

RONDEBOSCH BOYS' HIGH SCHOOL



GRADE 11

**MATHEMATICS PAPER 2
24 NOVEMBER 2016**

MARKS: 150

EXAMINER:

E DU TOIT

TIME: 3 HOURS

MODERATOR:

S CARLETTI

This question paper consists of 13 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 13 questions.
2. Answer ALL the questions in the SPECIAL ANSWER BOOK.
3. Clearly show ALL calculations, diagram, graphs, et cetera which you have used in determining the answers.
4. Answers only will NOT necessarily be awarded full marks.
5. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
6. If necessary, round off answers to TWO decimal places, unless stated otherwise.
7. Provide ALL REASONS unless stated otherwise.
8. If you use EXTRA SPACE, please number the questions clearly.
9. Write neatly and legibly.

QUESTION 1

- 1.1 Consider the following numbers: 12 22 34 44 58 76
- 1.1.1 Calculate the mean of the data. (2)
- 1.1.2 Write down the standard deviation of the data. (1)
- 1.1.3 Showing calculations, state how many of the numbers lie within one standard deviation of the mean. (3)
- 1.2 The first term of a sequence is 1 and the second term is 5. From the third term on, each term is the mean of all preceding terms. Find the 25th term. (2)

[8]

QUESTION 2

The speeds of 56 cars are recorded by a traffic officer.

- 2.1 Complete the cumulative frequency column in your ANSWER BOOK. (1)
- 2.2 Draw an ogive on the grid. (3)
- 2.3 The traffic department sends fines to motorists whose speeds are greater than 75 km/h. Using your ogive, find how many motorists will receive fines. (2)

[6]

QUESTION 3

The table below shows the amount of money spent on advertising, and the income of the company, in thousands of Rand, over a 6 month period.

Advertising	3	4,5	1	7	5	2,4
Income	32	56	18	60	48	23

- 3.1 Determine the equation of the least squares regression line. (3)
- 3.2 Calculate the correlation coefficient and then explain whether it is supported or not supported by the following quote.

Nothing except the mint can make money without advertising.

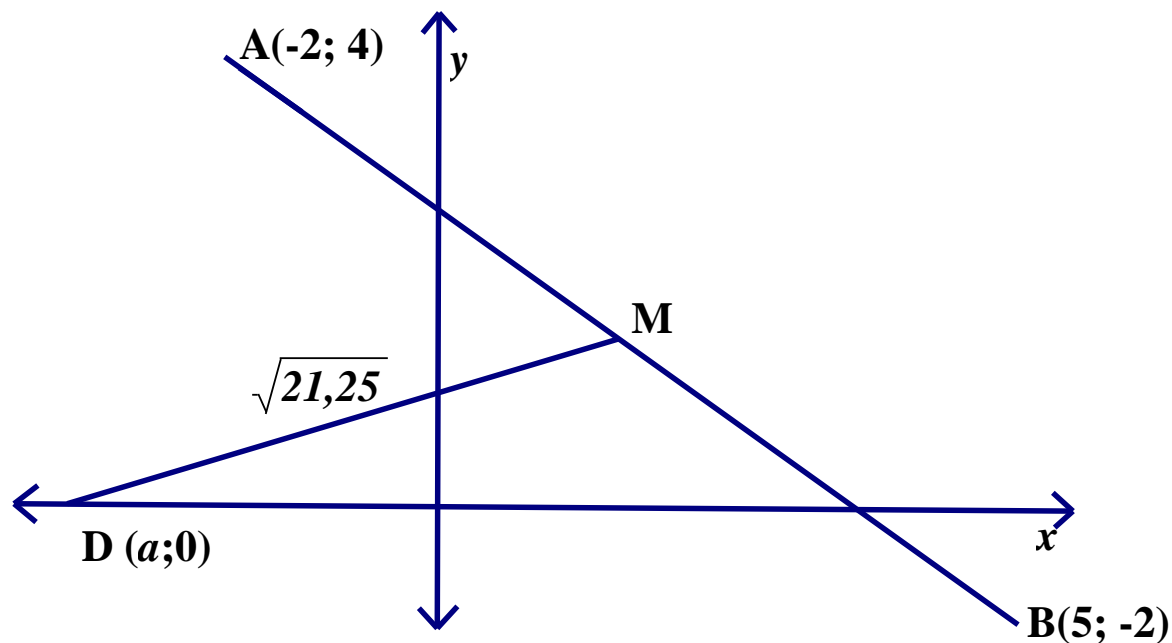
Thomas Babington Macaulay

(From: <http://www.brainyquote.com/quotes/keywords/advertising.html>) (2)

