KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS P2

PREPARATORY EXAMINATION

SEPTEMBER 2025

MARKS: 150

TIME: 3 hours

This question paper consists of 12 pages, 1 information sheet and an answer book of 18 pages.

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 ANSWER BOOK provided.

4. Clearly show ALL calculations, diagrams, graphs, etc. which you have used in determining your answers.

5. Answers only will NOT necessarily be awarded full marks.

6. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.

7. If necessary, round off answers correct to TWO decimal places, 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 Road Traffic Inspectorate is doing research on the legibility distance, i.e. the maximum distance at which the driver of a vehicle can read a road sign. For their research they tested 12 drivers of different ages to determine their legibility distances. They hope to improve road safety by examining the relationship between age (x) measured in years and legibility distance (y) measured in metres. The table below lists the data obtained in this way.

Age of driver in years (x)	19	24	28	29	32	35	49	55	63	74	79	82
Legibility distance in metres (y)	155	149	155	131	128	137	136	128	110	109	94	90

1.1 Determine the equation of the least squares regression line for the data. (3)

1.2 Write down the correlation coefficient. (1)

1.3 By referring to your answer to QUESTION 1.2, comment on the relationship between age and legibility distance. (1)

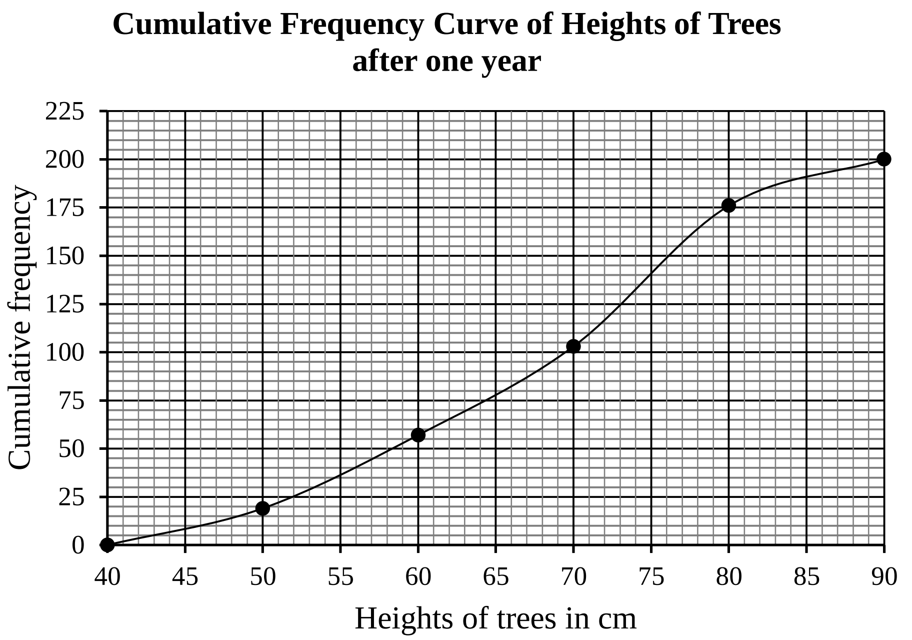
1.4 Predict the legibility distance for a 33-year-old. Give your answer correct to the nearest metre. (2)

1.5 Calculate the estimated decrease in legibility distance per age increase of 15 years, for people over 18. Give your answer correct to the nearest metre. (2)

[9]

QUESTION 2

A farmer germinated 200 seeds of a rare and valuable tree species and planted the seedlings in pots. The pots were placed in a greenhouse where they would grow faster than outside. After one year, the heights of the trees in the pots were measured and an ogive was drawn. The shortest tree was 41 cm high and the tallest tree 88 cm.



