GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION
2024

11092

TECHNICAL MATHEMATICS
(PAPER 2)

SURNAME:										
NAME:										
SCHOOL:										
DATE:	**2**	**0**	**2**	**4**	**-**			**-**		

	MARKER				MODERATOR			
QUESTION	**MARKS**			**MARKER'S INITIALS**	**MARKS**			**MODERATOR'S INITIALS**
1	**0**				**0**			
2	**0**				**0**			
3	**0**				**0**			
4	**0**				**0**			
5	**0**				**0**			
6	**0**				**0**			
7	**0**				**0**			
8	**0**				**0**			
9	**0**				**0**			
10	**0**				**0**			
11	**0**				**0**			
				TOTAL				

TIME: 3 hours

MARKS: 150

29 pages + a 2-page information sheet

P.T.O.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 11 questions.
2. Answer ALL the questions in the spaces provided.
3. Clearly show ALL calculations, diagrams, graphs, etc. that you have used in determining your 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. A 2-page INFORMATION SHEET with formulae is included at the end of the question paper.
9. Candidates may NOT retain a question paper or remove it from the examination room. Question papers must be returned to the invigilator at the end of the examination session.
10. Answers must be written in blue/black ink as distinctly as possible. Do NOT write in the margin.
11. Indicate the questions you have answered by drawing a circle around the relevant numbers on the front cover of the question paper where marks are to be recorded.
12. Draw a neat line through any work/rough work that must NOT be marked.
13. In the event that you use the additional space provided:

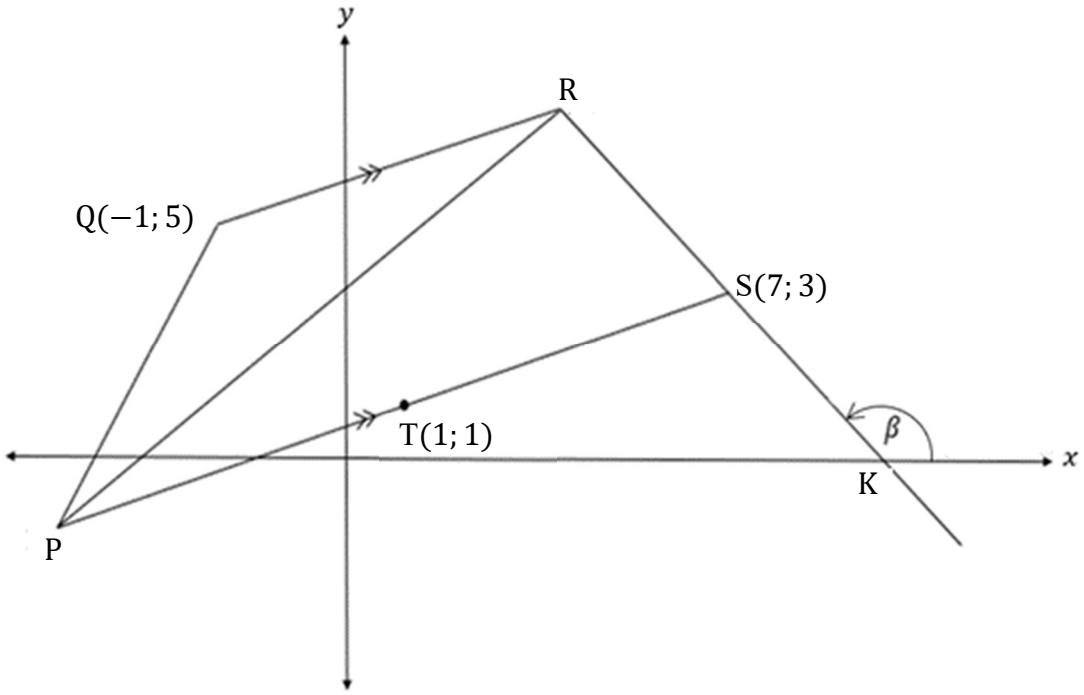
    13.1 Write down the number of the question.
    13.2 Leave a line and rule off after your answer.

14. Write neatly and legibly.

KEEP THIS PAGE BLANK.

