Province of the EASTERN CAPE EDUCATION

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NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2025

TECHNICAL MATHEMATICS P2

MARKS: **150**

TIME: **3 hours**

This question paper consists of 14 pages, including a 2 page information sheet.

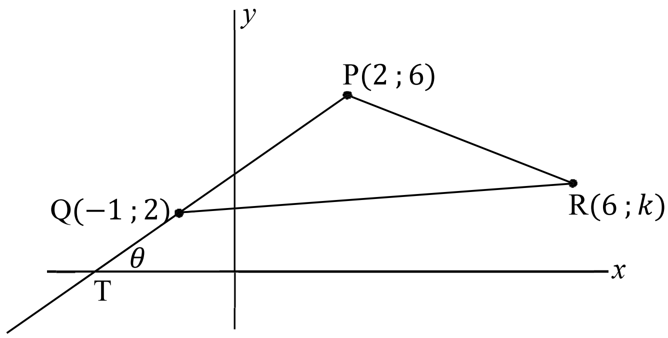
INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of ELEVEN questions.
2. Answer ALL the questions in the SPECIAL ANSWER BOOK provided.
3. Clearly show ALL calculations, diagrams, 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 your answers to TWO decimal places, unless stated otherwise.
7. Diagrams are NOT necessarily drawn to scale.
8. An information sheet with formulae is included at the end of the question paper.
9. Write neatly and legibly.

QUESTION 1

ΔPQR is right-angled at point P. Vertices P$(2\,;6)$, Q$(-1\,;2)$ and R$(6\,;k)$ are given. PQ is extended such that it passes through T at an angle θ to the x-axis.



1.1 Complete the following:

When lines are perpendicular, the product of the gradients is ... (1)

1.2 Determine the value of k. (4)

1.3 Determine the coordinates of S, such that QPRS is a rectangle. (4)

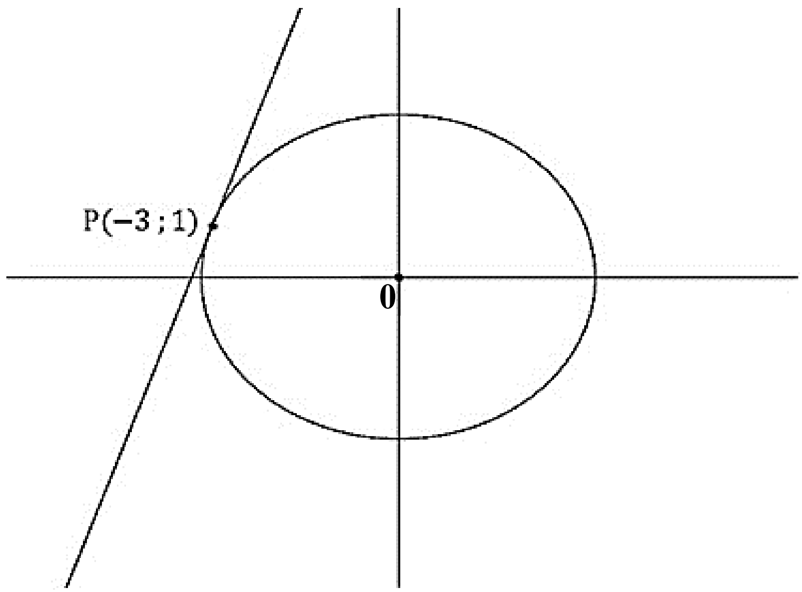
1.4 Determine θ, the angle of inclination of the line PT. (3)

1.5 Determine the equation of a line, parallel to line PT and going through point R. (4)

[16]

QUESTION 2

2.1 The diagram below shows a circle with equation $x^2 + y^2 = 10$. The contact point of a tangent to the circle is at P$(-3\,;1)$.



