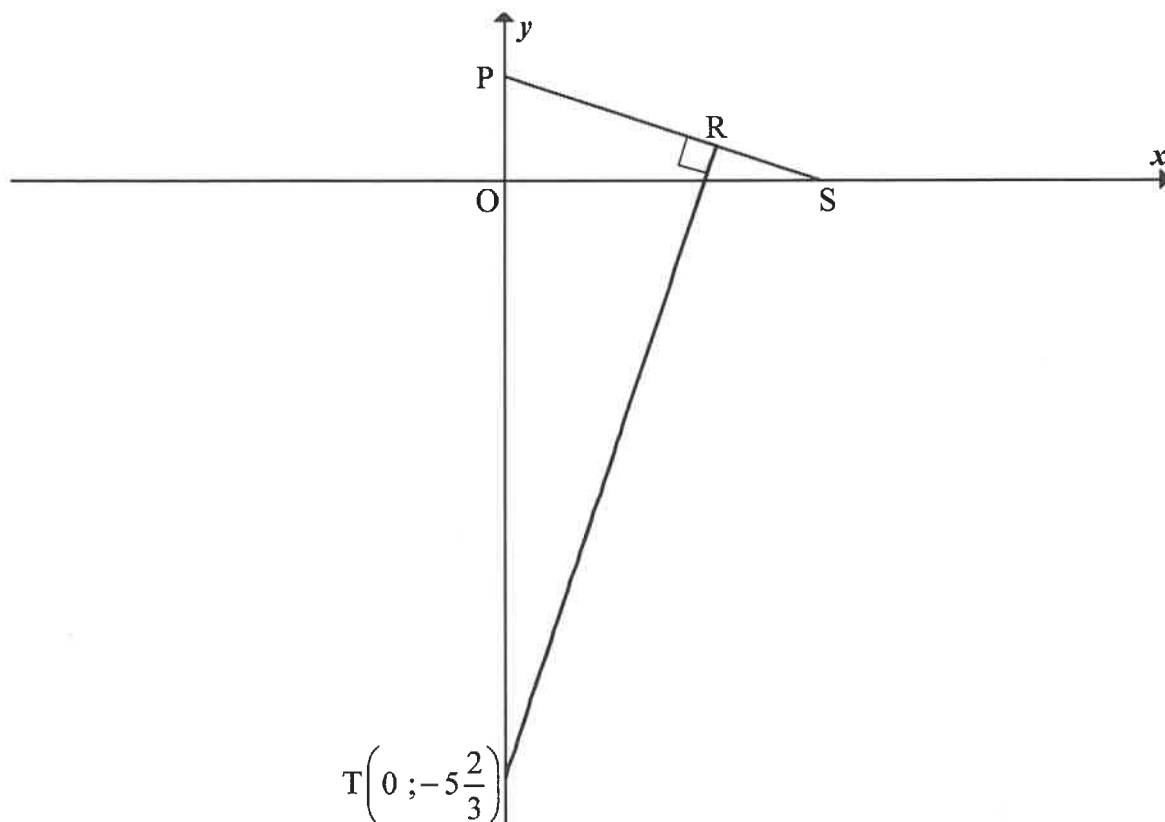


- 3.1 Calculate the gradient of the line  $AC$ . (2)
  - 3.2 Determine the equation of line  $DE$  in the form  $y = mx + c$ . (3)
  - 3.3 Calculate the size of  $\alpha$ . (3)
  - 3.4  $B$  is a point in the first quadrant such that  $ABDE$ , in that order, forms a rectangle. Calculate, giving reasons, the:
    - 3.4.1 Coordinates of  $M$ , the midpoint of  $BE$  (3)
    - 3.4.2 Length of diagonal  $BE$  (3)
- [14]**

**QUESTION 4**

In the diagram, the straight line  $SP$  is drawn having  $S$  and  $P$  as its  $x$ - and  $y$ -intercepts respectively. The equation of  $SP$  is  $x + ay - a = 0$ ,  $a > 0$ . It is also given that  $OS = 3OP$ .

The straight line  $RT$  is drawn with  $R$  on  $SP$  and  $RT \perp PS$ .  $RT$  cuts the  $y$ -axis in  $T\left(0; -5\frac{2}{3}\right)$ .