QUESTION 1

In the diagram below, P, $Q(-1;5)$, R and $S(7;3)$ are the vertices of trapezium PQRS with QR ‖ PS and $T(1;1)$ is the midpoint of PS. RS is produced to cut the x-axis at K. The angle of inclination of RS is β. The straight line RS is defined by $y = -2x + 17$.

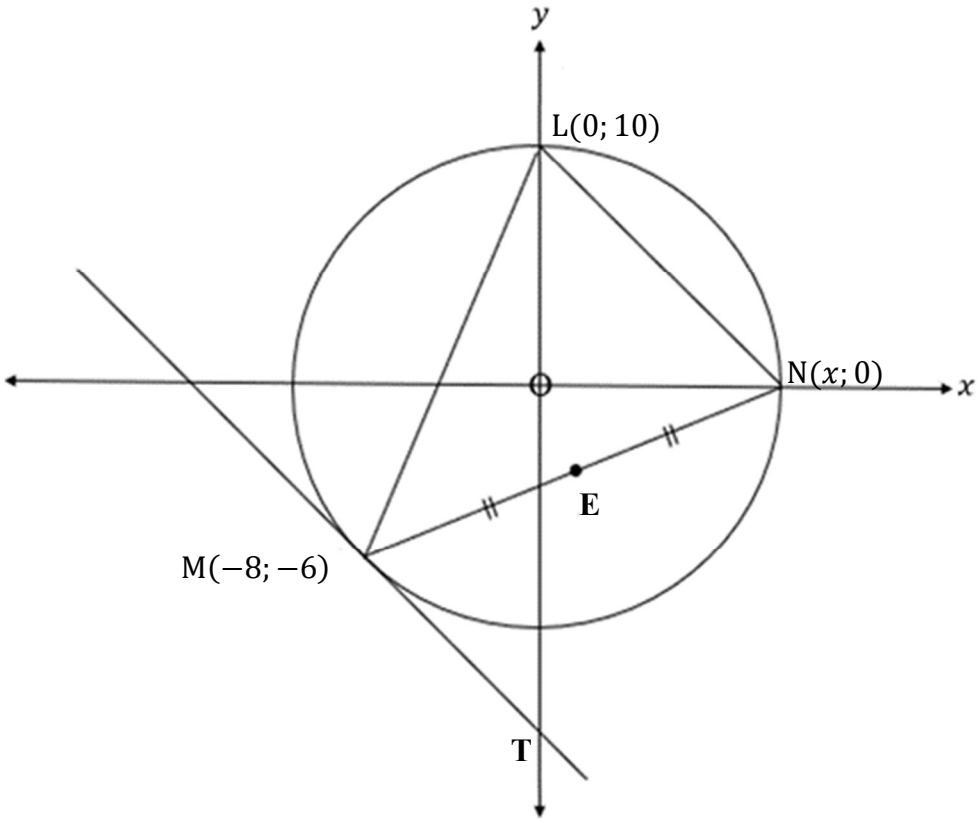


1.1	Write down the coordinates of K.	(2)
1.2	Calculate the size of β, the angle of inclination of RS. (Round-off to TWO decimal places.)	(3)

1.3	Determine the coordinates of P.	(3)
1.4	Determine the gradient of SP.	(2)
1.5	Determine the coordinates of R.	(4)
		[14]

