



# **basic education**

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

## **NATIONAL SENIOR CERTIFICATE**

**GRADE 12**

**MATHEMATICS P2**

**FEBRUARY/MARCH 2016**

**MARKS: 150**

**TIME: 3 hours**

**This question paper consists of 14 pages, 1 information sheet  
and a 25-page answer book.**

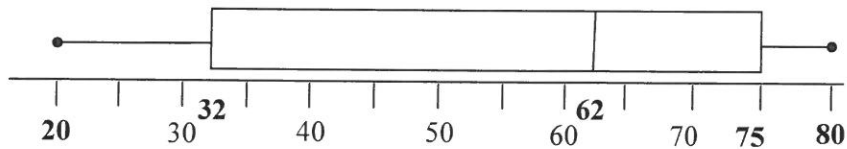
**INSTRUCTIONS AND INFORMATION**

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 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. An INFORMATION SHEET with formulae is included at the end of the question paper.
9. Write neatly and legibly.

**QUESTION 1**

The box and whisker diagram below shows the marks (out of 80) obtained in a History test by a class of nine learners.



- 1.1 Comment on the skewness of the data. (1)
- 1.2 Write down the range of the marks obtained. (2)
- 1.3 If the learners had to obtain 32 marks to pass the test, estimate the percentage of the class that failed the test. (2)
- 1.4 In ascending order, the second mark is 28, the third mark 36 and the sixth mark 69. The seventh and eighth marks are the same. The average mark for this test is 54.

	28	36			69			
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Fill in the marks of the remaining learners in ascending order.

(6)  
[11]

**QUESTION 2**

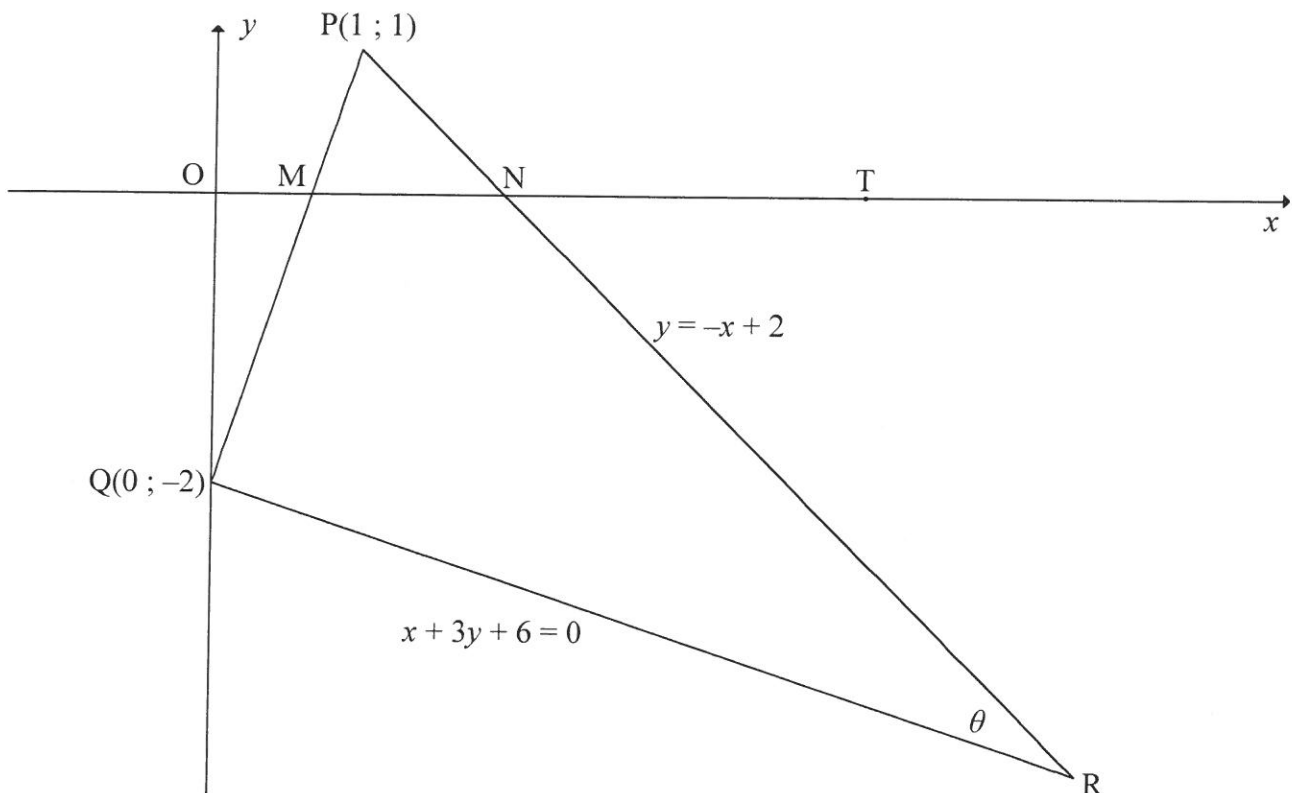
A company recorded the number of messages sent by e-mail over a period of 60 working days. The data is shown in the table below.

