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MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

MATHEMATICS P2

September 2018

MARKS: 150

TIME: 3 hours

This question paper consists of 15 pages an information sheet
and an answer book of 20 pages

QUESTION 1

Consider the following characteristics of a set of data:

- Median is 14
- Upper quartile is 20
- Lower quartile is 11
- Maximum value is 30
- Range is 20

- 1.1 Calculate the interquartile range of the data. (2)
- 1.2 Draw a box and whisker diagram on the number line in the answer book that represents the data. (3)
- 1.3 Comment on the skewness of the data. (1)

[6]

QUESTION 2

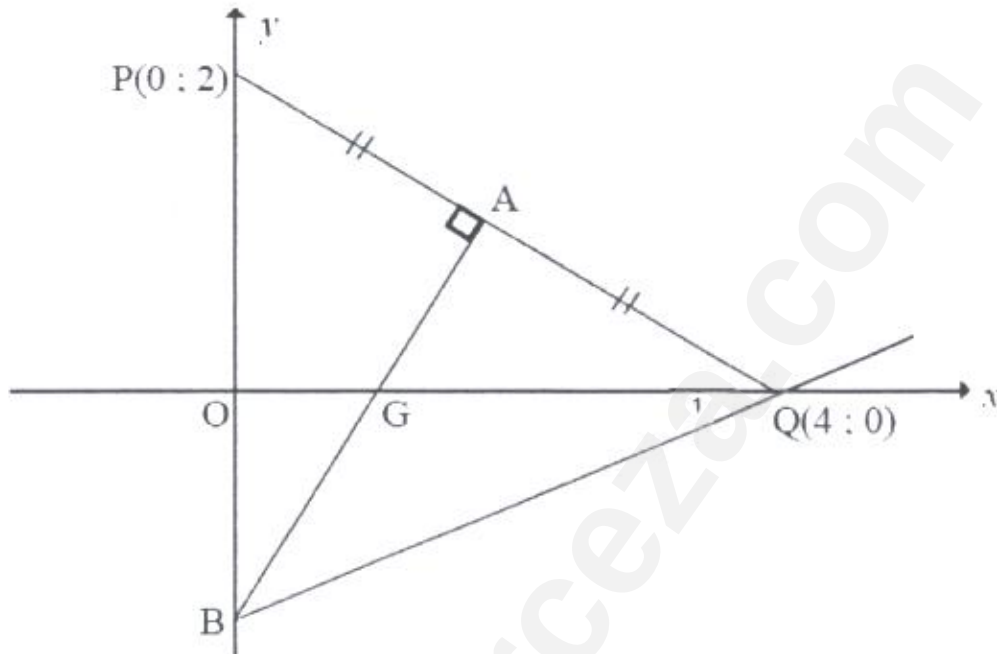
- 2.1 A training manager wants to know if there is a link between the hours in training spent by a particular category of employee and their productivity (units produced per day) on the job. The data below was extracted from the files of 10 employees.

Employee	1	2	3	4	5	6	7	8	9	10
Hours in training	16	36	20	38	40	30	35	22	40	24
Productivity (units produced per day)	45	70	44	56	60	48	75	60	63	38

- 2.1.1 Determine the equation of the least squares regression line. (3)
- 2.1.2 Estimate the productivity level for a particular employee who has received only 32 hours of training (to the nearest integer). (2)
- 2.1.3 Comment on the strength of the correlation between the hours in training spent and the productivity. Motivate your answer. (2)
- 2.2 Consider the productivity of units produced per day above and calculate:
- 2.2.1 The average units produced per day by the 10 employees. (2)
- 2.2.2 The number of employees whose productivity are above one standard deviation from the mean. (4)
- [13]

QUESTION 3

The diagram below, shows the points $P(0 ; 2)$ and $Q(4 ; 0)$. Point A is the midpoint of PQ . The line AB is perpendicular to PQ and intersects the x -axis at G and the y -axis at B .