2.1 Draw a box and whisker diagram of the heights of the trees after one year, using the number line provided in the ANSWER BOOK. (3)

2.2 Describe the skewness of the data set. (1)

2.3 The trees can be sold as soon as they have reached a height of 75 cm. Will the farmer be able to sell more trees in the short term if the data set is skewed to the left or to the right? (1)

2.4 The farmer selected 14 of these trees to undergo special experimental treatment to make them grow faster. The heights of these trees, in cm, are as follows:

46	47	51	53	53	56	62	68	70	71	74	77	81	86

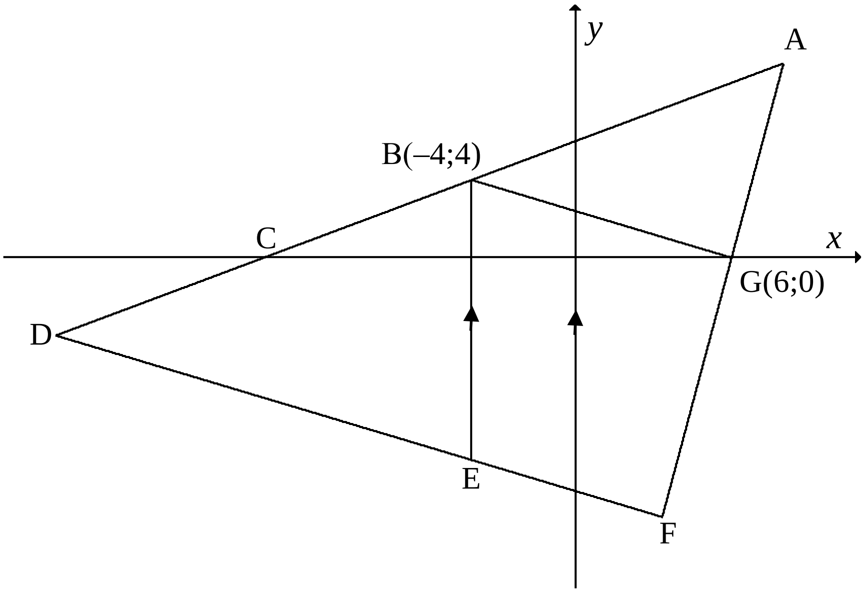
2.4.1 Calculate the standard deviation of the heights of these trees. (1)

2.4.2 How many of the trees have heights outside one standard deviation from the mean? Show all your working. (4)

[10]

QUESTION 3

In the diagram A, D and F are the vertices of ΔADF. The equation of AD is $y=\frac{1}{2}x+6$ and AD cuts the *x*-axis at C. $B(-4\ ;\ 4)$ lies on AD and E lies on DF such that BE is parallel to the *y*-axis. AF cuts the *x*-axis at $G(6\ ;\ 0)$. BG is drawn. The equation of DF is $5y+2x+60=0$.