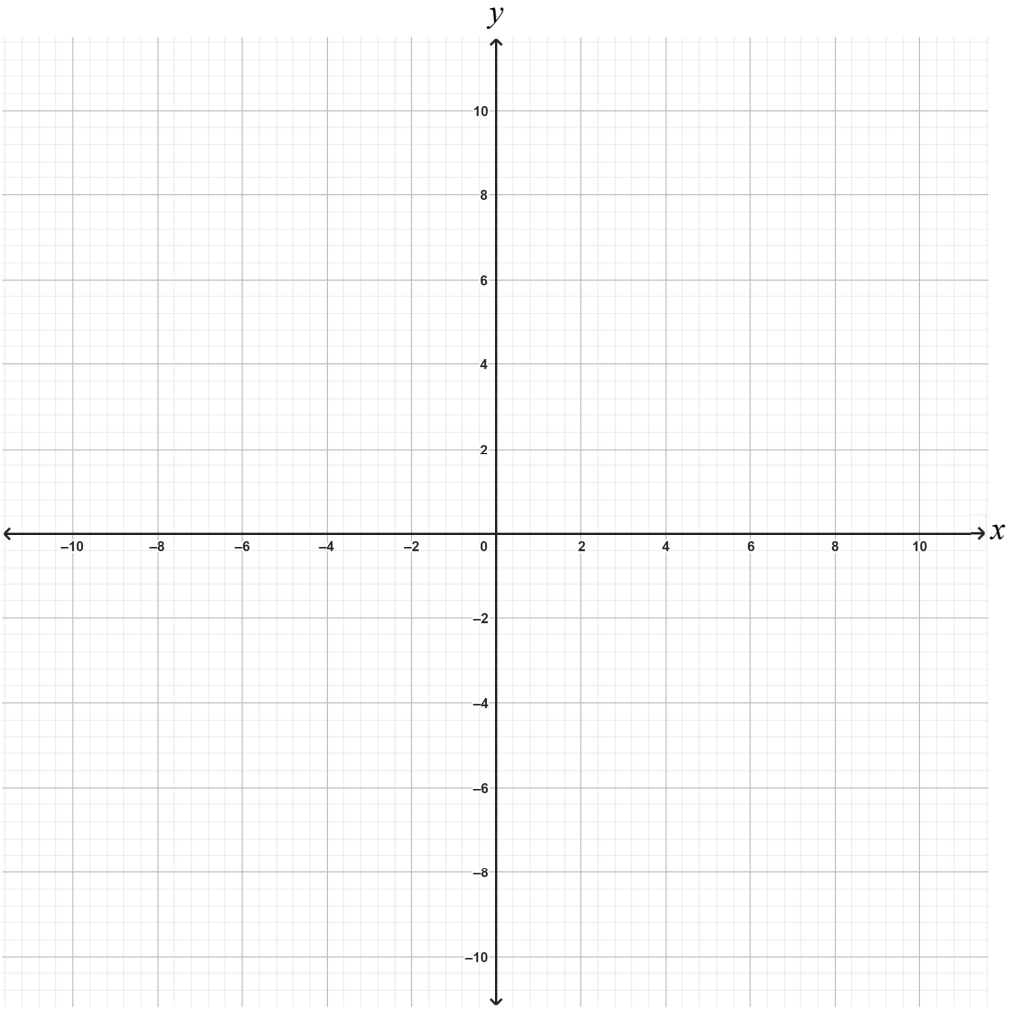
QUESTION 2

2.1 In the diagram below, the circle with centre O passes through $N(x; 0)$, $L(0; 10)$ and $M(-8; -6)$.
E is the mid-point of MN.



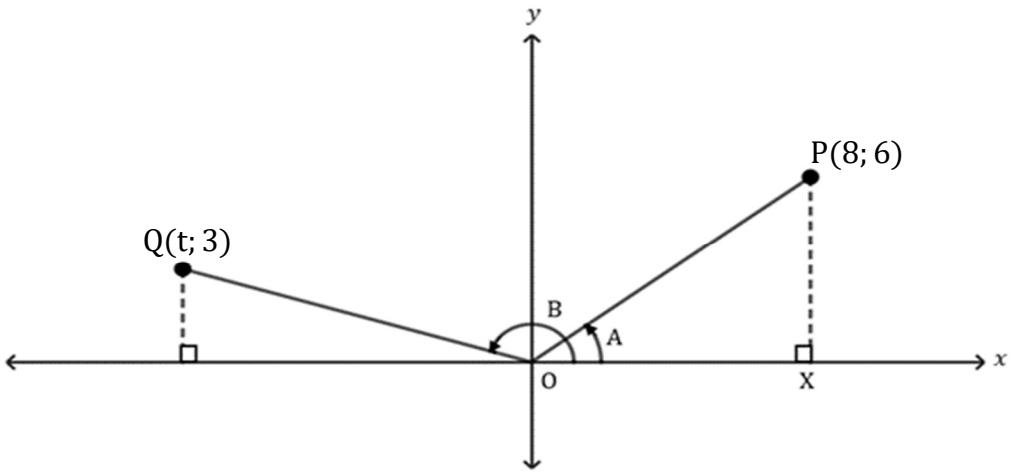
2.1.1	Determine the equation of the circle passing through L, M and N.	
		(2)