[5]

QUESTION 4

On the Cartesian plane below M is the midpoint of line AB with $A(-2; 4)$ and $B(5; -2)$. Point $D(a; 0)$ lies on the negative x -axis. The length of MD is $\sqrt{21,25}$.

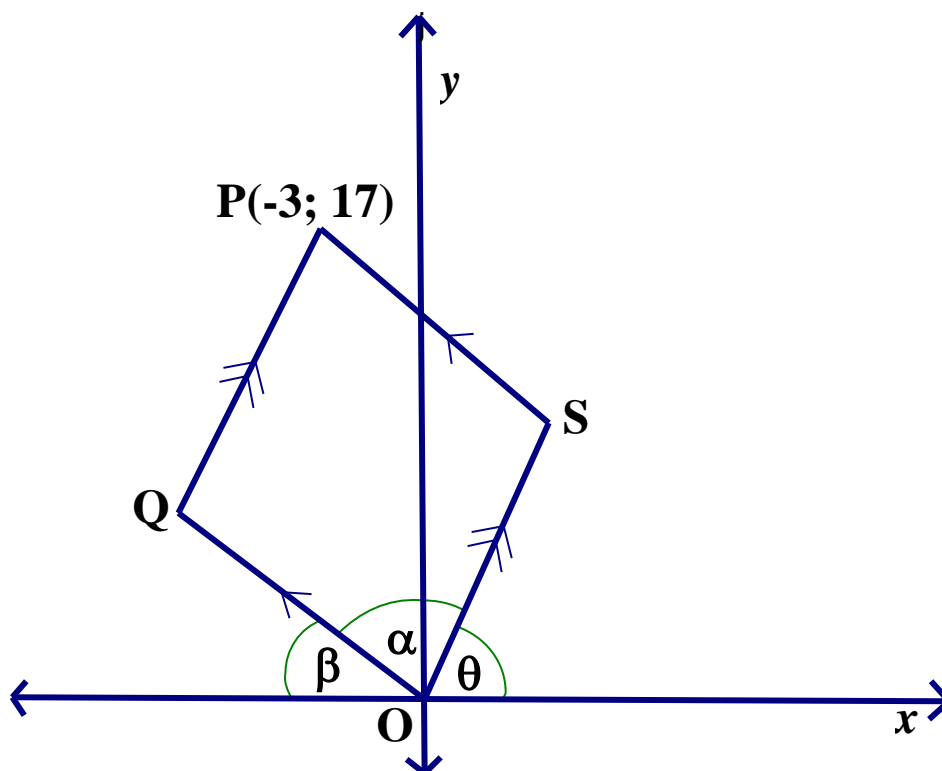


- 4.1 Find the gradient of AB . (2)
- 4.2 Find the coordinates of M , the midpoint of AB . (2)
- 4.3 Determine the coordinates of D . Show all calculations. (4)
- 4.4 Determine the coordinates of C , if $BDCM$ is a parallelogram. (2)

[10]

QUESTION 5

In the diagram below $P(-3; 17)$, Q , O and S are the vertices of a parallelogram. The sides OS and OQ are defined by the equations $y = 6x$ and $y = -x$ respectively. $\widehat{QOS} = \alpha$, $\widehat{SOX} = \theta$ and $\widehat{QOX} = \beta$.



- 5.1 Determine the equation of QP in the form $y = mx + c$. (3)
- 5.2 Hence, determine the coordinates of Q . (4)
- 5.3 Calculate the size of α . (3)
- 5.4 Calculate the length of OS , in simplified surd form. (4)
- 5.5 If $OS = 2\sqrt{37}$ units, calculate the length of QS . (3)

[17]

QUESTION 6

The line $4y - 3x = 24$ cuts the x - axis at A and the y - axis at B . Calculate the coordinates of C , on AB , such that $3AC = 2AB$.