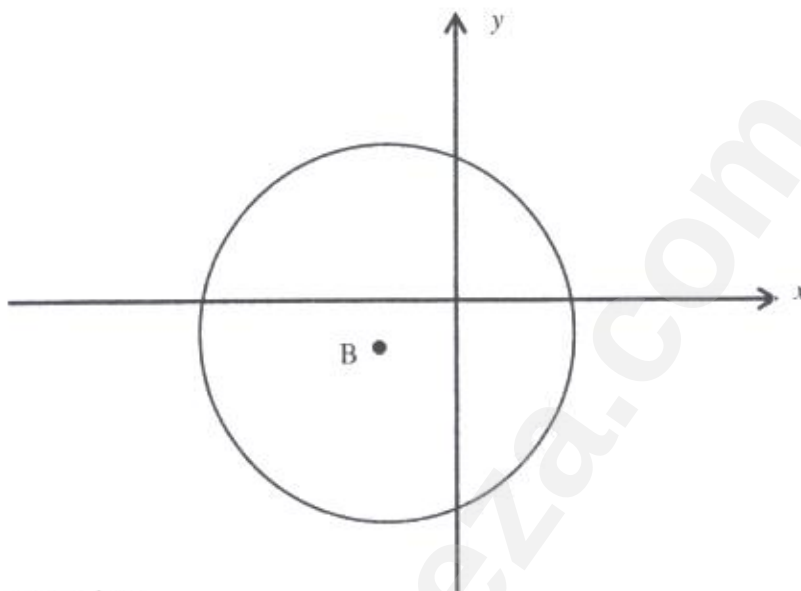


- 3.1 Write down the gradient of PQ . (1)
- 3.2 Calculate the coordinates of A . (2)
- 3.3 Determine the equation of the line AB in the form $y = mx + c$. (3)
- 3.4 Calculate the length of BQ if it is given that $B(0 ; -3)$. (2)
- 3.5 If $PBQR$ is a rhombus, with R in the first quadrant, calculate the coordinates of R . (4)
- 3.6 Calculate the size of angle $\hat{A}BQ$. (5)
- 3.7 Determine:
- 3.7.1 The equation of the circle passing through the points A , P and B . (6)
- 3.7.2 The equation of the tangent to the circle in **Question 3.7.1** at point P . (2)

[25]

QUESTION 4

In the diagram below, $x^2 + y^2 + 8x + 4y - 28 = 0$, is the equation of the circle centred at B.



- 4.1 Determine:
- 4.1.1 The coordinates of B. (4)
- 4.1.2 The radius of the circle. (1)
- 4.2 Another circle, with centre A, is drawn. The equation of the circle is $(x-4)^2 + (y-6)^2 = 26$. Show by calculations that these two circles intersect each other. (6)
- 4.3 The two circles centred at A and B intersect each other at C and D. Determine the gradient of CD if AB passes through the midpoint of CD. (3)
- [14]**

QUESTION 5

5.1

Consider: $\frac{1 - \tan^2 \theta}{1 + \tan^2 \theta}$ 5.1.1 Calculate the value of the expression if $\theta = 20^\circ$. (2)5.1.2 Prove without using a calculator, that $\frac{1 - \tan^2 \theta}{1 + \tan^2 \theta} = \cos 2\theta$. (5)

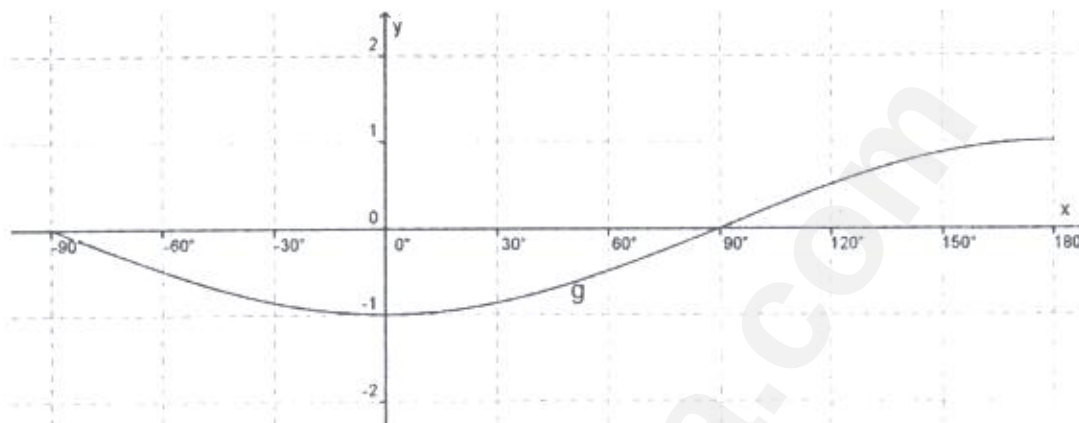
5.1.3 Hence, determine the general solution, without using a calculator if