2.1.1 Write down the radius of the circle in simplified surd form. (1)

2.1.2 Determine the equation of the tangent to the circle at point P in the form $y = \ldots$ (4)

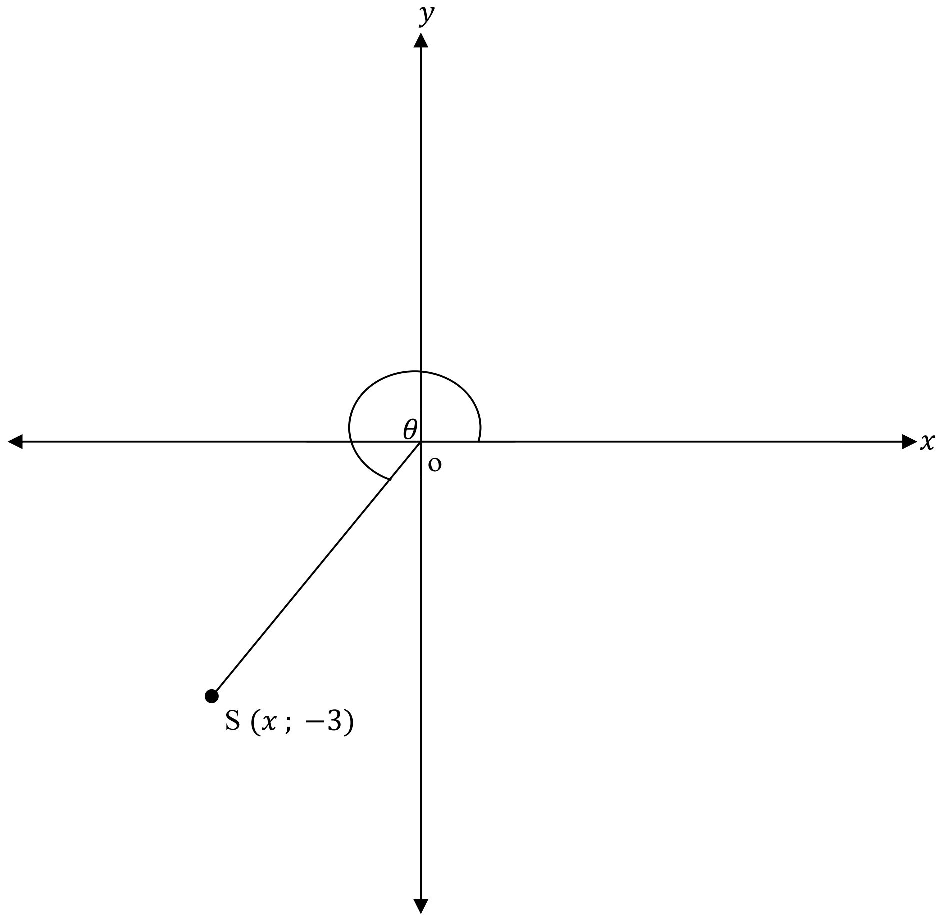
2.1.3 Give the equation of the semicircle, if $0 < y < \sqrt{10}$. (2)

2.2 Sketch the graph of $\frac{x^2}{64} + \frac{y^2}{25} = 1$. Clearly indicate the intercepts. (3)

[10]

QUESTION 3

3.1 In the diagram below S(x ; -3) and OS = 5 are given.



Determine the value of the following, without using a calculator:

3.1.1 x (3)

3.1.2 $\cos\theta$ (1)

3.1.3 $\operatorname{cosec}(180° - \theta)$ (2)

3.2 Determine the values of x, if $3\sin 2x = 1{,}465$ and $0° \leq 2x \leq 360°$. (4)

[10]

QUESTION 4

4.1 Simplify: $\dfrac{\tan(180°-\theta).\cot(360°-\theta)-\sin^2(180°+\theta)}{\sec(180°-\theta)\cdot\sec\theta+\tan^2\theta}$ (7)

4.2 Prove that: $\dfrac{\sin x}{-\operatorname{cosec} x} + \dfrac{\cos^2(x).\tan x}{\tan(180°-x)} = -1$ (6)

[13]

QUESTION 5

Given the functions defined by $f(x) = \tan x - 1$ and $g(x) = \cos 2x$ for $x \in [0°\,;360°]$.