[4]

QUESTION 7

7.1 Simplify without the use of a calculator:

$$\frac{\cos(90^\circ + \theta) \sin(180^\circ - \theta)}{(\cos 90^\circ + \cos \theta)(\cos 90^\circ - \cos \theta)} \quad (5)$$

7.2 If $\sin 28^\circ = m$, determine the value of the following in terms of m without the use of a calculator:

7.2.1 $\sin(-28^\circ)$ (2)

7.2.2 $\cos 478^\circ$ (2)

7.2.3 $\tan 152^\circ$ (3)

7.3 Prove the following identity:

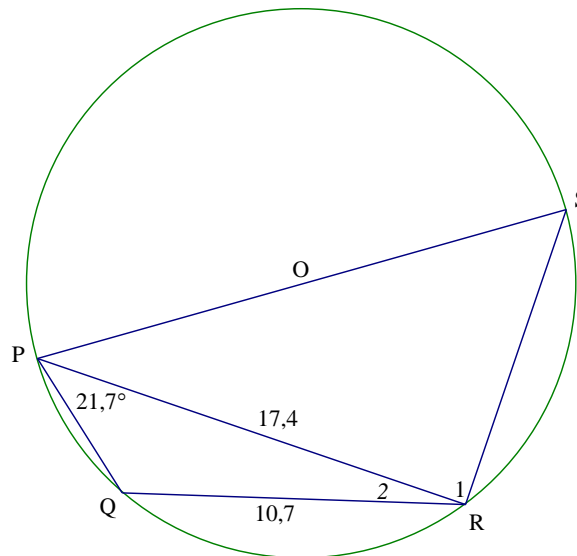
$$\tan \beta + \frac{\cos \beta}{1 + \sin \beta} = \frac{\cos \beta}{1 - \sin^2 \beta} \quad (5)$$

7.4 Solve for x , $x \in [-180^\circ; 360^\circ]$: $\frac{\sin \frac{1}{2}x}{\cos \frac{1}{2}x} = \tan \frac{1}{2}x$ (3)

[20]

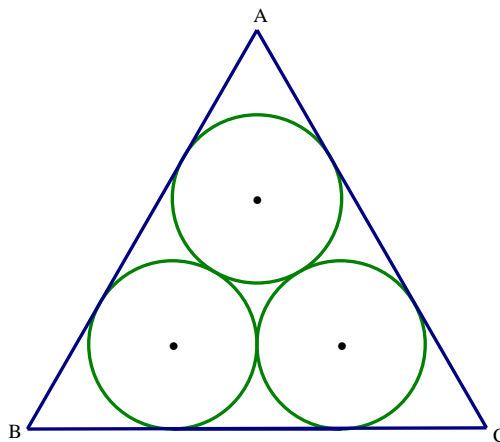
QUESTION 8

- 8.1 The accompanying diagram shows a cyclic quadrilateral $PQRS$ with $\widehat{Q} > 90^\circ$. PS is a straight line. O is the centre of the circle. $PR = 17,4$ units, $QR = 10,7$ units and $\widehat{QPR} = 21,7^\circ$.



Calculate:

- 8.1.1 the size of \widehat{Q} . (3)
- 8.1.2 the size of \widehat{S} . (2)
- 8.1.3 the diameter of the circle. (4)
- 8.2 8.2.1 Draw a special triangle with angles of 30° , 60° and 90° . Show the lengths of the sides. (1)
- 8.2.2 Hence, consider the diagram below. Three circles of radius 1 fit snugly into equilateral triangle ABC , and they just touch each other as well as the sides of the triangle, as shown. Determine the area of the triangle, without the use of a calculator. Leave your answer in simplified surd form.