NUMBER OF MESSAGES	NUMBER OF DAYS
$10 < x \leq 20$	2
$20 < x \leq 30$	8
$30 < x \leq 40$	5
$40 < x \leq 50$	10
$50 < x \leq 60$	12
$60 < x \leq 70$	18
$70 < x \leq 80$	3
$80 < x \leq 90$	2

- 2.1 Estimate the mean number of messages sent per day, rounded off to TWO decimal places. (3)
- 2.2 Draw a cumulative frequency graph (ogive) of the data on the grid provided in the ANSWER BOOK. (4)
- 2.3 Hence, estimate the number of days on which 65 or more messages were sent. (2)
- [9]

**QUESTION 3**

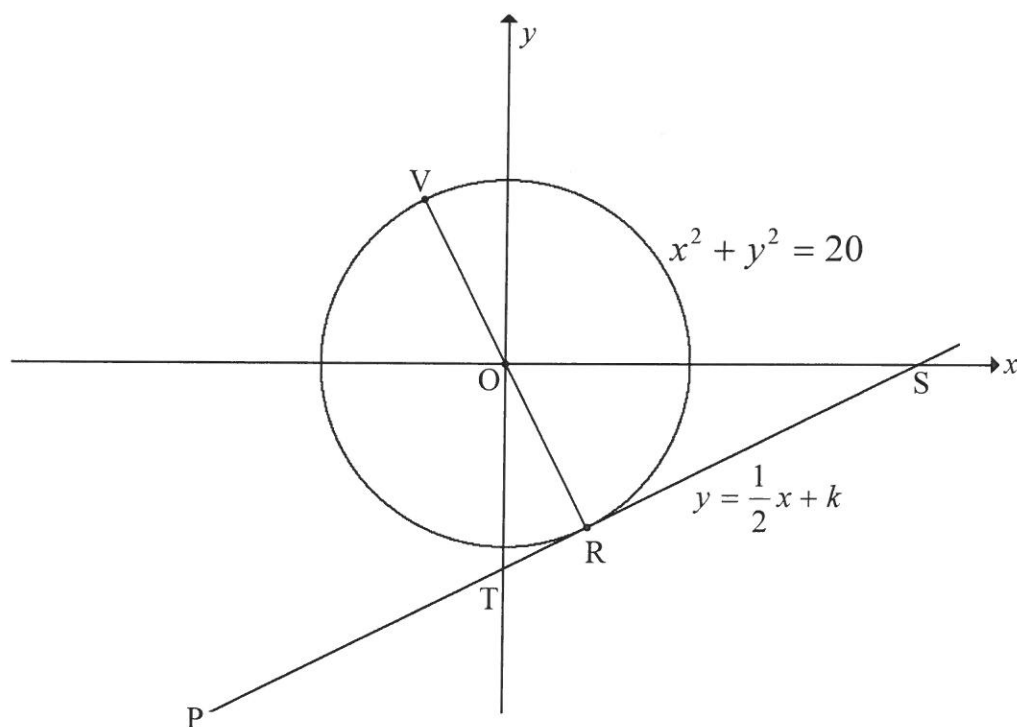
In the diagram below,  $P(1 ; 1)$ ,  $Q(0 ; -2)$  and  $R$  are the vertices of a triangle and  $\hat{P}RQ = \theta$ . The  $x$ -intercepts of  $PQ$  and  $PR$  are  $M$  and  $N$  respectively. The equations of the sides  $PR$  and  $QR$  are  $y = -x + 2$  and  $x + 3y + 6 = 0$  respectively.  $T$  is a point on the  $x$ -axis, as shown.