5.1 On the same axes, given in your SPECIAL ANSWER BOOK, draw the graphs of f and g. Clearly show the turning points, asymptotes, endpoints and the intercepts with the axes. (8)

5.2 Write down the period of g. (2)

5.3 Give the equation of h, if f is moved 3 units up. (2)

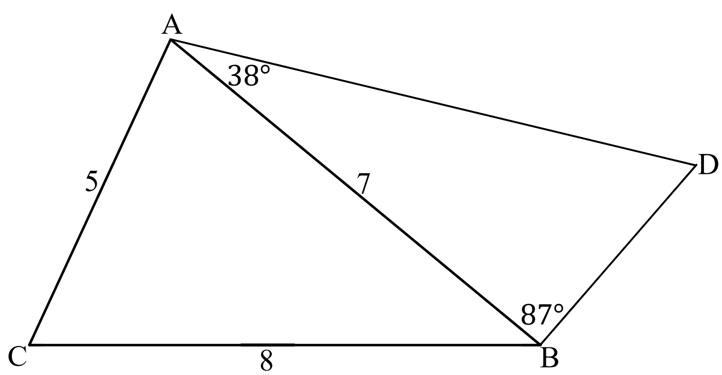
5.4 Use your graphs to determine for which values of x is:

5.4.1 $\cos 2x + 1 \leq \tan x$, for the interval $x \in [-180°\,;0]$ (2)

5.4.2 $g(x) < 0$ (2)

[16]

QUESTION 6



6.1 Write down the cosine rule for ΔABC. (1)

6.2 Calculate the length of DB, correct to ONE decimal place. (3)

6.3 Calculate the size of $C\hat{A}B$. (3)

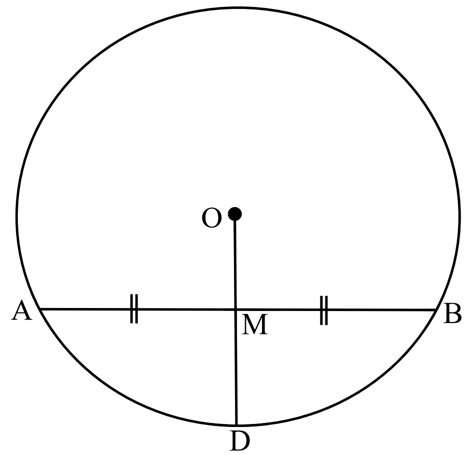
6.4 Determine the area of ΔABC. (3)

6.5 Calculate the shortest distance between C and the line AB. (4)

[14]

QUESTION 7

In the diagram below, O is the centre of the circle. AB = 24 cm; M is the midpoint of AB and MD = 8 cm. (**HINT**: Let OM = x)



7.1 Write down the length of AM. (1)

7.2 Write down the length of OD in terms of x. (1)

7.3 Give a reason why OA = OB = OD. (1)

7.4 Determine the length of OA, in terms of x, in ΔAOM. (5)

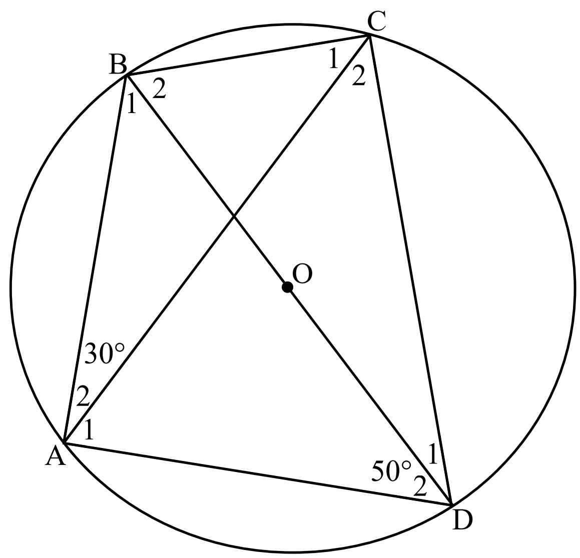
7.5 Determine the value of x. (4)

7.6 Give the value of the radius. (2)

[14]

QUESTION 8

In the diagram below, AC is a chord in the circle with centre O. $\hat{D}_2 = 50°$; $\hat{A}_2 = 30°$ and BD is the diameter.