(5)

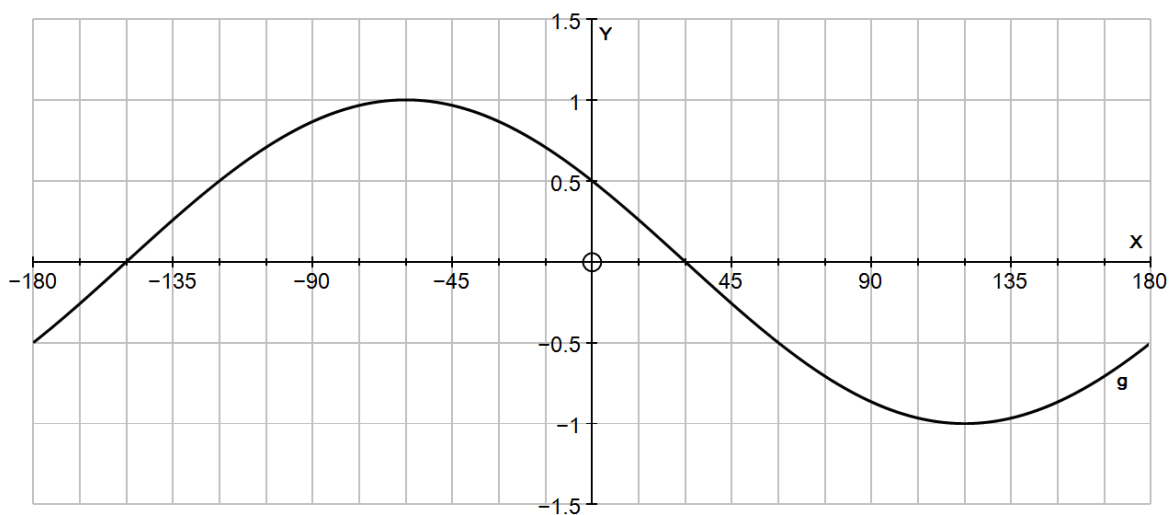
[15]

QUESTION 9

9.1 Given two functions $f(x) = \sin 2x$ and $g(x) = \cos(x + 60^\circ)$.

9.1.1 Give the general solution for x if $f(x) = g(x)$. (5)

9.1.2 The graph of $g(x)$ is given. Draw the graph of $f(x)$ on the same set of axes for $x \in [-180^\circ \leq x \leq 180^\circ]$.

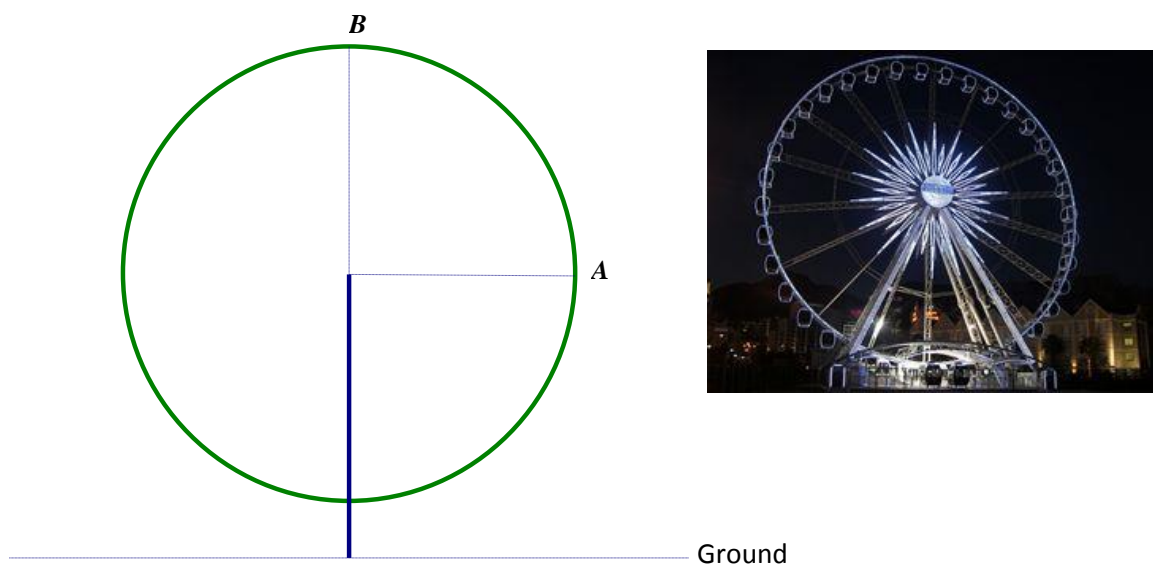


(3)