2.1.2	Write down the coordinates of N.	(1)
2.1.3	Determine the length of LE, correct to TWO decimal places.	(4)
2.1.4	Determine the equation of the tangent MT.	(4)

2.2	Given: $\frac{x^2}{36}+\frac{y^2}{81}=1$	
2.2.1	Express the equation in the form $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$.	(1)
2.2.2	Hence, sketch the graph defined by $\frac{x^2}{36}+\frac{y^2}{81}=1$.	
		(2)
		[14]

QUESTION 3

3.1 In the diagram below $P(8; 6)$ and $Q(t; 3)$ are two points in the Cartesian plane. $X\hat{O}P = A$ and $X\hat{O}Q = B$.



Determine the value of:		
3.1.1	$\sin A$	(3)
3.1.2	$\tan A \cdot \cos(2\pi - A)$	(3)

3.1.3	$\widehat{A}$ (correct to TWO decimal places).	(2)
3.1.4	t, if $\tan B = -0,3$.	(3)
3.2	Determine the numerical value of $\cot(m+n)$ if $m = 1,427$ radians and $n = 3,324$ radians.	(3)
		[14]

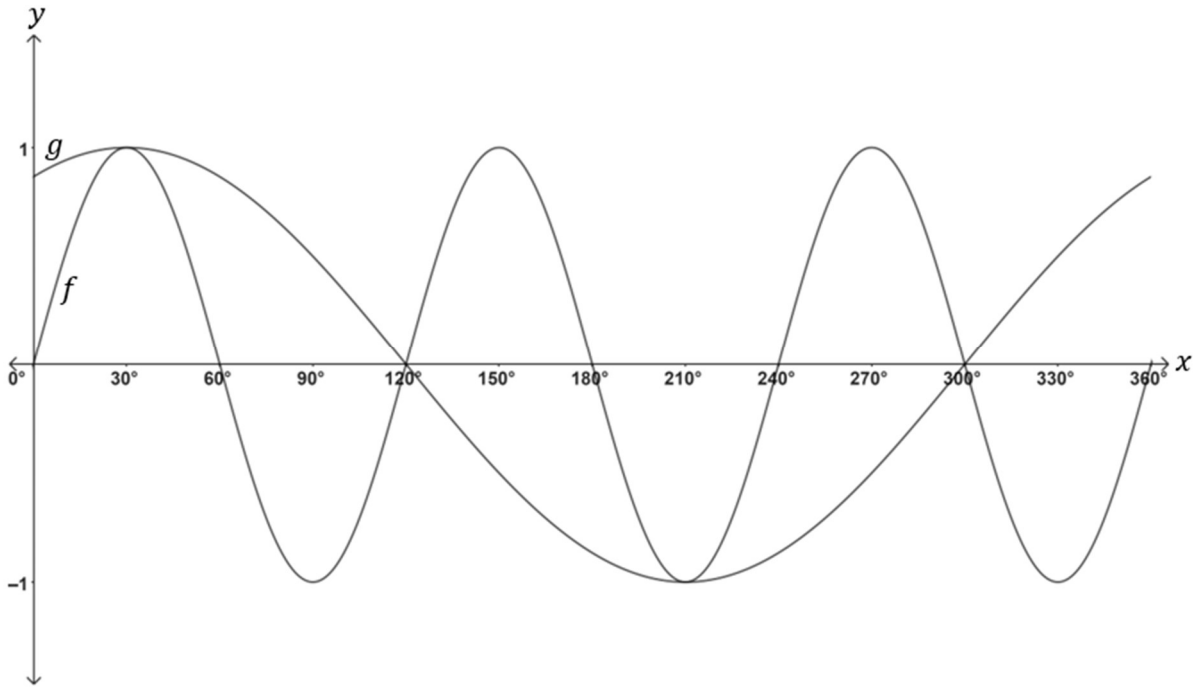
QUESTION 4

4.1	Complete the following identity: $\text{cosec}^2 x - 1 = \ldots$	(1)
4.2	Simplify the following **WITHOUT the use of a calculator**: $\dfrac{\tan(180^\circ + x).\sin(360^\circ - x).\cos 225^\circ}{\sin^2 x.\tan\dfrac{5\pi}{4}}$	(8)