- 3.1 Determine the gradient of  $QP$ . (2)
  - 3.2 Prove that  $\hat{P}QR = 90^\circ$ . (2)
  - 3.3 Determine the coordinates of  $R$ . (3)
  - 3.4 Calculate the length of  $PR$ . Leave your answer in surd form. (2)
  - 3.5 Determine the equation of a circle passing through  $P$ ,  $Q$  and  $R$  in the form  $(x - a)^2 + (y - b)^2 = r^2$ . (6)
  - 3.6 Determine the equation of a tangent to the circle passing through  $P$ ,  $Q$  and  $R$  at point  $P$  in the form  $y = mx + c$ . (3)
  - 3.7 Calculate the size of  $\theta$ . (5)
- [23]**

**QUESTION 4**

In the diagram below, the equation of the circle with centre  $O$  is  $x^2 + y^2 = 20$ . The tangent  $PRS$  to the circle at  $R$  has the equation  $y = \frac{1}{2}x + k$ .  $PRS$  cuts the  $y$ -axis at  $T$  and the  $x$ -axis at  $S$ .

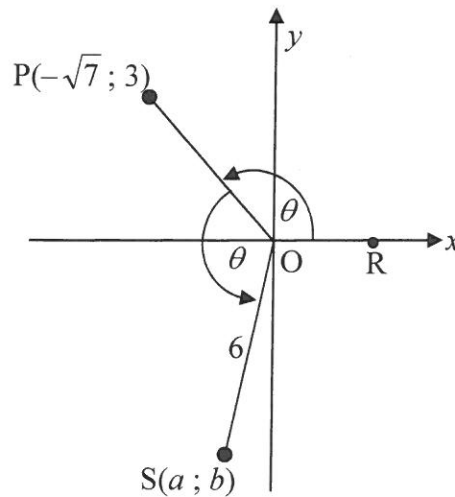


- 4.1 Determine, giving reasons, the equation of  $OR$  in the form  $y = mx + c$ . (3)
- 4.2 Determine the coordinates of  $R$ . (4)
- 4.3 Determine the area of  $\triangle OTS$ , given that  $R(2; -4)$ . (6)
- 4.4 Calculate the length of  $VT$ . (4)

**[17]**

**QUESTION 5**

- 5.1  $P(-\sqrt{7}; 3)$  and  $S(a; b)$  are points on the Cartesian plane, as shown in the diagram below.  $\angle POR = \angle POS = \theta$  and  $OS = 6$ .