9.1.3 Hence, determine the value(s) of x for $x \in [-90^\circ; 90^\circ]$ where

$$\frac{f(x)}{g(x)} \leq 0 \quad (3)$$

- 9.2 You go for a ride on the Cape Wheel of Excellence at the V&A Waterfront. The wheel has a diameter of 20 m. Its centre is 12 meters above the ground. The wheel rotates anti-clockwise and is timed for every revolution once it reaches its working speed at A.



The timing of the ride starts when your chair is at A. The wheel rotates every 36 seconds. B is the highest point reached by your chair.

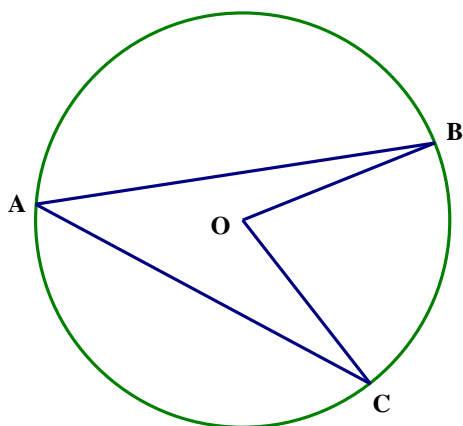
The equation $y = a + b \sin(10t)^\circ$ is a suitable model for the height, y meters, of your chair above the ground, t seconds after the timing starts.

- 9.2.1 Determine the value of a . (Hint: $t = 0$ at A.) (2)
- 9.2.2 Determine the value of b . (1)
- 9.2.3 Calculate the times during the first minute when your chair is 17 metres above the ground. (2)

[16]

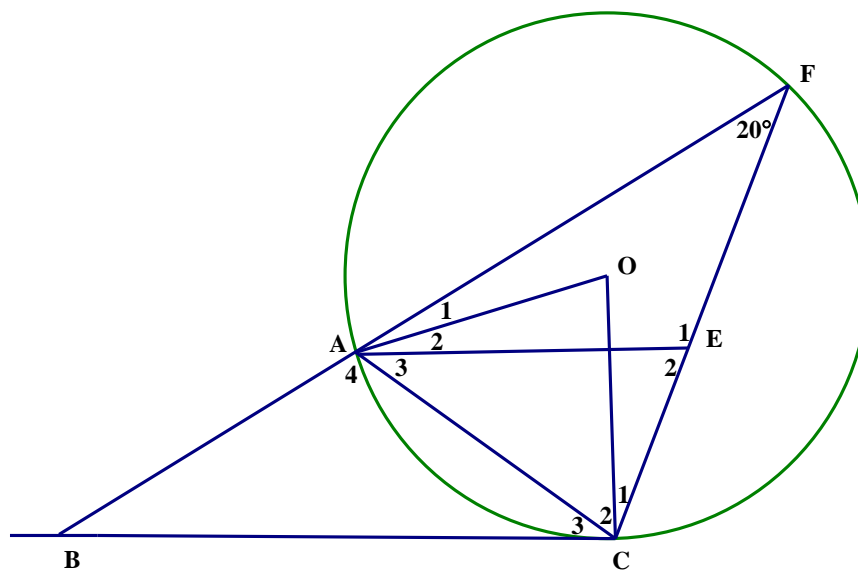
QUESTION 10

- 10.1 Prove the theorem that states that the angle at the centre of a circle is double the angle subtended by the same arc on the circumference of the circle.



(5)

- 10.2 In the figure below, O is the centre of the circle, $AE = EF$ and BC is a tangent to the circle.