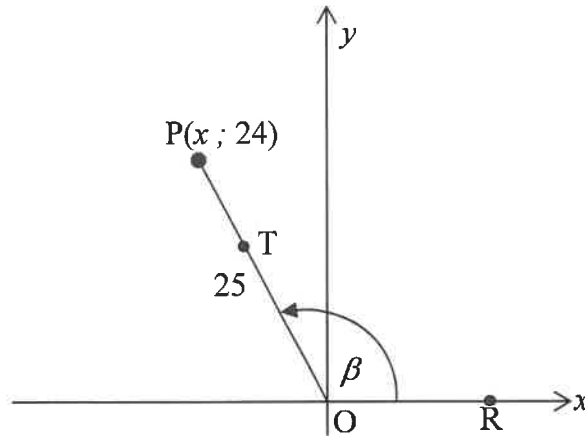


- 4.1 Calculate the coordinates of  $P$ . (2)
- 4.2 Calculate the value of  $a$ . (2)
- 4.3 Determine the equation of  $RT$  in the form  $y = mx + c$  if it is given that  $a = 3$ . (3)
- 4.4 Calculate the coordinates of  $R$ , the point where  $PS$  and  $TR$  meet. (4)
- 4.5 Calculate the area of  $\Delta PRT$  if it is given that  $R\left(2; \frac{1}{3}\right)$ . (3)
- 4.6 Calculate, giving reasons, the radius of a circle passing through the points  $P$ ,  $R$  and  $T$ . (2)

**[16]**

**QUESTION 5**

- 5.1 In the diagram below,  $P(x; 24)$  is a point such that  $OP = 25$  and  $\widehat{R\hat{O}P} = \beta$ , where  $\beta$  is an obtuse angle.



- 5.1.1 Calculate the value of  $x$ . (2)
- 5.1.2 Determine the value of each of the following WITHOUT using a calculator:
- (a)  $\sin \beta$  (1)
- (b)  $\cos(180^\circ - \beta)$  (2)
- (c)  $\tan(-\beta)$  (2)
- 5.1.3 T is a point on OP such that  $OT = 15$ . Determine the coordinates of T WITHOUT using a calculator. (4)

- 5.2 Determine the value of the following expression:

$$\frac{2 \sin x \cdot \cos x (1 + \tan^2 x)}{\tan x} \quad (4)$$

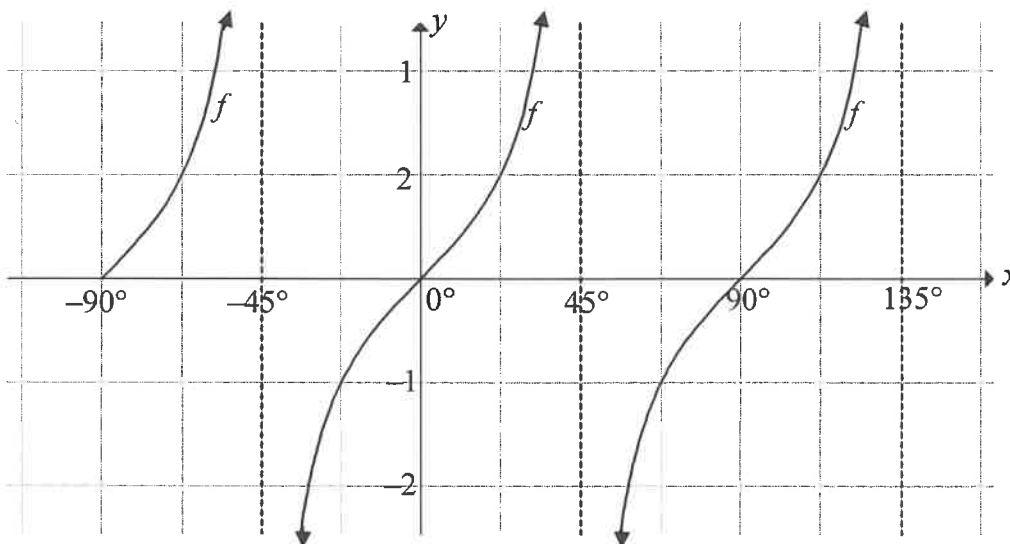
- 5.3 Consider:  $\frac{1 - \cos^2 A}{4 \cos(90^\circ + A)}$