4.3	Solve for θ: $\sin(\theta + 40^{\circ}) = \frac{\sqrt{3}}{2}$ for $\theta \in [0^0 ; 360^0]$	(3)
		[12]

QUESTION 5

The graphs below represent the functions defined by $f(x) = sin3x$ and $g(x) = \cos(x - 30^{\circ})$ for $0^0 \leq x \leq 360^0$.



5.1	Write down the range of g.	(2)

5.2	Write down the period of f.	(1)
5.3	Determine the value of $f(360^\circ) - g(360^\circ)$.	(2)
5.4	Write down the value(s) of x for which $sin3x = \cos(x - 30^\circ)$here $x \in [0^\circ; 270^\circ]$.	(3)
5.5	For which value(s) of x will both f and g be negative?	(2)
		[10]

QUESTION 6

6.1.	Complete for any ΔABC:	
6.1.1	$\frac{\sin A}{a} = \frac{...}{c}$	(1)
6.1.2	$... = a^2 + c^2 - 2ac.cosB$	(1)

6.2 A farmer wishes to calculate the area of the land he bought. The land is in the shape of a quadrilateral as shown in Diagram 1 below. He walks the perimeter of the land and measures the sides and one angle as shown in Diagram 2 below. ST = 200 m, TU = 120 m, UV = 70 m, SV = 280 m and $\widehat{T} = 110^{\circ}$.