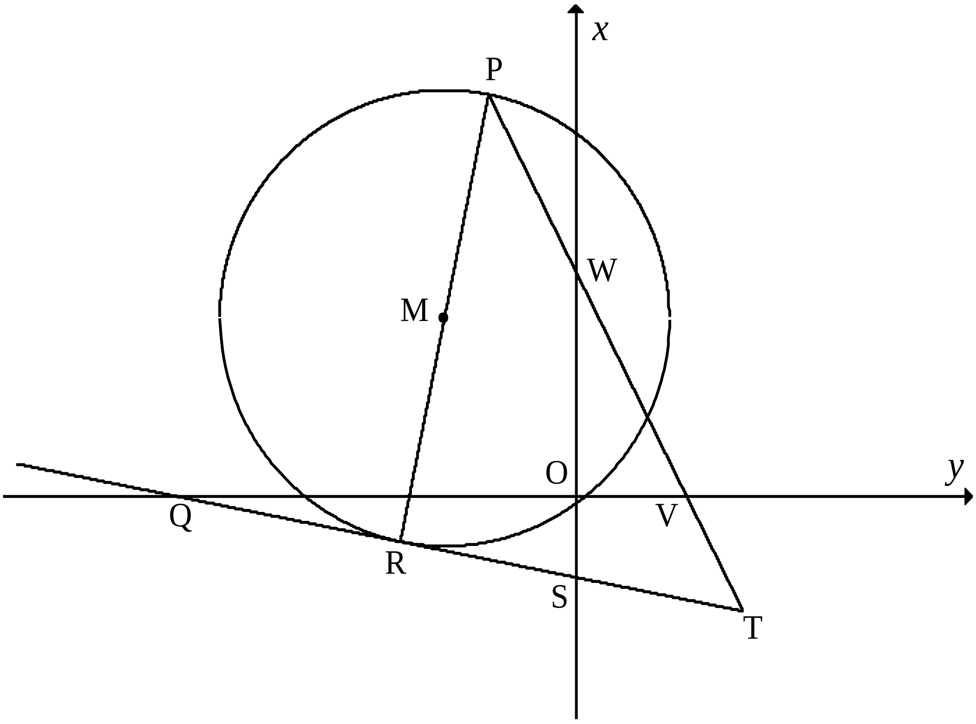


3.1	Calculate the gradient of BG.	(2)
3.2	Show that BG is parallel to DF.	(2)
3.3	Calculate the coordinates of D.	(4)
3.4	Calculate the length of BE.	(4)
3.5	Let J be a point in the third quadrant such that DJEB, in that order, forms a parallelogram. Calculate the area of DJEB.	(4)

[16]

QUESTION 4

4.1 In the diagram, the equation of the circle with centre M is $(x+3)^2+(y-4)^2=26$
PMR is a diameter of the circle. The equation of the tangent QRST to the circle at R is $y=-\frac{1}{5}x+k$. Q and S are respectively the *x*- and *y*-intercepts of QRST.
PWVT is a straight line, with *y*-intercept W and *x*-intercept V.



4.1.1 Write down:

(a) the coordinates of M. (1)

(b) the length of the radius (1)

4.1.2 Determine the equation of the diameter PMR. (3)

4.1.3 Determine the coordinates of R. (6)

4.1.4 Calculate the value of k. (2)

4.1.5 If $O\hat{W}V = 11{,}31°$, prove that WVSQ is a cyclic quadrilateral. (4)

4.2 Prove that the radius of the circle having equation $x^2+y^2+4x\cos\theta+8y\sin\theta+3=0$ can never exceed $\sqrt{13}$ for any value of θ. (5)

[22]

QUESTION 5

5.1 Given: $\cos 16° = k$.
Without using a calculator, determine each of the following in terms of k:

5.1.1 $\sin 344°$ (3)

5.1.2 $\tan 106°$ (3)

5.1.3 $\cos 8°$ (3)

5.2 Without using a calculator, simplify the following to a single trigonometric ratio:
$\cos^2(180° + x)\left[\tan(360° - x).\cos(90° + x) + \sin(x - 90°).\cos 180°\right]$ (7)

5.3 Given: $\dfrac{\cos 3\theta + \cos 7\theta}{\cos 5\theta} = 2\cos 2\theta$

5.3.1 Prove the given identity. (4)

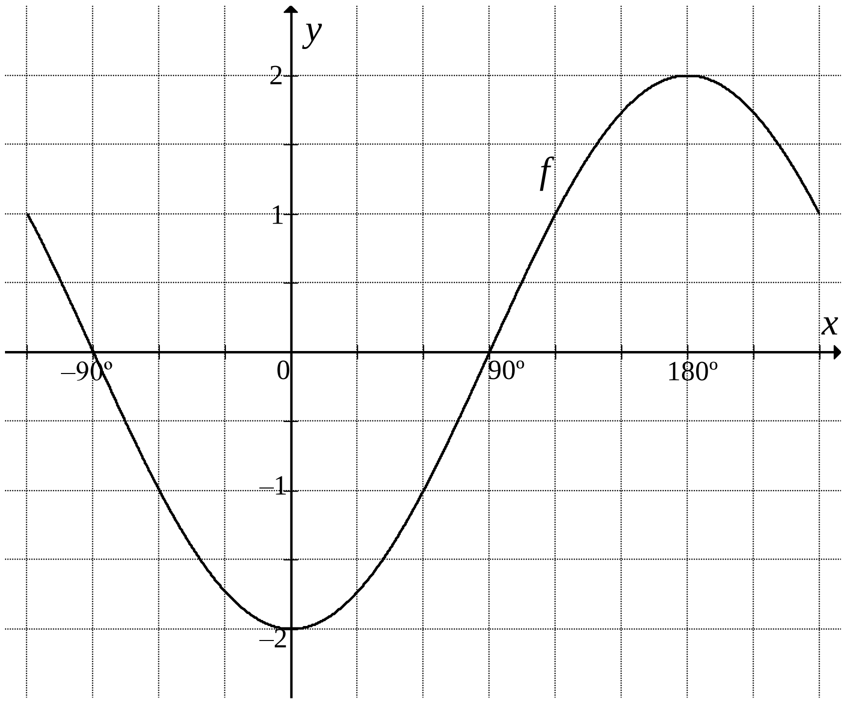
5.3.2 Hence, determine the value of $\dfrac{\cos 157{,}5° + \cos 67{,}5°}{\cos 112{,}5°}$ without the use of a calculator. (3)