Determine, with reasons, the sizes of the following:

8.1 $\hat{D}_1$ (2)

8.2 $\hat{A}_1$ (2)

8.3 $\hat{C}_1$ (2)

8.4 $\hat{C}_2$ (2)

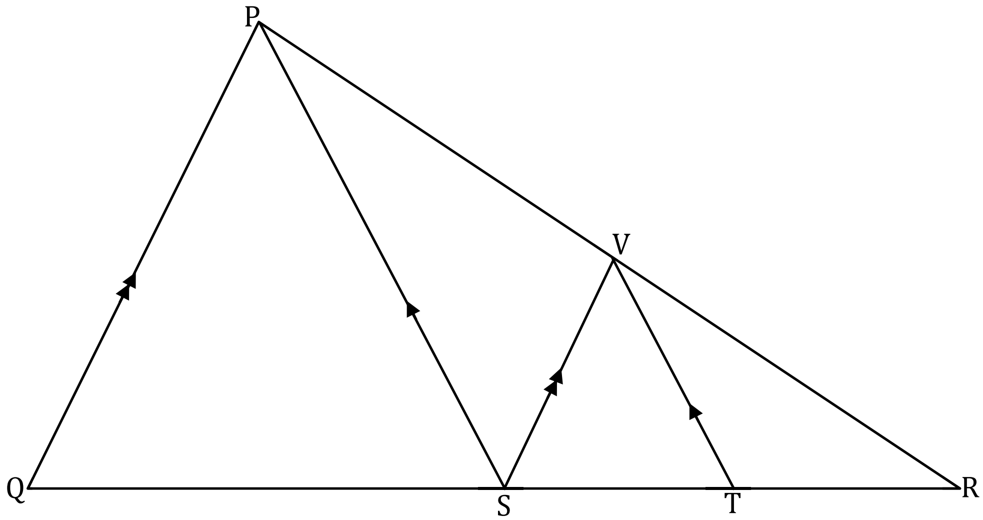
8.5 $\hat{B}_1$ (2)

8.6 $\hat{B}_2$ (2)

[12]

QUESTION 9

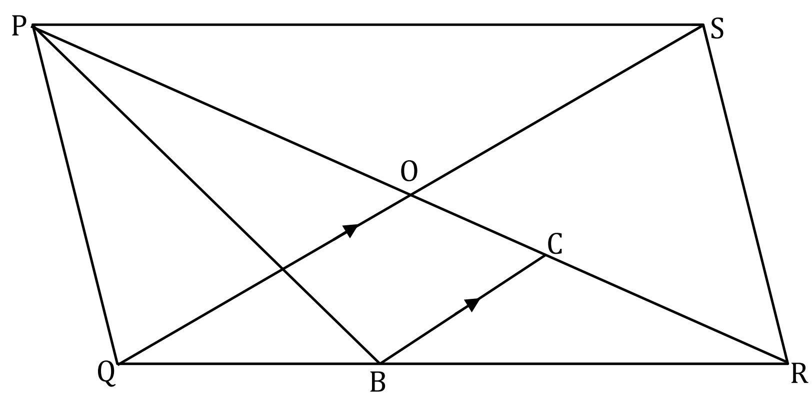
9.1 In the diagram below, PV = 24 cm; VR = 22 cm and ST = 12 cm. PQ ∥ VS and PS ∥ VT.



9.1.1 Determine the length of TR. (4)

9.1.2 Determine the length of QR, correct to ONE decimal place. (4)

9.2 In the diagram below, PQRS is a parallelogram and QS ∥ BC and $\frac{QB}{BR} = \frac{2}{3}$.

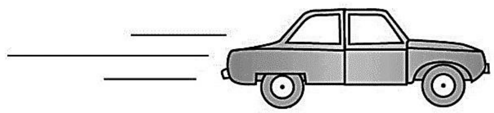


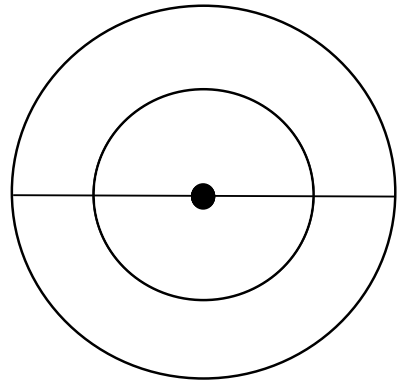
Determine $\frac{PO}{OC}$. (4)