Diagram 1

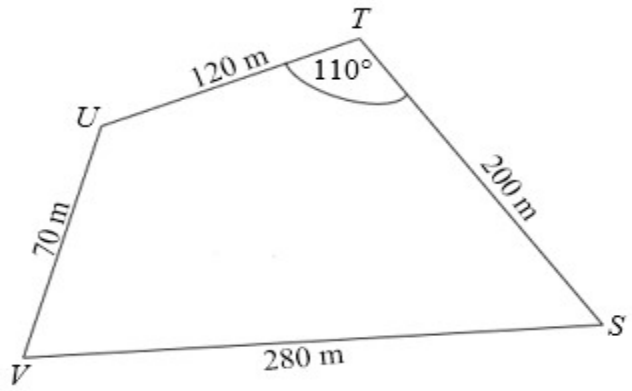


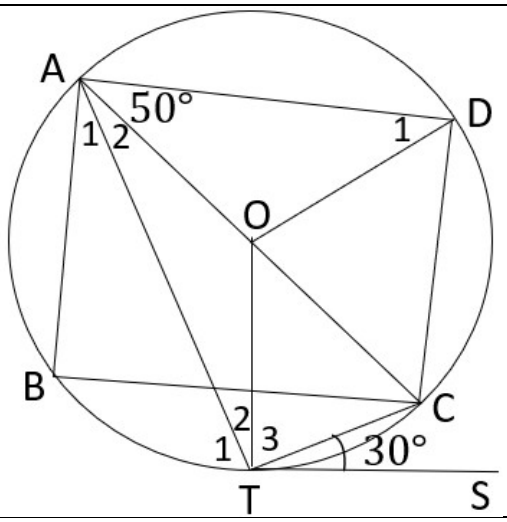
Diagram 2

6.2.1	Determine the length of US.	(3)

6.2.2	Calculate the size of $\hat{V}$.	(4)
6.2.3	Determine the total area of the land.	(4)
		[13]

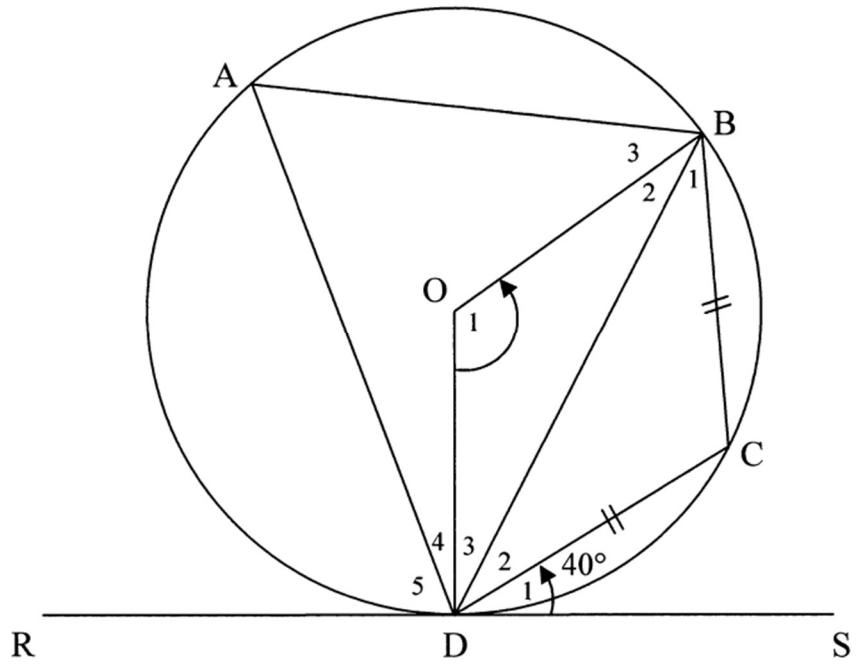
Give reasons for your statements in QUESTIONS 7, 8 and 9.

QUESTION 7

7.1	Complete the following:	
	The tangent to a circle is ... to the radius/diameter of the circle at the point of contact.	
		(1)
7.2	In the diagram below, A, B, C, D and T are points on the circle with centre O. TS is a tangent to the circle at T. $S\widehat{T}C = 30°$ and $O\widehat{A}D = 50°$.	
		
Determine, stating reasons, the size of the following angles:		
7.2.1	$\widehat{A}_2$	
		(2)
7.2.2	$T\widehat{C}O$	
		(3)

7.2.3	$\hat{T}_2$	(2)
7.2.4	$\hat{A}_1$, if it is given that BC ∥ TS.	(4)
7.3	Show that ABCD is NOT a parallelogram.	(2)
		[14]