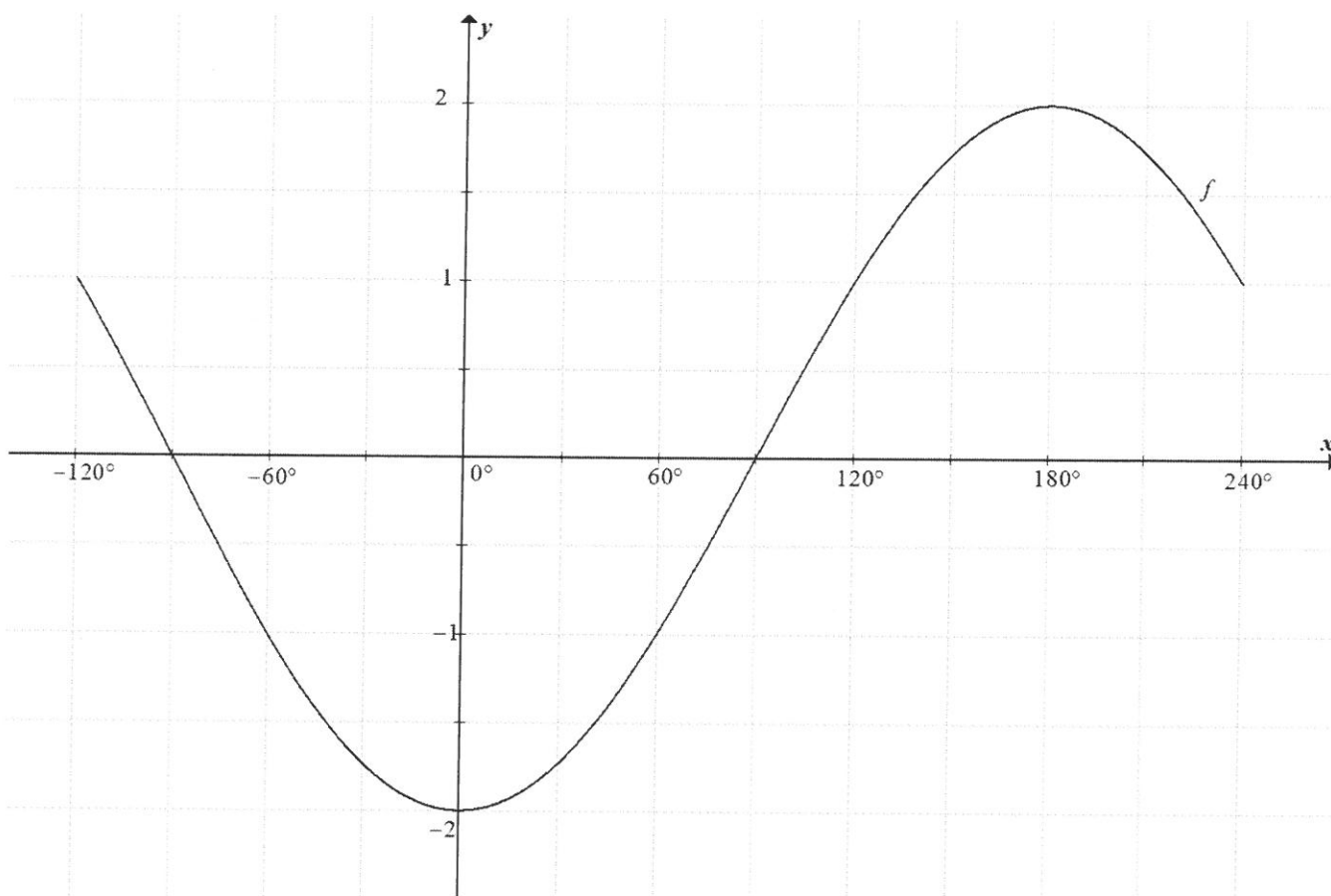
Determine, WITHOUT using a calculator, the value of:

- 5.1.1  $\tan \theta$  (1)
- 5.1.2  $\sin(-\theta)$  (3)
- 5.1.3  $a$  (4)
- 5.2 5.2.1 Simplify  $\frac{4 \sin x \cos x}{2 \sin^2 x - 1}$  to a single trigonometric ratio. (3)
- 5.2.2 Hence, calculate the value of  $\frac{4 \sin 15^\circ \cos 15^\circ}{2 \sin^2 15^\circ - 1}$  WITHOUT using a calculator. (Leave your answer in simplest surd form.) (2)
- [13]**

**QUESTION 6**

Given the equation:  $\sin(x + 60^\circ) + 2\cos x = 0$

- 6.1 Show that the equation can be rewritten as  $\tan x = -4 - \sqrt{3}$ . (4)
- 6.2 Determine the solutions of the equation  $\sin(x + 60^\circ) + 2\cos x = 0$  in the interval  $-180^\circ \leq x \leq 180^\circ$ . (3)
- 6.3 In the diagram below, the graph of  $f(x) = -2\cos x$  is drawn for  $-120^\circ \leq x \leq 240^\circ$ .