5.4 Determine the general solution of the following equation:
$(4\sin 3x + 1)(\sin x - 5\cos x) = 0$ (6)

[29]

QUESTION 6

In the diagram below, the graph of $f(x) = -2\cos x$ for $x \in [-120° ; 240°]$ is drawn.



6.1 On the same system of axes in the ANSWER BOOK, sketch the graph of $g(x) = \sin(x + 60°)$. Clearly indicate the intercepts with the axes, as well as the coordinates of the turning points and the endpoints. (4)

6.2 Write down the:

6.2.1 period of g. (1)

6.2.2 range of $f(x) - 3$. (2)

6.2.3 number of solutions to $f(x) = g(x)$ in the interval $x \in [-120° ; 240°]$. (1)

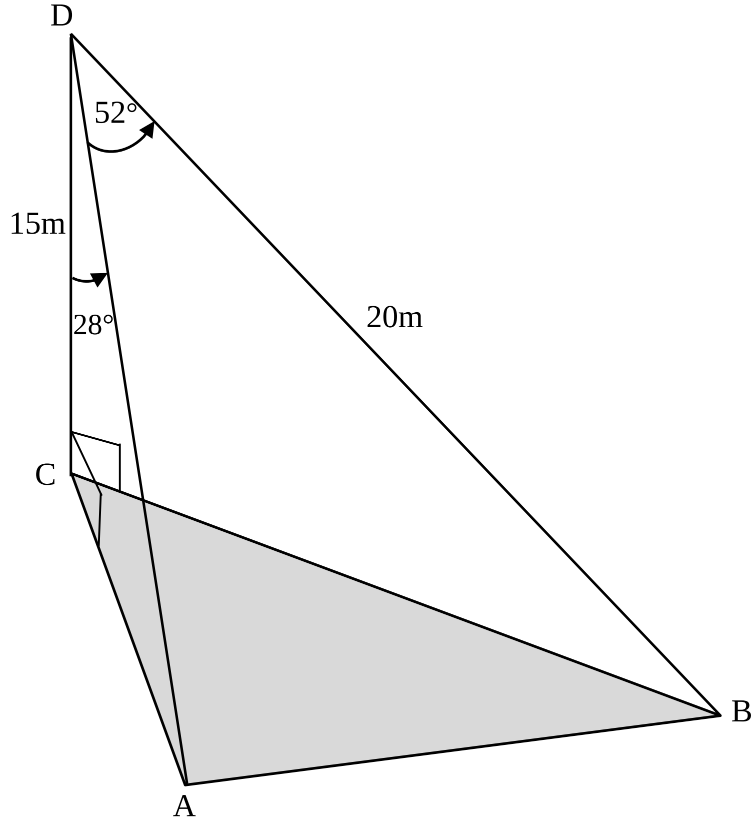
6.3 For which value(s) of k, will $g(x) - k = 1$ have no real roots? (3)

6.4 The graph of h is obtained by reflecting g in the line $x = -30°$. Write down the equation of h in its simplest form. (2)