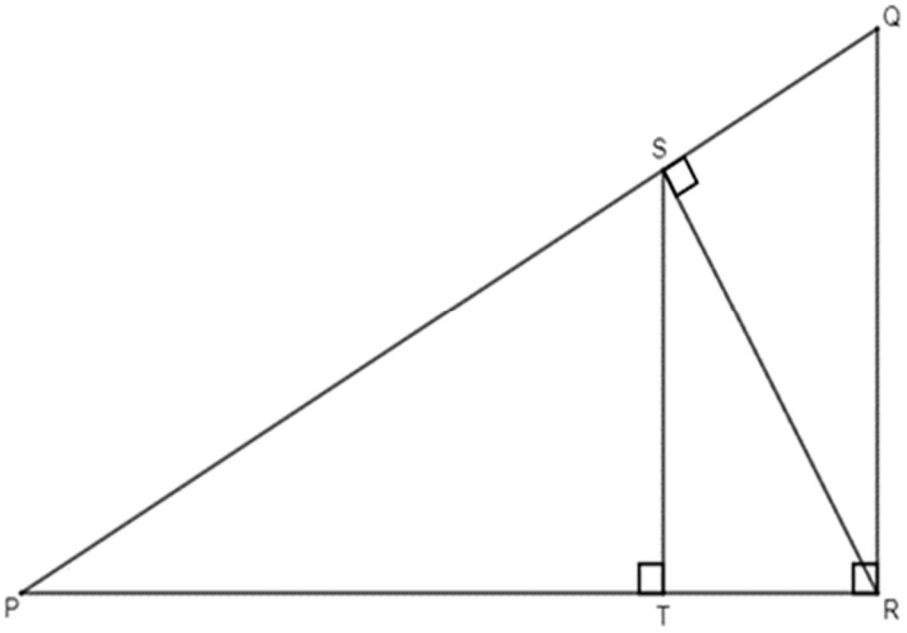
QUESTION 8

8.1	Complete the statements below by filling in the missing word(s) so that the statements are CORRECT.	
8.1.1	The angle subtended by an arc at the centre of a circle is ... the size of the angle subtended by the same arc at the centre.	
		(1)
8.1.2	The angle between the tangent to a circle and the chord drawn from the point of contact is ... to the angle in the alternate segment.	
		(1)
8.1.3	The opposite angles of a cyclic quadrilateral are	
		(1)
8.2	In the figure below, RDS is a tangent to circle O at D. If $BC = DC$ and $C\widehat{D}S = 40°$, calculate with reasons, the size of:	
		
8.2.1	$\widehat{D}_2$	
		(2)

8.2.2	$\hat{C}$	(1)
8.2.3	$\hat{A}$	(1)
8.2.4	$\hat{O}_1$	(2)
		[9]

QUESTION 9

9.1	Complete the following statement: If two triangles are equiangular, then the corresponding sides are in … (and consequently the triangles are similar).	(1)
9.2	Given right angled triangle ΔPQR with $P\hat{R}Q = 90°$. Line RS is drawn perpendicular to PQ. $\Delta PSR \;|||\; \Delta RSQ$ $PS : SQ = 5 : 2$ $PS = 10\text{ cm}$	



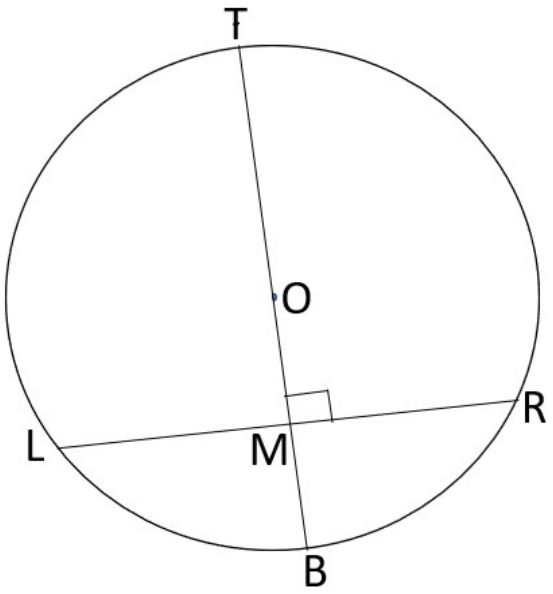
Determine, with reason(s) the length of:		
9.2.1	QS	
		(4)

9.2.2	RS	(5)
9.2.3	PR	(3)
9.2.4	PT	(3)
		[16]

QUESTION 10

10.1	The wheel in the picture and the diagram below has a radius of 22,86 cm and it rotates at 150 revolutions per minute.

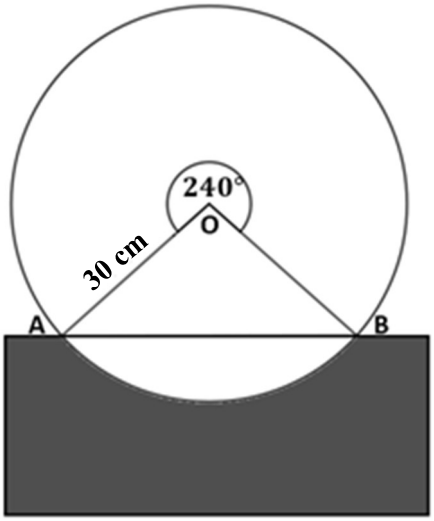




Calculate the following for the rotating wheel:

10.1.1	The circumferential velocity in metres per second.	
		(4)

10.1.2	The angular velocity in radians per second.	(3)
10.2	Calculate the height of the minor segment if the chord LR has a length of 20 cm.	(4)