- 5.3.1 Simplify the expression to a single trigonometric term. (3)
- 5.3.2 Hence, determine the general solution of  $\frac{1 - \cos^2 2x}{4 \cos(90^\circ + 2x)} = 0,21$ . (6)

**[24]**

**QUESTION 6**

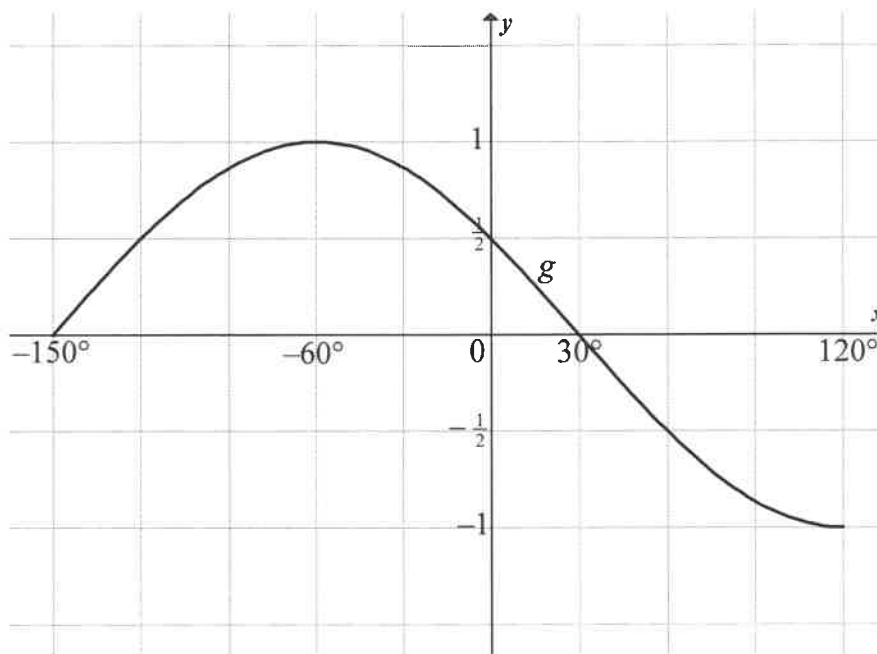
6.1 In the diagram, the graph of  $f(x) = \tan bx$  is drawn for the interval  $-90^\circ \leq x \leq 135^\circ$ .



- 6.1.1 Determine the value of  $b$ . (1)
- 6.1.2 Determine the values of  $x$  in the interval  $0^\circ \leq x \leq 135^\circ$  for which  $f(x) \leq -1$ . (2)
- 6.1.3 Graph  $h$  is defined as  $h(x) = \tan b(x + 55^\circ)$ . Write down the equations of the asymptotes of  $h$  in the interval  $-90^\circ \leq x \leq 135^\circ$ . (2)



- 6.2 In the diagram, the graph of  $g(x) = \cos(x + 60^\circ)$  is drawn for the interval  $-150^\circ \leq x \leq 120^\circ$ .