[12]

QUESTION 10

A tyre, of a car driving on the highway, has an average rotation of 1 500 rpm. The tyre has a diameter of 55,9 cm. The cartoon and diagram below, represent the tyre.





10.1 Convert the rotations to rotations per second. (2)

10.2 Determine the circumferential velocity of the tyre in mm/s. (4)

10.3 Determine the angular velocity of the tyre in rad/sec. (3)

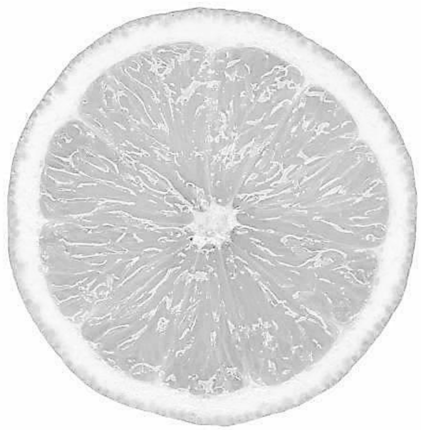
10.4 What will the diameter of the tyre be, if it decreases by $\frac{1}{3}$? (3)

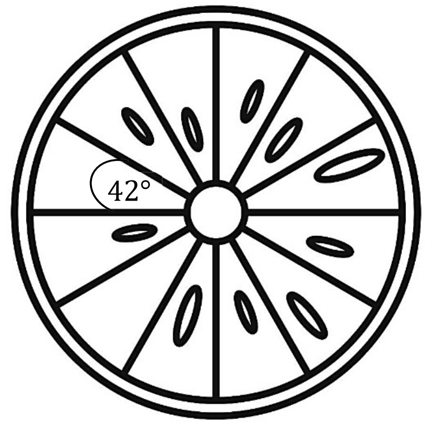
10.5 What will the new circumferential velocity of the tyre, with the decreased diameter, be in cm/min? (3)

[15]

QUESTION 11

11.1 The picture and diagram below, represent a lemon that was cut in half. The diameter of the lemon is 8 cm and the angle formed at the centre is approximately 42°.



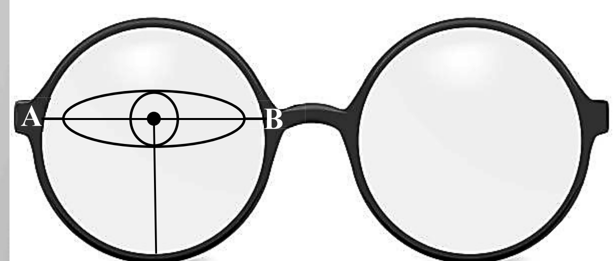


11.1.1 Determine the length of one of the arcs of a segment of the lemon. (4)

11.1.2 Determine the area of one of the segments. (3)

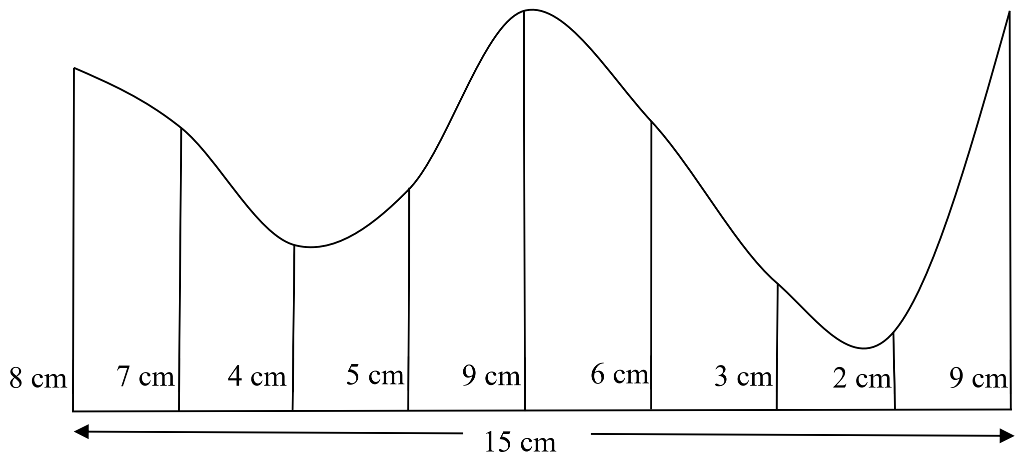
11.1.3 What will the approximate area be of all the wedges in the diagram? (2)