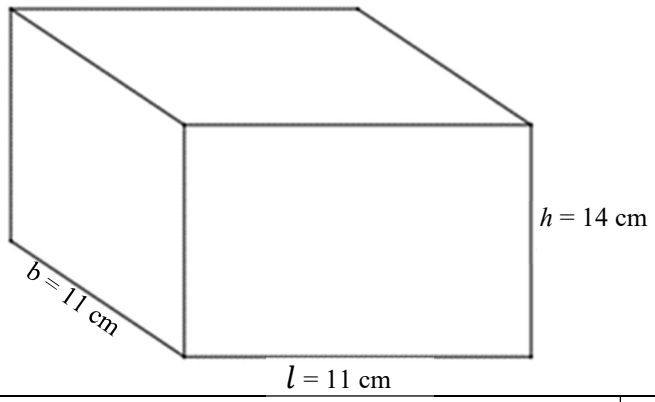
10.3	A spherical ball is placed inside a rectangular prism where a hole has been hollowed out (drilled out) from the rectangular prism. The diagram below is a side view of a cut made through the middle of the model.	
		
10.3.1	Calculate the obtuse angle $A\hat{O}B$.	(1)
10.3.2	Convert the obtuse angle $A\hat{O}B$ to radians.	(2)

10.3.3	Calculate the length of the minor arc AB.	
		(3)
10.3.4	The original area for the rectangle that can been seen is $700\ cm^2$. Calculate the remaining area of the rectangle (shaded area) after the hole has been milled out for the sphere to fit exactly into the rectangle.	
		(5)
		[22]

QUESTION 11

11.1	A certain number of multi-coloured educational counting and sorting cubes measuring 40 mm on each side are to be put into a bigger rectangular container for storage. The dimensions of the container are: $l = 11$ cm, $b = 11$ cm and height $h = 14$ cm.	





Calculate the:

11.1.1	Volume of the rectangular container that will be used for storing the cubes.	(2)
11.1.2	Total number of complete cubes that can fit inside the rectangular container.	(3)

11.1.3	Total surface area for all the cubes inside the rectangular container.	
		(2)
11.1.4	Total amount of money spent on the paint used to colour all the cubes in the container if it will cost R4,50 to paint one cube, irrespective of the colour used.	
		(2)
11.2	Calculate an area of an irregular figure which has one straight side divided into five (5) equal parts of 80 mm each. The lengths of the ordinates dividing this side are 26 mm, 52 mm, 143 mm, 290 mm, 182 mm and 78 mm.	
		(3)
		[12]

ADDITIONAL SPACE		

ADDITIONAL SPACE		

TOTAL: 150

END

INFORMATION SHEET: TECHNICAL MATHEMATICS

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

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

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

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

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

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

$$\int \frac{1}{x} dx = \ln x + C, x > 0 \qquad \int \frac{k}{x} dx = k\, ln\, x + C, x > 0$$

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

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

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

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

In ΔABC: $\quad \frac{a}{sinA} = \frac{b}{sinB} = \frac{c}{sinC} \qquad a^2 = b^2 + c^2 - 2bc.cosA$

Area of $\Delta ABC = \frac{1}{2} ab.sinC$

$$sin^2\theta + cos^2\theta = 1 \qquad 1 + tan^2\theta = sec^2\theta \qquad 1 + cot^2\theta = cosec^2\theta$$

$\pi rad = 180°$

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, 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 circle and x = length of chord
$A_T = a(m_1 + m_2 + m_3 + \cdots + m_n)$	where a = width of the equal parts, $m_1 = \frac{o_1+o_2}{2}$ $O_n = n^{th}$ ordinate and n = number of ordinates
	OR
$A_T = a\left(\frac{o_1 + o_n}{2} + o_2 + o_3 + \cdots + o_{n-1}\right)$	where a = width of the equal parts, $o_n = n^{th}$ ordinate and n =number of ordinates

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION 2024

11092

TECHNICAL MATHEMATICS
(PAPER 2)

TECHNICAL MATHEMATICS: Paper 2

11092E

X05