$$\frac{1 - \tan^2 \theta}{1 + \tan^2 \theta} = \frac{1}{2} \quad (5)$$

5.2 If $\cos 25^\circ = k$, express the following in terms of k :5.2.1 $\sin 245^\circ$ (3)5.2.2 $\sin 25^\circ$ (2)5.2.3 $\cos 50^\circ$ (2)5.3 Consider: $\sqrt{3} \cos \beta + \sin \beta$ 5.3.1 Rewrite $\sqrt{3} \cos \beta + \sin \beta$ in the form $p \sin(\alpha + \beta)$. (5)5.3.2 Determine the maximum value of $\sqrt{3} \cos \beta + \sin \beta - 5$. (2)**[26]**

QUESTION 6

In the diagram the graph of $g(x) = -\cos x$ is drawn for the interval $x \in [-90^\circ; 180^\circ]$.

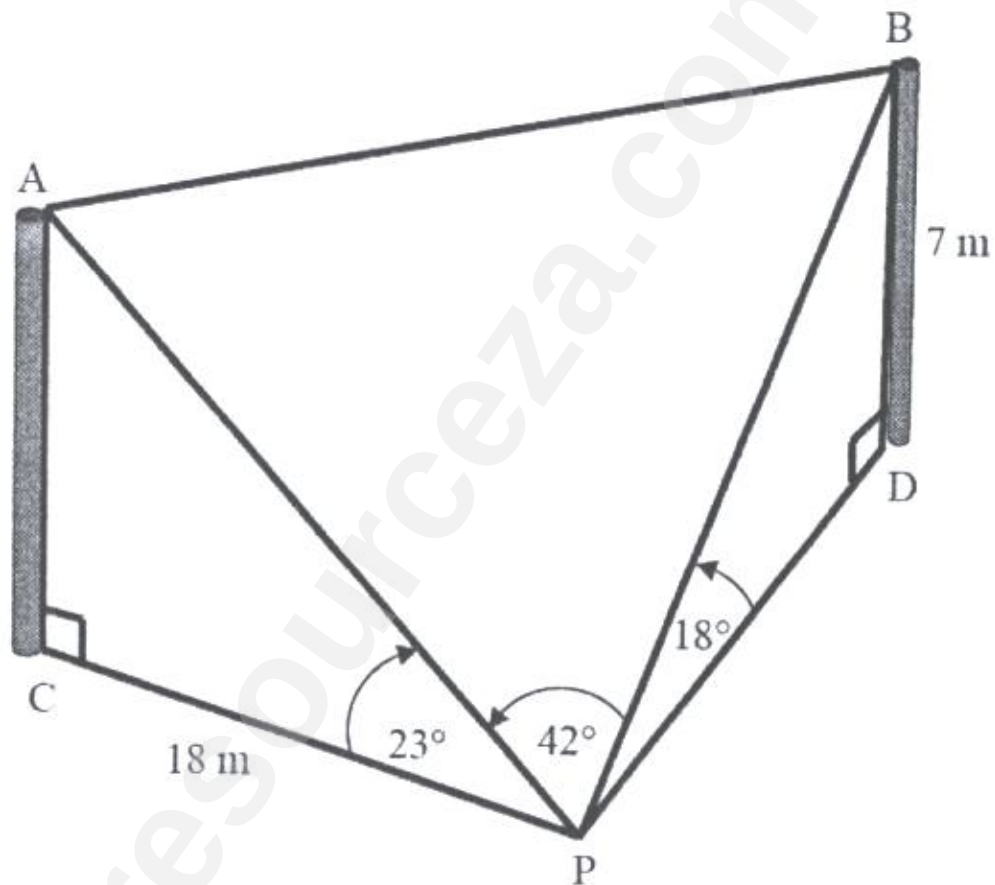


- 6.1 On the same set of axis in the answer book draw the graph of $f(x) = \sin(x + 30^\circ)$ for $x \in [-90^\circ; 180^\circ]$. Show clearly all the intercepts with the axes, as well as the turning points. (4)