11.2 Below is a picture of a man wearing circular eye glasses and on the right is a diagram depicting the image. A chord AB is drawn through the pupil of the eye. The length of the chord is 7 cm. The diameter of the glasses is 10 cm.



Determine the height from the pupil to the bottom rim of the glasses. (5)

11.3 The ordinates in the irregular figure are 8 cm; 7 cm; 4 cm ; 5 cm; 9 cm; 6 cm; 3 cm; 2 cm and 9 cm as indicated in the diagram below. The width of the irregular figure is 15 cm.



Determine the area of the above irregular shape. (4)

[18]

TOTAL: 150

INFORMATION SHEET

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

$a^x = b \Leftrightarrow x = \log_a b, \quad a > 0,\ a \neq 1 \text{ and } b > 0$

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

$i_{eff} = \left(1 + \frac{i}{m}\right)^m - 1$

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

$\int x^n dx = \frac{x^{n+1}}{n+1} + C \quad , \ n \neq -1$ $\quad \int kx^n dx = k \cdot \frac{x^{n+1}}{n+1} + C \quad , \ n \neq -1$

$\int \frac{1}{x} dx = \ln(x) + C, \quad x > 0$ $\quad \int \frac{k}{x} dx = k \cdot \ln(x) + C, \quad x > 0$

$\int a^x dx = \frac{a^x}{\ln a} + C, a > 0$ $\quad \int ka^{nx} dx = k \cdot \frac{a^{nx}}{n \ln a} + C \quad , \ a > 0$

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

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

$x.x_1 + y.y_1 = r^2$

$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

In ΔABC:

$\frac{a}{\sin \mathrm{A}} = \frac{b}{\sin \mathrm{B}} = \frac{c}{\sin \mathrm{C}}$ $\quad a^2 = b^2 + c^2 - 2bc \cos \mathrm{A}$ $\quad \text{Area} = \frac{1}{2} ab.\sin \mathrm{C}$

$\sin^2\theta + \cos^2\theta = 1$ $\quad \tan^2\theta + 1 = \sec^2\theta$ $\quad 1 + \cot^2\theta = \mathrm{cosec}^2\theta$

$\pi rad = 180°$

Angular velocity = $\omega = 2\pi n$ where n = rotation frequency

Angular velocity = $\omega = 360°n$ where n = rotation frequency

Circumferential velocity = $v = \pi Dn$ where D = diameter and n = rotation frequency

Circumferential velocity = $v = \omega r$ where ω = angular velocity and r = radius

Arc length $s = r\theta$ where r = radius and θ = central angle in radians

Area of a sector $= \frac{rs}{2}$ where r = radius and s = arc length

Area of a sector $= \frac{r^2\theta}{2}$ where r = radius and θ = central angle in radians

$4h^2 - 4dh + x^2 = 0$ where h = height of segment, d = diameter of the circle and x = length of chord

$A_T = a(m_1 + m_2 + m_3 + ... + m_{n-1})$ where a = width of equal parts, $m_1 = \frac{o_1 + o_2}{2}$ and n = number of ordinates

OR

$A_T = a\left(\frac{o_1 + o_n}{2} + o_2 + o_3 + o_4 + ... + o_{n-1}\right)$ where a = width of equal parts, $o_i = i^{th}$ ordinate and n = number of ordinates