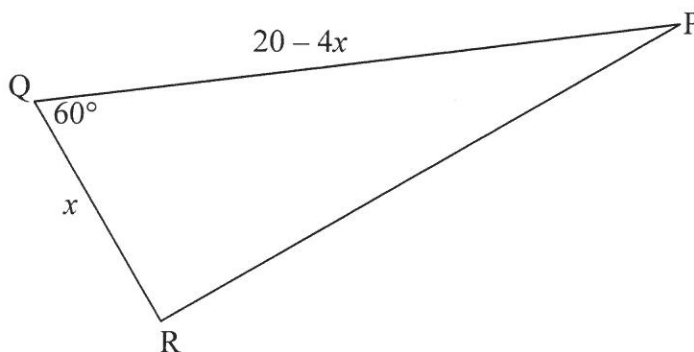
- 6.3.1 Draw the graph of  $g(x) = \sin(x + 60^\circ)$  for  $-120^\circ \leq x \leq 240^\circ$  on the grid provided in the ANSWER BOOK. (3)
- 6.3.2 Determine the values of  $x$  in the interval  $-120^\circ \leq x \leq 240^\circ$  for which  $\sin(x + 60^\circ) + 2\cos x > 0$ . (3)

**[13]**

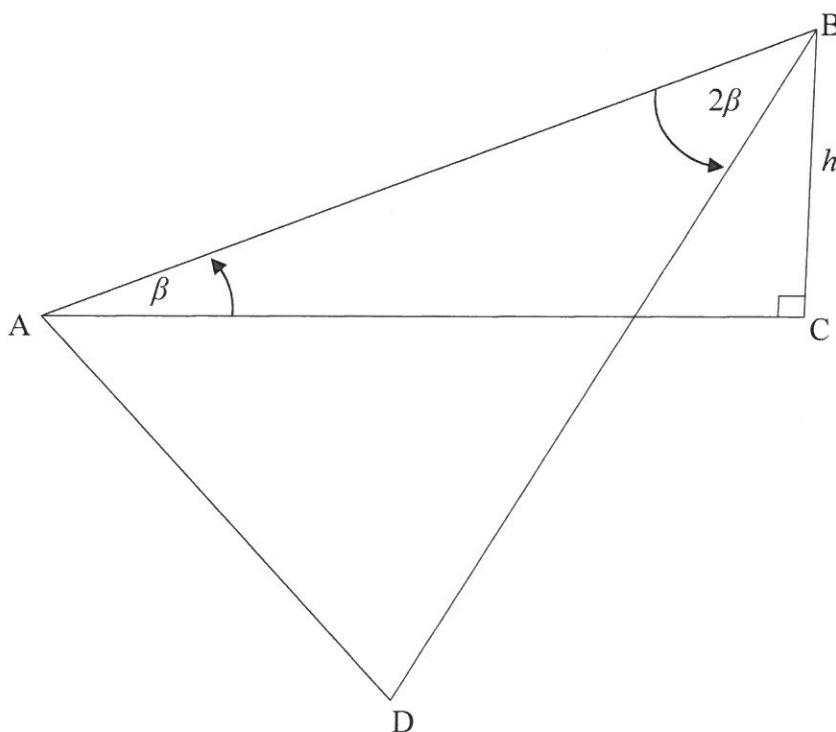


**QUESTION 7**

- 7.1 In the diagram below,  $\triangle PQR$  is drawn with  $PQ = 20 - 4x$ ,  $RQ = x$  and  $\hat{Q} = 60^\circ$ .