- 6.2 Write down the period of $g(2x)$. (2)
- 6.3 Determine for which values of x ; $x \in [-90^\circ; 180^\circ]$, the graphs of f and g are both increasing. (2)

[8]

QUESTION 7

Thandi is standing at point P on the ground and observes two poles, AC and BD, of different heights. P, C and D are in the same horizontal plane. From P the angles of inclination to the top of the poles A and B are 23° and 18° respectively. Thandi is 18 m from the base of pole AC. The height of pole BD is 7 m.



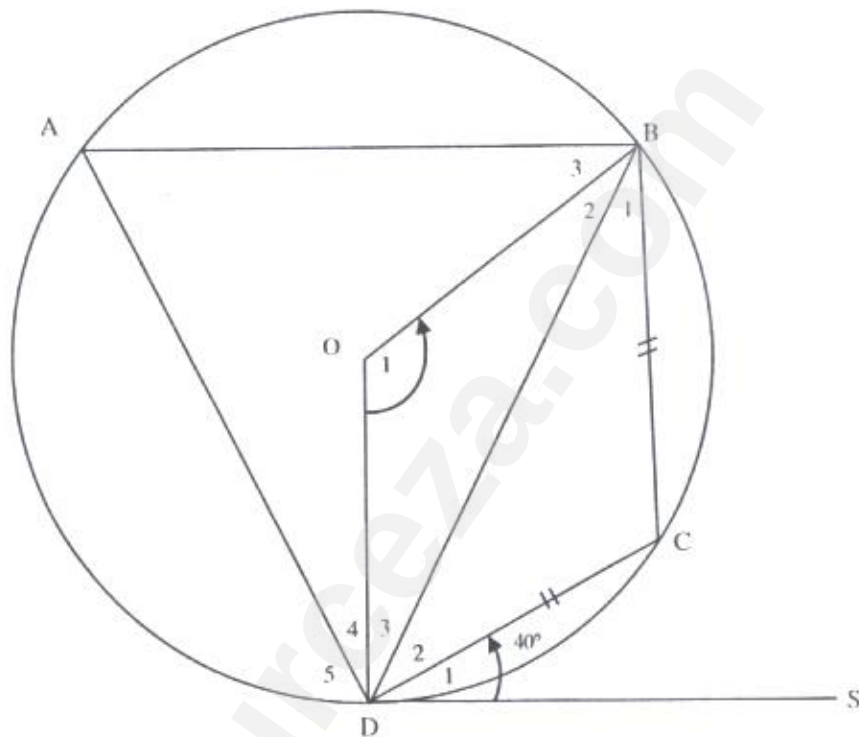
Calculate:

- 7.1 The distance from Thandi to the top of pole AC, in other words AP. (2)
- 7.2 The distance between the top of the poles, AB, if $\hat{APB} = 42^\circ$ and $PB = 22.65$ m. (4)

[6]