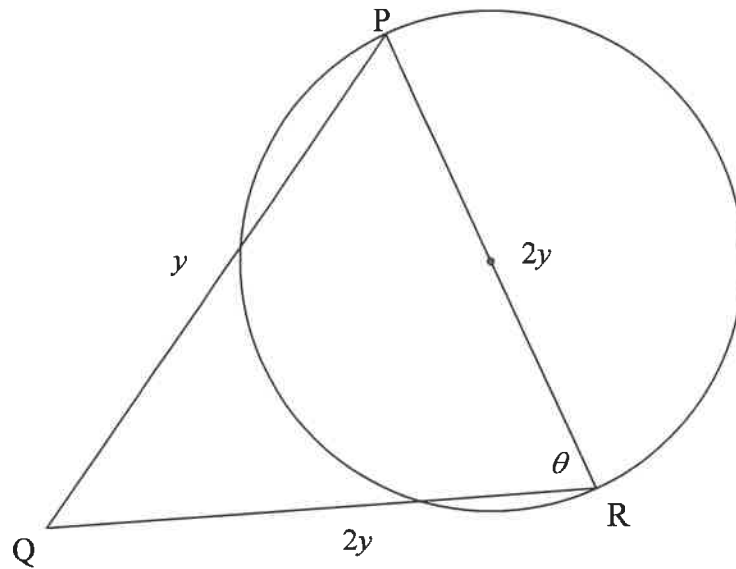


- 6.2.1 On the same system of axes, draw the graph of  $k(x) = -\sin x$  for the interval  $-150^\circ \leq x \leq 120^\circ$ . Show ALL the intercepts with the axes as well as the coordinates of the turning points and end points of the graph. (4)
- 6.2.2 Determine the minimum value of  $h(x) = \cos(x + 60^\circ) - 3$ . (2)
- 6.2.3 Solve the equation  $\cos(x + 60^\circ) + \sin x = 0$  for the interval  $-150^\circ \leq x \leq 120^\circ$ . (6)
- 6.2.4 Determine the values of  $x$  for the interval  $-150^\circ \leq x \leq 120^\circ$ , for which  $\cos(x + 60^\circ) + \sin x > 0$ . (2)
- 6.2.5 The function  $g$  can also be defined as  $y = -\sin(x - \theta)$ , where  $\theta$  is an acute angle. Determine the value of  $\theta$ . (2)

[21]

**QUESTION 7**

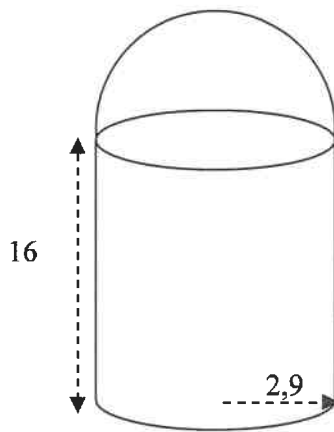
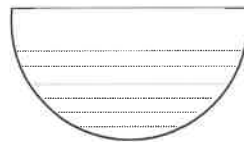
In the diagram,  $PR$  is the diameter of the circle. Triangle  $PQR$  is drawn with vertex  $Q$  outside the circle.  $\hat{R} = \theta$ ,  $PR = QR = 2y$  and  $PQ = y$ .



- 7.1 Determine the value of  $\cos \theta$ . (4)
- 7.2 If  $QR$  cuts the circumference of the circle at  $T$ , determine  $PT$  in terms of  $y$  and  $\theta$ . (3)
- [7]**

**QUESTION 8**

A cylindrical aerosol can has a lid in the shape of a hemisphere that fits exactly on the top of the can. The height of the can is 16 cm and the radius of the base of the can is 2,9 cm.

**FIGURE 1****FIGURE 2**

$$\text{Volume of sphere} = \frac{4}{3} \pi r^3$$

$$\text{Surface area of sphere} = 4\pi r^2$$

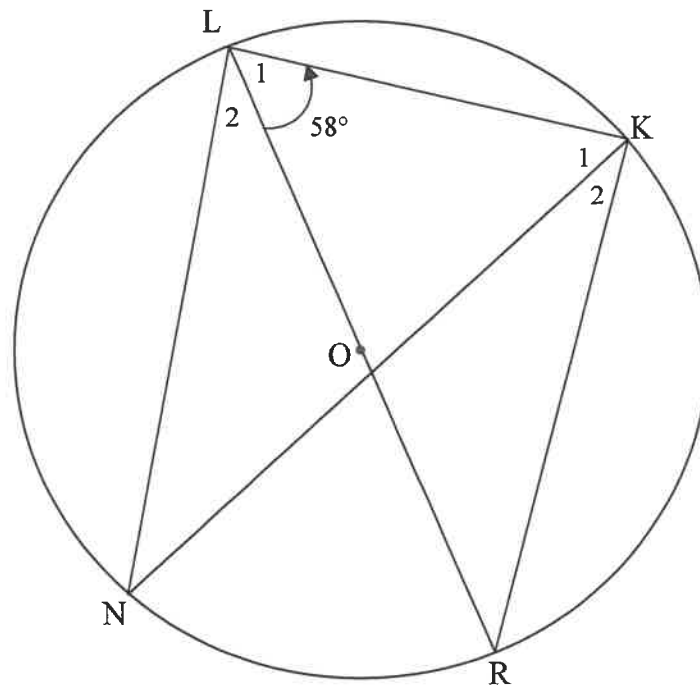
- 8.1 Calculate the surface area of the can with the lid in place, as shown in FIGURE 1. (5)
- 8.2 If the lid is 80% filled with a liquid, as shown in FIGURE 2, calculate the volume of the liquid in the lid. (3)

**[8]**

Give reasons for your statements and calculations in QUESTIONS 9, 10 and 11.