- 10.2.1 If $\hat{F} = 20^\circ$, find the size of the following angles:

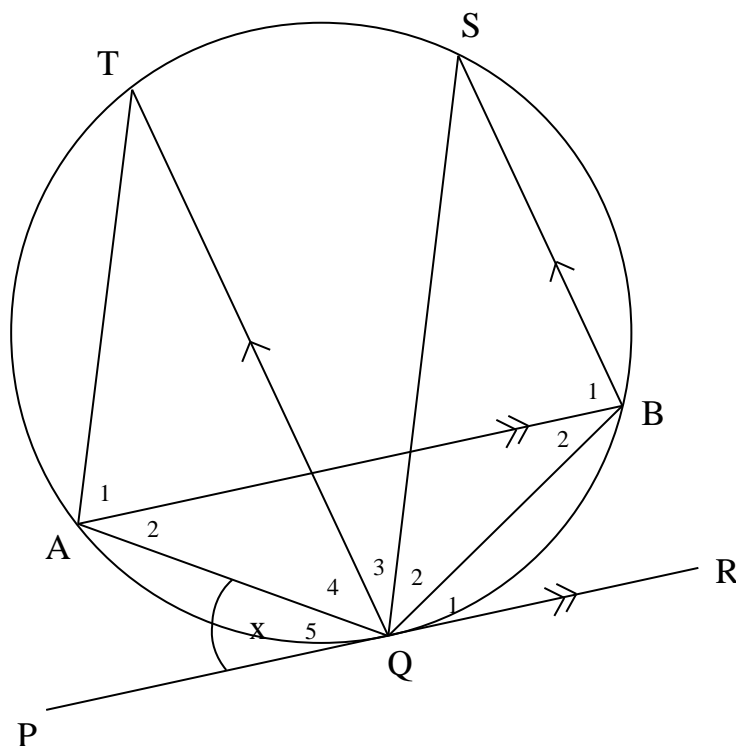
- a) \hat{FAE} (2)
- b) \hat{C}_3 (2)
- c) \hat{AOC} (2)
- d) \hat{E}_2 (2)

- 10.2.2 Can a circle be drawn such that its circumference touches the point A, O, E and C ? Give a reason for your answer. (2)

[15]

QUESTION 11

In the figure below, PQR is a tangent, all the chords drawn are straight lines with $AB \parallel PR$ and $BS \parallel QT$.

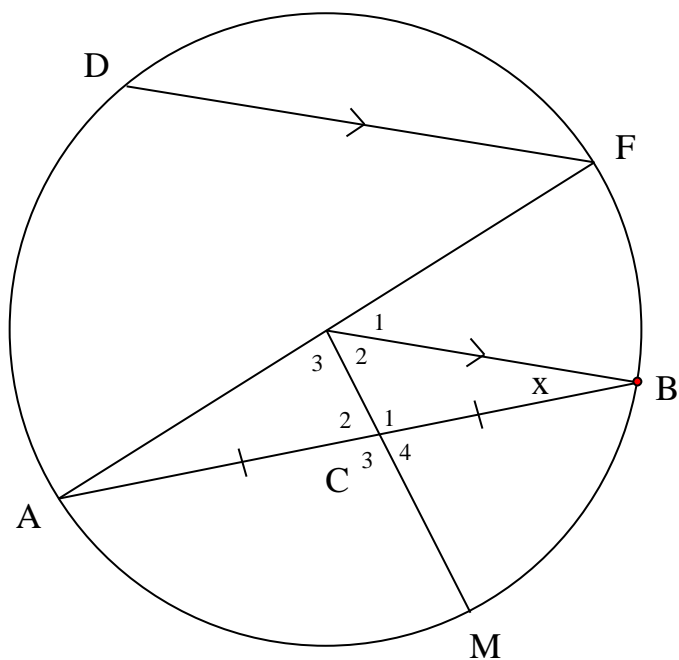


- 11.1 If $\hat{Q}_5 = x$, complete the table in your ANSWER BOOK, giving reasons why \hat{A}_2 , \hat{ATQ} , \hat{B}_2 and \hat{Q}_1 are all equal to x . (4)
- 11.2 Prove that $AQ = BQ$. (2)
- 11.3 Prove that $AT \parallel QS$. (4)

[10]

QUESTION 12

AF is a diameter of circle O with chords AB and DF . M is a point on the circumference so that OM bisects AB at C . OB is joined, with $OB \parallel DF$. Let $\hat{B} = x$.