QUESTION 8

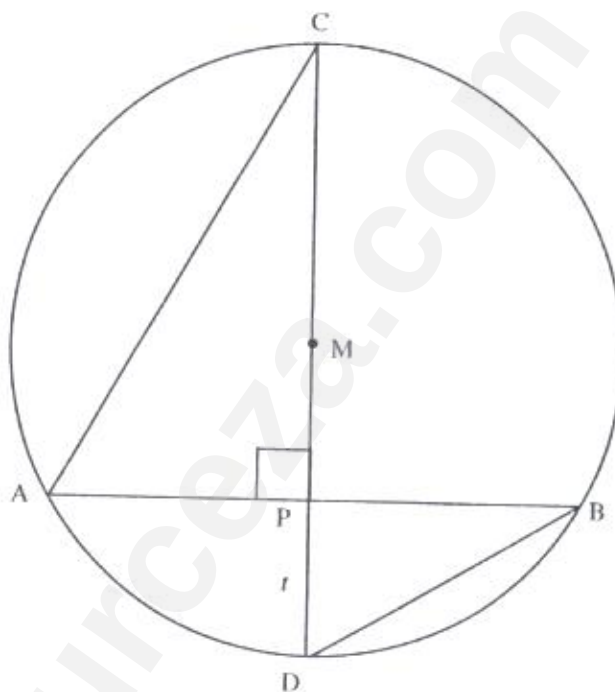
- 8.1 In the figure below, ABCD is a cyclic quadrilateral in the circle centred at O and $\triangle DOB$ is drawn. DS is a tangent to the circle at D. $BC = DC$ and $\angle CDS = 40^\circ$.



Calculate, with reasons, the size of:

- | | | |
|-------|--------------|-----|
| 8.1.1 | $\angle BDC$ | (3) |
| 8.1.2 | $\angle C$ | (2) |
| 8.1.3 | $\angle A$ | (2) |
| 8.1.4 | $\angle O_1$ | (2) |

- 8.2 In the diagram, M is the centre of circle and diameter CMPD is perpendicular to chord AB. $AB = 4t$, $PD = t$ and $CP = 15$ cm.

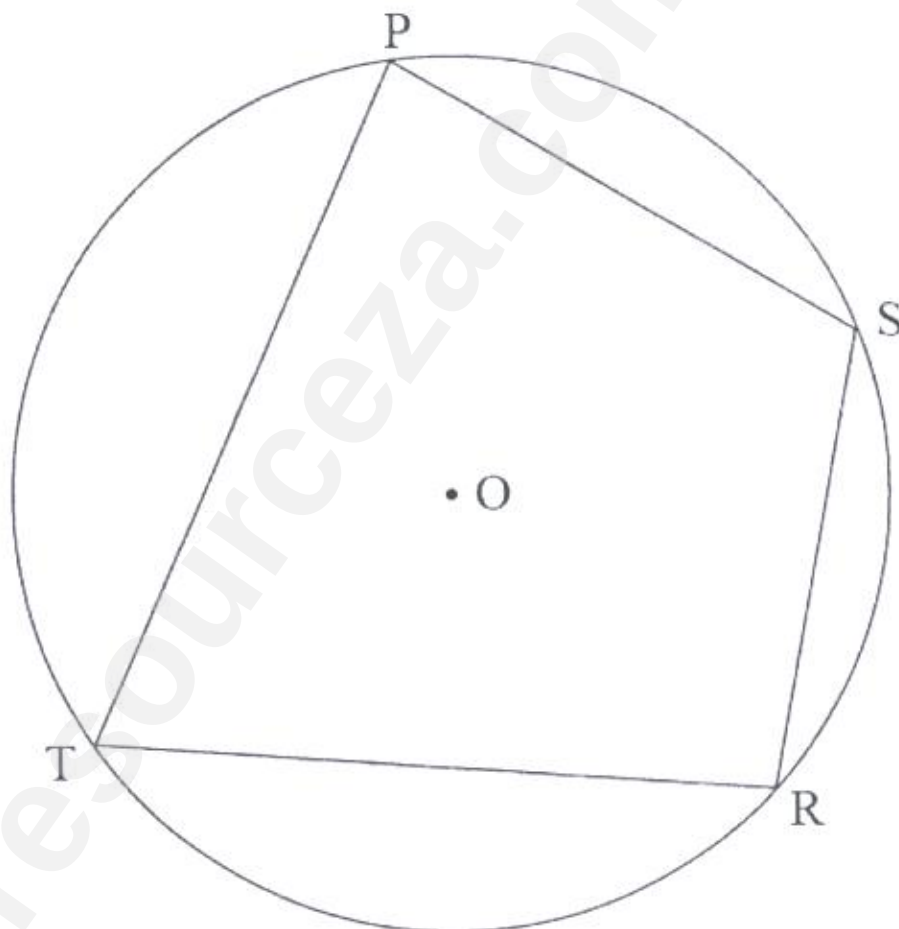


- 8.2.1 Give a reason why $AP = 2t$. (1)
- 8.2.2 If it is further given that $\triangle CAP \parallel \triangle BDP$, calculate:
- a) The value of t . (4)
- b) The length of the radius of the circle. (2)
- [16]