- 7.1.1 Show that the area of  $\triangle PQR = 5\sqrt{3}x - \sqrt{3}x^2$ . (2)
- 7.1.2 Determine the value of  $x$  for which the area of  $\triangle PQR$  will be a maximum. (3)
- 7.1.3 Calculate the length of  $PR$  if the area of  $\triangle PQR$  is a maximum. (3)
- 7.2 In the diagram below,  $BC$  is a pole anchored by two cables at  $A$  and  $D$ .  $A$ ,  $D$  and  $C$  are in the same horizontal plane. The height of the pole is  $h$  and the angle of elevation from  $A$  to the top of the pole,  $B$ , is  $\beta$ .  $\hat{ABD} = 2\beta$  and  $BA = BD$ .



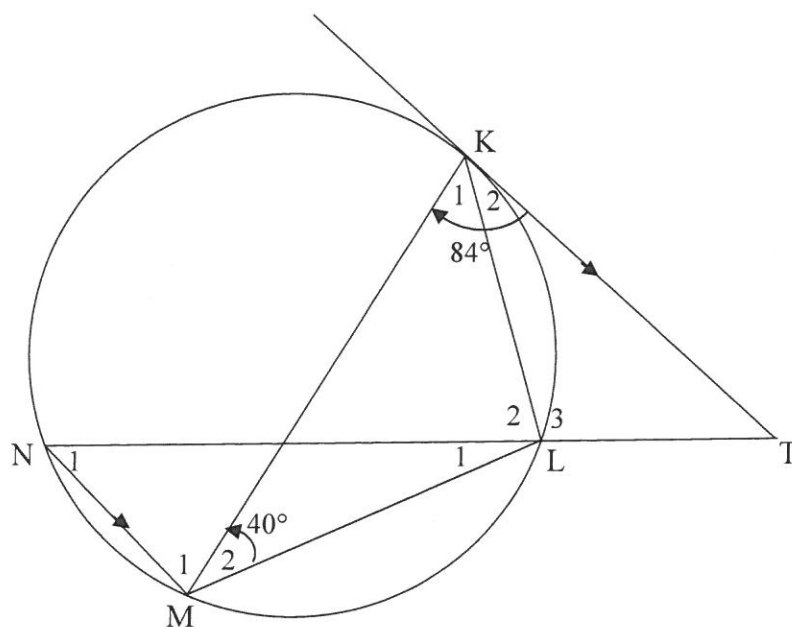
Determine the distance  $AD$  between the two anchors in terms of  $h$ .

(7)  
[15]

Give reasons for ALL statements in QUESTIONS 8, 9 and 10.

### QUESTION 8

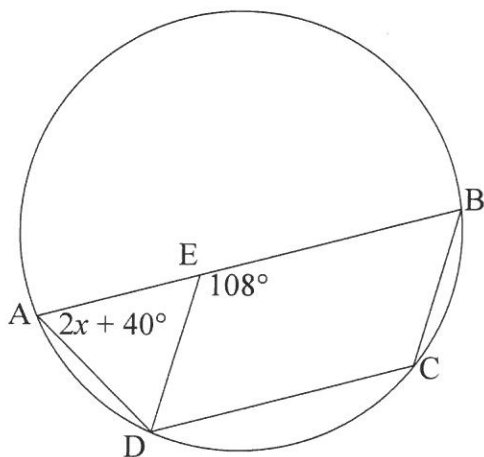
- 8.1 In the diagram below, tangent  $KT$  to the circle at  $K$  is parallel to the chord  $NM$ .  $NT$  cuts the circle at  $L$ .  $\triangle KML$  is drawn.  $\hat{M}_2 = 40^\circ$  and  $\hat{MKT} = 84^\circ$ .