[13]

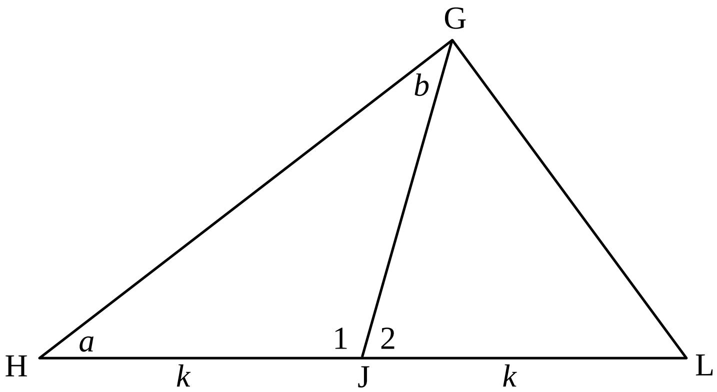
QUESTION 7

7.1 In the diagram, CD is a vertical pillar and A, B and C are points in the same horizontal plane. AD and BD are straight cables. $CD = 15\text{ m}$, $BD = 20\text{ m}$, $A\hat{D}C = 28°$ and $A\hat{D}B = 52°$.



Calculate the length of AB. (5)

7.2 J is a point on side HL of ΔGHL, such that HJ = JL = k units. $\hat{H} = a$ and $H\hat{G}J = b$.



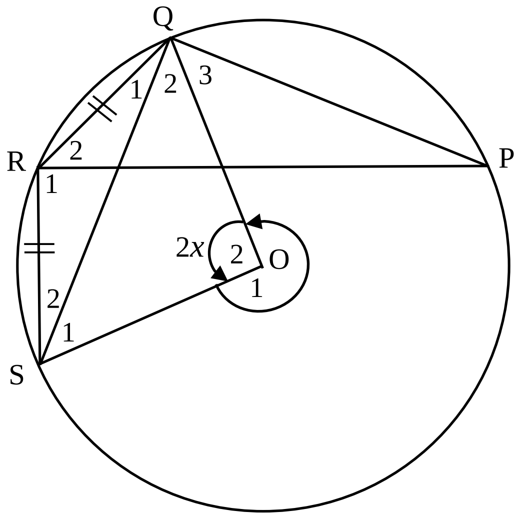
Prove that: Area of $\Delta GJL = \dfrac{k^2 \sin a . \sin(a+b)}{2 \sin b}$ (5)

[10]

GIVE REASONS FOR YOUR STATEMENTS IN QUESTIONS 8, 9 AND 10.

QUESTION 8

8.1 In the figure below, O is the centre of the circle. P, Q, R and S are points on the circumference of the circle such that $QR = RS$ and $\hat{O}_2 = 2x$.



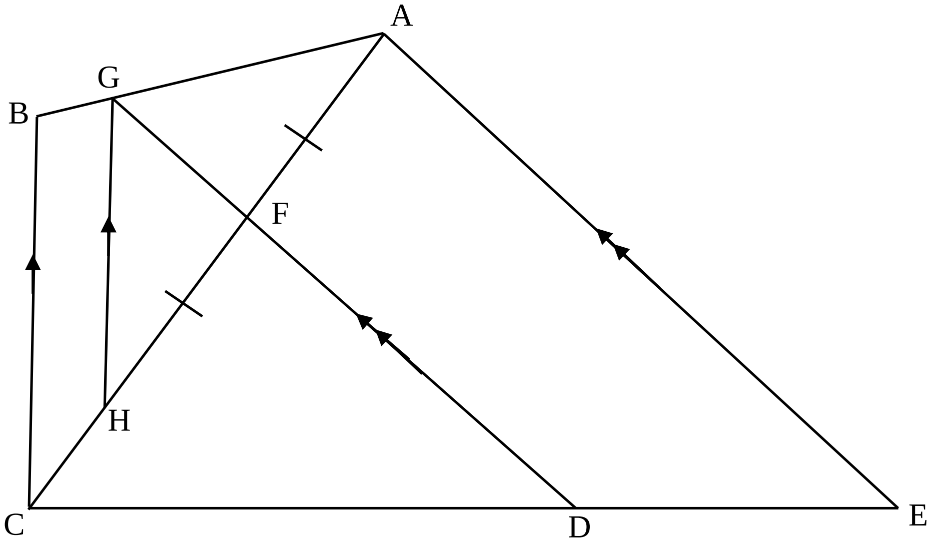
Express the following in terms of x, giving reasons for all statements:

8.1.1 $Q\hat{R}S$ (3)

8.1.2 $\hat{Q}_1$ (3)

8.1.3 $\hat{P}$ (2)

8.2 In the diagram, ΔACE has point D on CE and F and H on AC, such that $DF \parallel EA$.
DF is produced to G. AGB, GH and BC is drawn, with $BC \parallel GH$. HF = FA.
$DE : CE = 2 : 5$ and BG = 12 units.

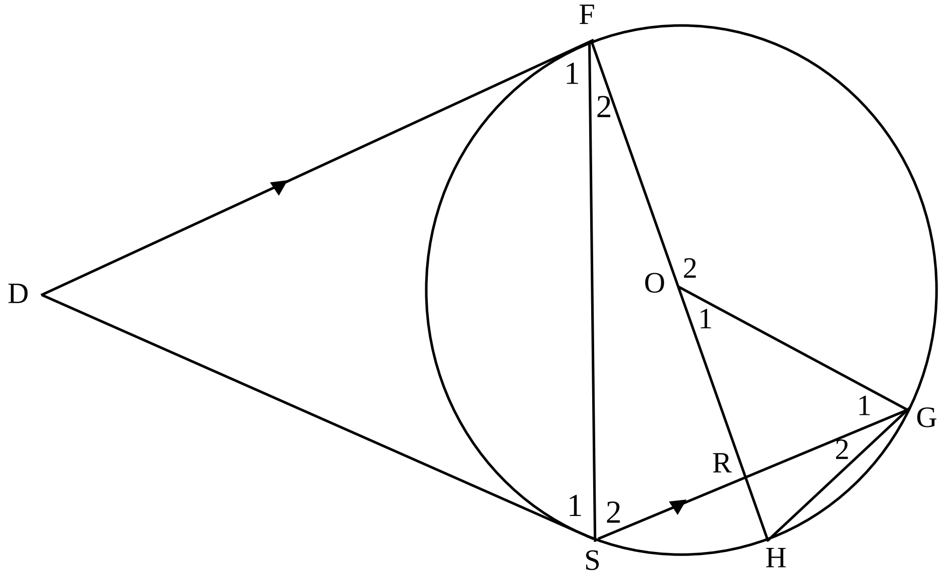


Calculate the length of AG. (6)

[14]

QUESTION 9

In the diagram, the circle with centre O passes through F, S, H and G. DF and DS are tangents to the circle at F and S respectively. SG is parallel to DF. Diameter FOH intersects SG at R. OG and GH are drawn.



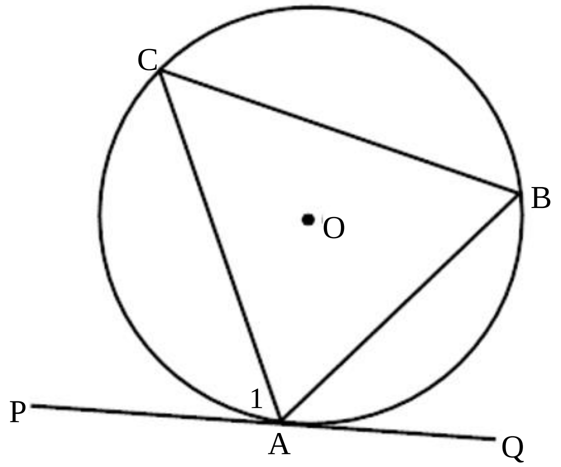
9.1 Prove that $\Delta DSF \parallel\!| \Delta OGH$. (6)