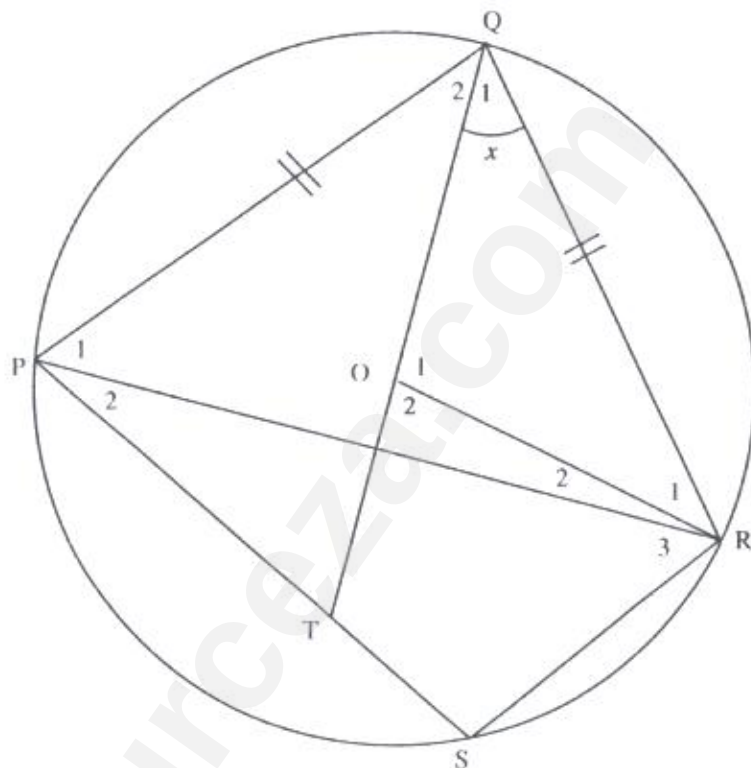
QUESTION 9

- 9.1 In the diagram below, O is the centre of the circle. PSRT is a cyclic quadrilateral. Prove the theorem that states that $\hat{PTR} + \hat{PSR} = 180^\circ$.

(5)



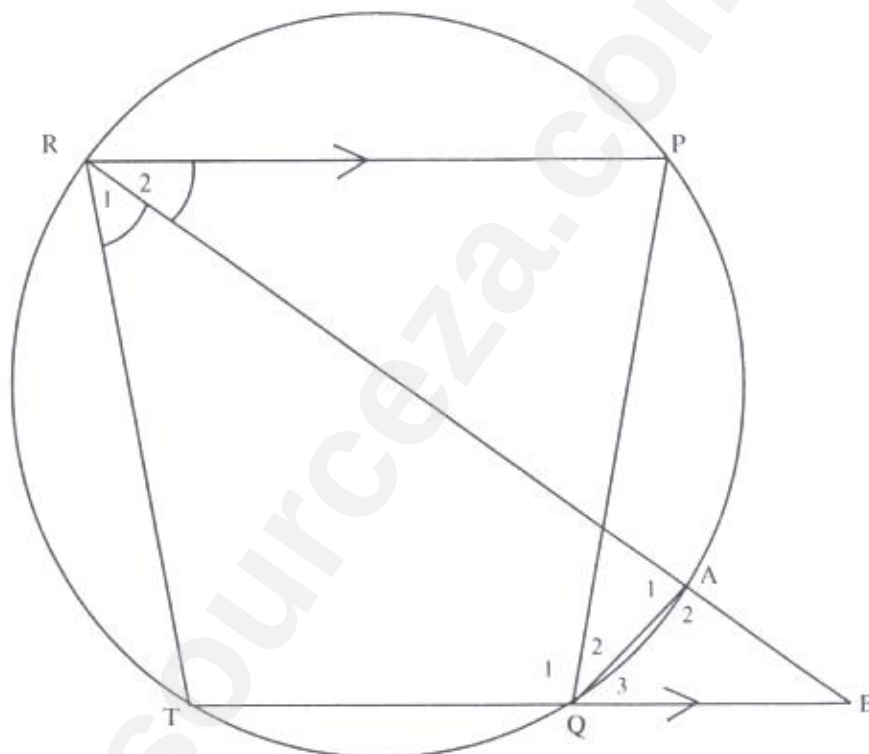
- 9.2 In the diagram below, O is the centre of the circle. P , Q , R and S are points on the circumference of the circle. TOQ is a straight line such that T lies on PS . $PQ = QR$ and $\angle Q_1 = x$.