Determine, giving reasons, the size of:

- |       |             |     |
|-------|-------------|-----|
| 8.1.1 | $\hat{K}_2$ | (2) |
| 8.1.2 | $\hat{N}_1$ | (3) |
| 8.1.3 | $\hat{T}$   | (2) |
| 8.1.4 | $\hat{L}_2$ | (2) |
| 8.1.5 | $\hat{L}_1$ | (1) |

- 8.2 In the diagram below,  $AB$  and  $DC$  are chords of a circle.  $E$  is a point on  $AB$  such that  $BCDE$  is a parallelogram.  $\angle DEB = 108^\circ$  and  $\angle DAE = 2x + 40^\circ$ .

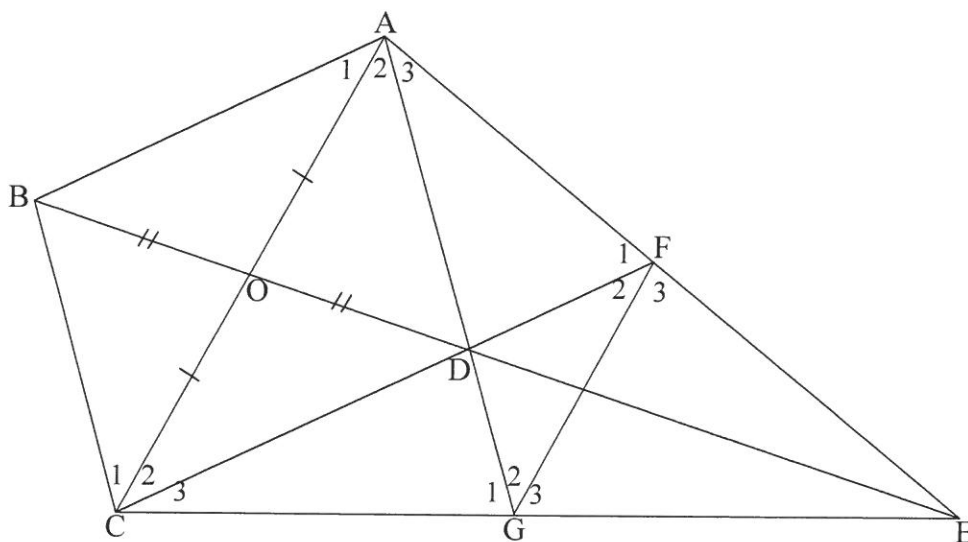


Calculate, giving reasons, the value of  $x$ .

(5)  
[15]

**QUESTION 9**

In the diagram below, EO bisects side AC of  $\triangle ACE$ . EDO is produced to B such that  $BO = OD$ . AD and CD produced meet EC and EA at G and F respectively.



9.1 Give a reason why  $ABCD$  is a parallelogram. (1)

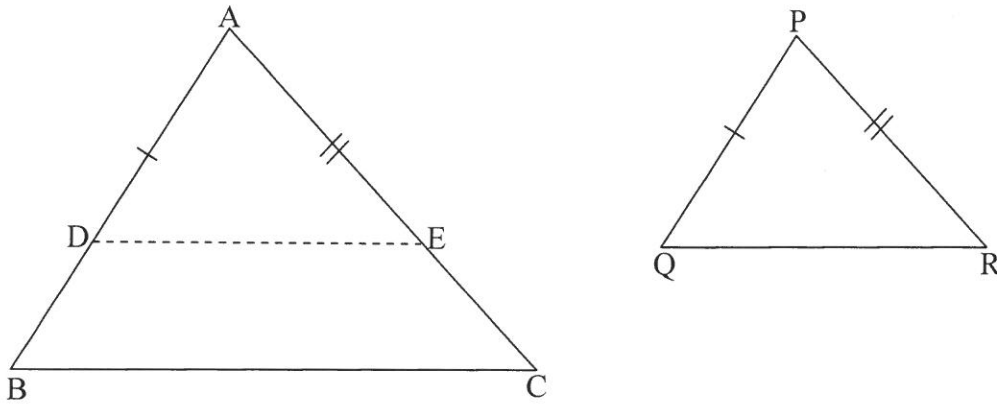
9.2 Write down, with reasons, TWO ratios each equal to  $\frac{ED}{DB}$ . (4)