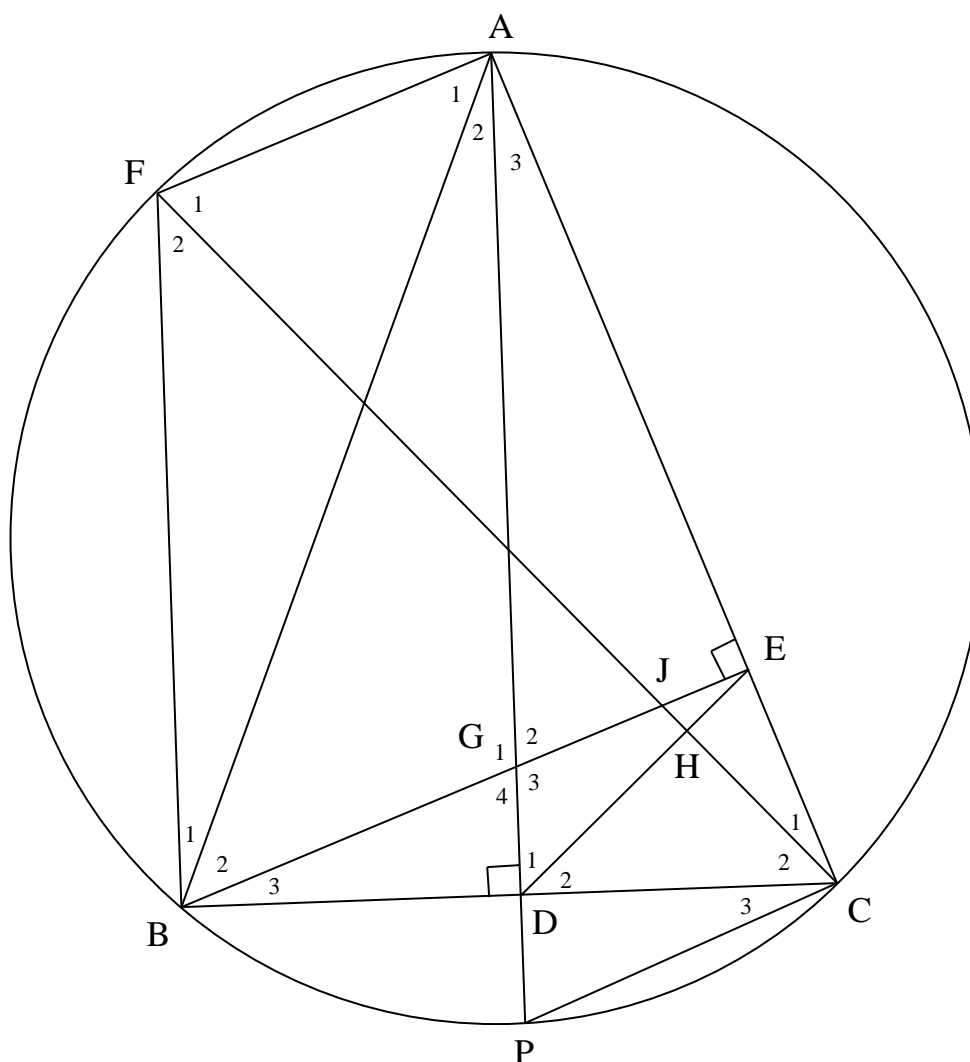
12.1 Prove that $\hat{F} = 2x$. (4)

12.2 If it is given that $CM = 8 \text{ mm}$ and $AC = 12 \text{ mm}$, determine the length of OC , giving reasons. (6)

[10]

QUESTION 13

In the diagram $AP \perp BC$ and $BE \perp AC$.



- 13.1 Prove that $ABDE$ is a cyclic quadrilateral. (2)
- 13.2 Prove that $GDCE$ is a cyclic quadrilateral. (2)
- 13.3 If it is given that CF is a diameter, prove that $AFBG$ is a parallelogram. (4)
- 13.4 Prove that $AFHE$ is a cyclic quadrilateral. (6)

[14]

TOTAL MARKS: 150