- 9.2.1 Calculate, with reasons, $\hat{P}_1$ in terms of x . (4)
- 9.2.2 Prove that TQ bisects $\hat{PQR}$. (3)
- 9.2.3 Prove that $STOR$ is a cyclic quadrilateral. (5)
- [17]

QUESTION 10

In the diagram below, points R, P, A, Q and T lie on a circle. RA bisects $\hat{R}$ and $RP \parallel TB$. RA and TQ produced meet at B.



Prove that:

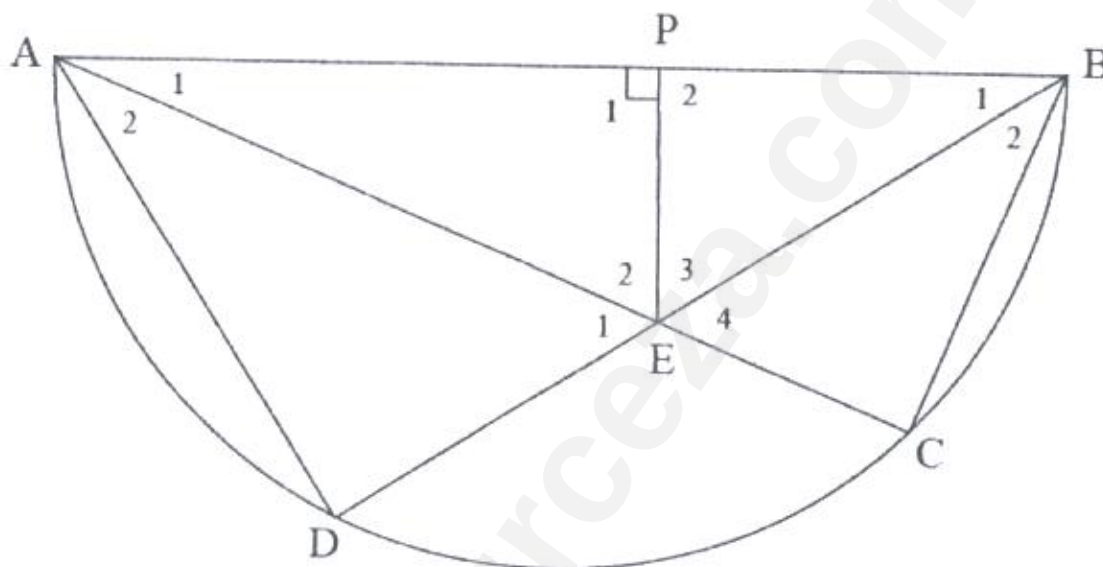
10.1 AQ bisects $\hat{PQB}$. (5)

10.2 $\hat{TRP} = \hat{A}_1$ (4)

[9]

QUESTION 11

In the diagram below, AB is the diameter of semi-circle ADCB. Chords AC and BD intersect at E. EP is perpendicular to AB.



11.1 Prove that $\triangle BPE \sim \triangle BDA$. (4)

11.2 Prove that $AB^2 = BD^2 + \frac{BD^2 \cdot PE^2}{BP^2}$ (6)

[10]

TOTAL: 150 MARKS