9.3 Prove that  $\hat{A}_1 = \hat{F}_2$ . (5)

9.4 It is further given that  $ABCD$  is a rhombus. Prove that  $ACGF$  is a cyclic quadrilateral. (3)  
[13]

**QUESTION 10**

10.1 In the diagram below,  $\triangle ABC$  and  $\triangle PQR$  are given with  $\hat{A} = \hat{P}$ ,  $\hat{B} = \hat{Q}$  and  $\hat{C} = \hat{R}$ .



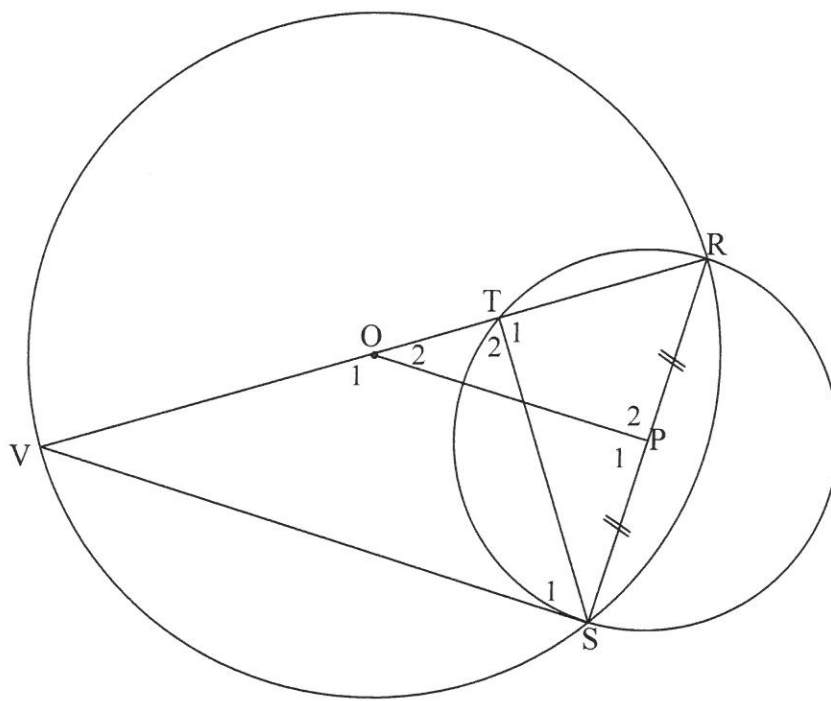
$DE$  is drawn such that  $AD = PQ$  and  $AE = PR$ .

10.1.1 Prove that  $\triangle ADE \equiv \triangle PQR$ . (2)

10.1.2 Prove that  $DE \parallel BC$ . (3)

10.1.3 Hence, prove that  $\frac{AB}{PQ} = \frac{AC}{PR}$ . (2)

- 10.2 In the diagram below,  $VR$  is a diameter of a circle with centre  $O$ .  $S$  is any point on the circumference.  $P$  is the midpoint of  $RS$ . The circle with  $RS$  as diameter cuts  $VR$  at  $T$ .  $ST$ ,  $OP$  and  $SV$  are drawn.



- 10.2.1 Why is  $OP \perp PS$ ? (1)
- 10.2.2 Prove that  $\triangle ROP \parallel \triangle RVS$ . (4)
- 10.2.3 Prove that  $\triangle RVS \parallel \triangle RST$ . (3)
- 10.2.4 Prove that  $ST^2 = VT \cdot TR$ . (6)
- [21]

**TOTAL: 150**

## INFORMATION SHEET

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

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

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

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

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

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

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

$$T_n = ar^{n-1}$$

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

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

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

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

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

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

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

$$y = mx + c$$

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

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

$$m = \tan \theta$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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