**QUESTION 9**

In the diagram,  $O$  is the centre of the circle. Diameter  $LR$  subtends  $\hat{L}KR$  at the circumference of the circle.  $N$  is another point on the circumference and chords  $LN$  and  $KN$  are drawn.  $\hat{L}_1 = 58^\circ$ .

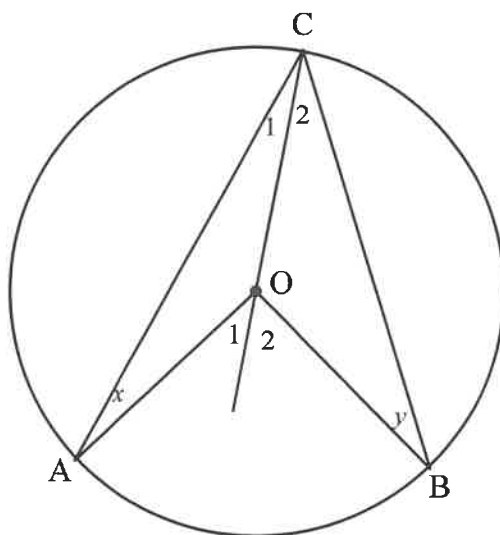


Calculate, giving reasons, the size of:

- 9.1  $\hat{L}KR$  (2)
  - 9.2  $\hat{R}$  (2)
  - 9.3  $\hat{N}$  (2)
- [6]**

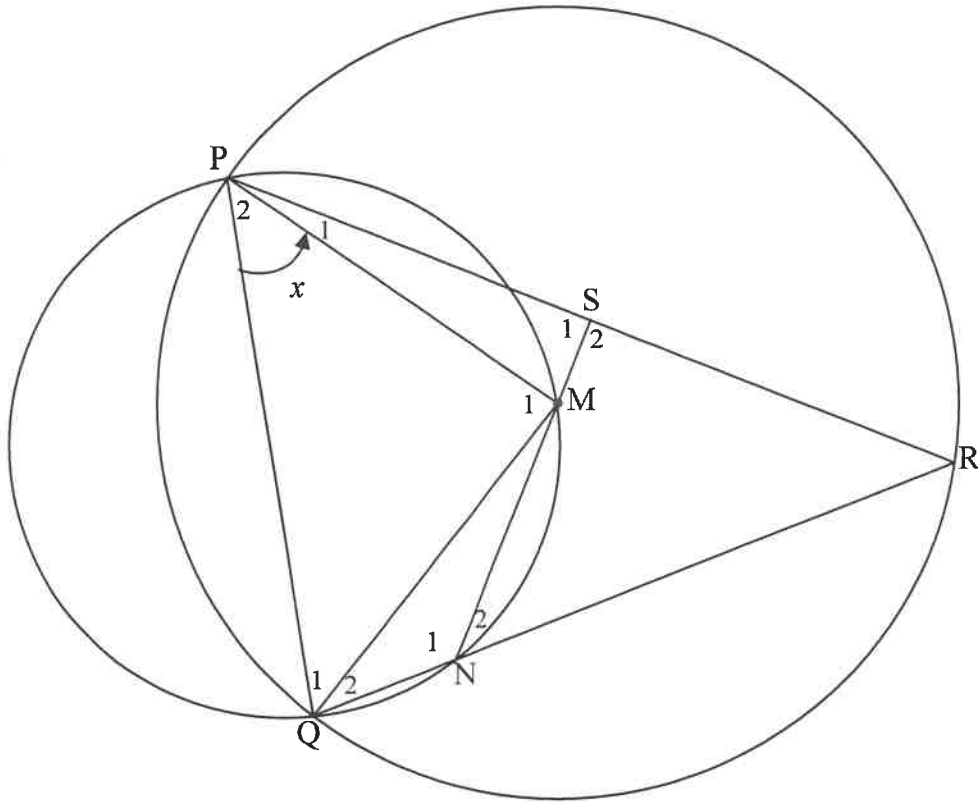
**QUESTION 10**

- 10.1 In the diagram,  $O$  is the centre of the circle.  $A$ ,  $B$  and  $C$  are points on the circumference of the circle. Chords  $AC$  and  $BC$  and radii  $AO$ ,  $BO$  and  $CO$  are drawn.  $\hat{A} = x$  and  $\hat{B} = y$ .



- 10.1.1 Determine the size of  $\hat{O}_1$  in terms of  $x$ . (3)
- 10.1.2 Hence, prove the theorem that states that the angle subtended by an arc at the centre is equal to twice the angle subtended by the same arc at the circumference, that is  $\hat{AOB} = 2\hat{ACB}$ . (3)

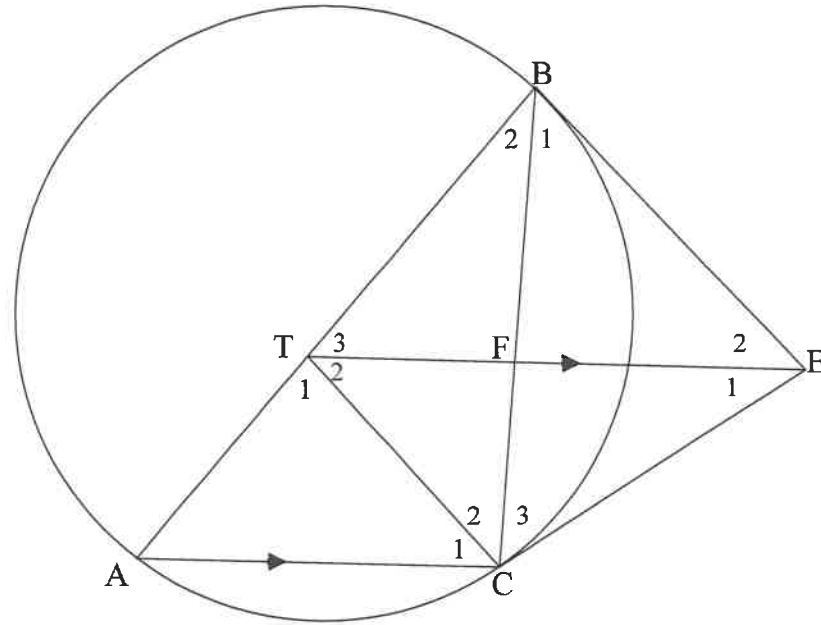