9.2 It is further given that OG = 7,5 units and RH = 1,5 units.
Calculate the length of SG. (4)

[10]

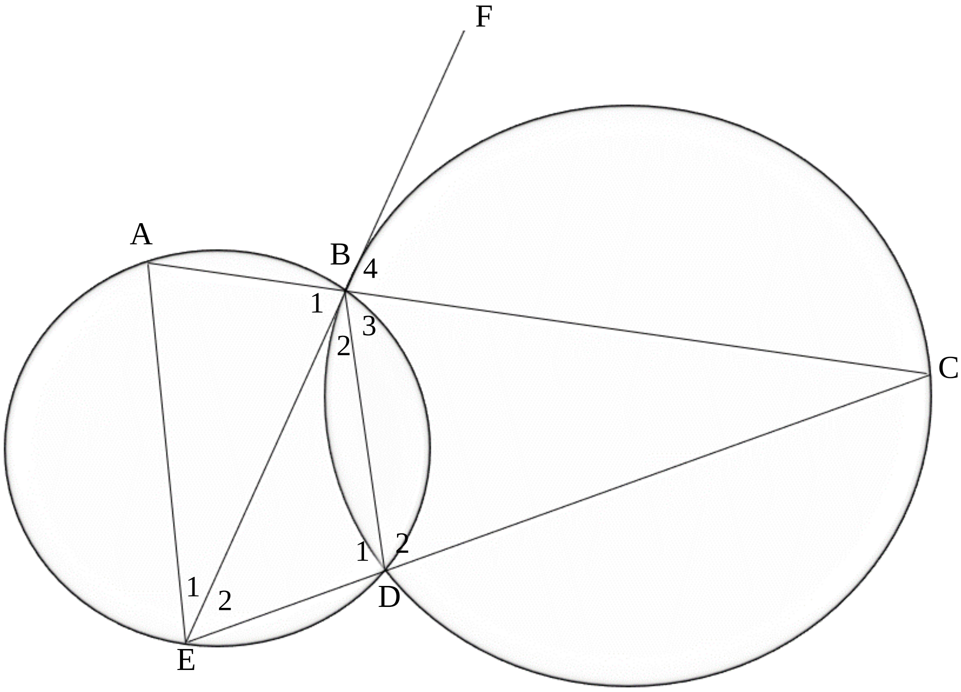
QUESTION 10

10.1 Use the diagram below to prove the theorem which states $C\hat{A}P = A\hat{B}C$.



(5)

10.2 In the diagram, EBF is a tangent to the larger circle BCD at B. CDE and ABC are straight lines with E and A on the smaller circle AEDB.



Prove that:

10.2.1 EA = EB (6)

10.2.2 The lengths ED, EA and EC (in this order) form a geometric sequence. (6)

[17]

TOTAL: 150

INFORMATION SHEET: MATHEMATICS

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

$A = P(1+ni)$ $\quad A = P(1-ni)$ $\quad A = P(1-i)^n$ $\quad A = P(1+i)^n$

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

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

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

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

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ $\quad \mathrm{M}\left(\frac{x_1 + x_2}{2} ; \frac{y_1 + y_2}{2}\right)$

$y = mx + c$ $\quad y - y_1 = m(x - x_1)$ $\quad m = \frac{y_2 - y_1}{x_2 - x_1}$ $\quad m = \tan\theta$

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

InΔABC: $\quad \frac{a}{\sin \mathrm{A}} = \frac{b}{\sin \mathrm{B}} = \frac{c}{\sin \mathrm{C}}$

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

$$area\,\Delta\mathrm{ABC} = \frac{1}{2}ab.\sin \mathrm{C}$$

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

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

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

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

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

$\mathrm{P(A)} = \frac{n(\mathrm{A})}{n(\mathrm{S})}$ $\quad$ P(A or B) = P(A) + P(B) – P(A and B)

$\hat{y} = a + bx$ $\quad b = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sum(x - \bar{x})^2}$