- 10.2 In the diagram, PQ is a common chord of the two circles. The centre, M, of the larger circle lies on the circumference of the smaller circle. PMNQ is a cyclic quadrilateral in the smaller circle. QN is produced to R, a point on the larger circle. NM produced meets the chord PR at S.  $\hat{P}_2 = x$ .



- 10.2.1 Give a reason why  $\hat{N}_2 = x$ . (1)
- 10.2.2 Write down another angle equal in size to  $x$ . Give a reason. (2)
- 10.2.3 Determine the size of  $\hat{R}$  in terms of  $x$ . (3)
- 10.2.4 Prove that  $PS = SR$ . (3)
- [15]**

**QUESTION 11**

In the diagram, the vertices A, B and C of  $\triangle ABC$  are concyclic. EB and EC are tangents to the circle at B and C respectively. T is a point on AB such that  $TE \parallel AC$ . BC cuts TE in F.



- 11.1 Prove that  $\hat{B}_1 = \hat{T}_3$ . (4)
  - 11.2 Prove that TBEC is a cyclic quadrilateral. (4)
  - 11.3 Prove that ET bisects  $\hat{BTC}$ . (2)
  - 11.4 If it is given that TB is a tangent to the circle through B, F and E, prove that  $TB = TC$ . (4)
  - 11.5 Hence, prove that T is the centre of the circle through A, B and C. (3)
- [17]**

**TOTAL: 150**