GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION
2025

11091

TECHNICAL MATHEMATICS
(PAPER 1)

NAME OF SCHOOL:										
SURNAME:										
NAME:										
DATE:	**2**	**0**	**2**	**5**	**-**	**M**	**M**		**D**	**D**

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

TIME: 3 hours

MARKS: 150

29 pages + a 2-page information sheet

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of NINE 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 margins.
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. If 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.

QUESTION 1

1.1	Solve for x:	
1.1.1	$-x\,(2-4x)=0$	(2)
1.1.2	$x^2-3=4-5x$ (Correct to TWO decimal places)	(4)

1.1.3	$x^2 + 5x \leq 6$	(3)
1.2	Solve for x and y simultaneously if: $x + y = 3$ and $x^2 + y^2 = 89$	(6)

1.3	The relationship between the temperatures of the hot and cold reservoirs and the engine's efficiency is used to determine the temperature of the cold reservoir in a thermodynamic system like a Carnot engine. The efficiency (η) of an ideal Carnot engine is given by the formula: $\eta = 1 - \frac{T_c}{T_h}$ Where: η = efficiency (in decimal form) T_c = temperature of the cold reservoir (in Kelvin) T_h = temperature of the hot reservoir (in Kelvin)	
1.3.1	Make T_C the subject of the formula.	
		(2)
1.3.2	Hence, or otherwise, calculate the temperature of the cold reservoir in Kelvin if the efficiency of a Carnot engine is 0,4 and the temperature of the hot reservoir is 600 K.	
		(2)

1.4	Evaluate the following expression and leave your answer in binary form. (Show ALL calculations.) $(11101_2 + 13) - 111_2$	
		(4)
		[23]

QUESTION 2

Given: $x^2 - px + p + 3 = 0$		
2.1	Express Δ (the discriminant) of the given equation in terms of p.	
		(2)

2.2	Hence, determine the value(s) of p for which the roots of the equation will be real and equal.	
		(3)
		[5]

QUESTION 3

3.1	Simplify the following **without the use of a calculator.** (Show ALL calculations.)	
3.1.1	$\sqrt{25x^2 - 16x^2}$	
		(2)
3.1.2	$(\log_2 32)(\log_2 4)$	
		(3)

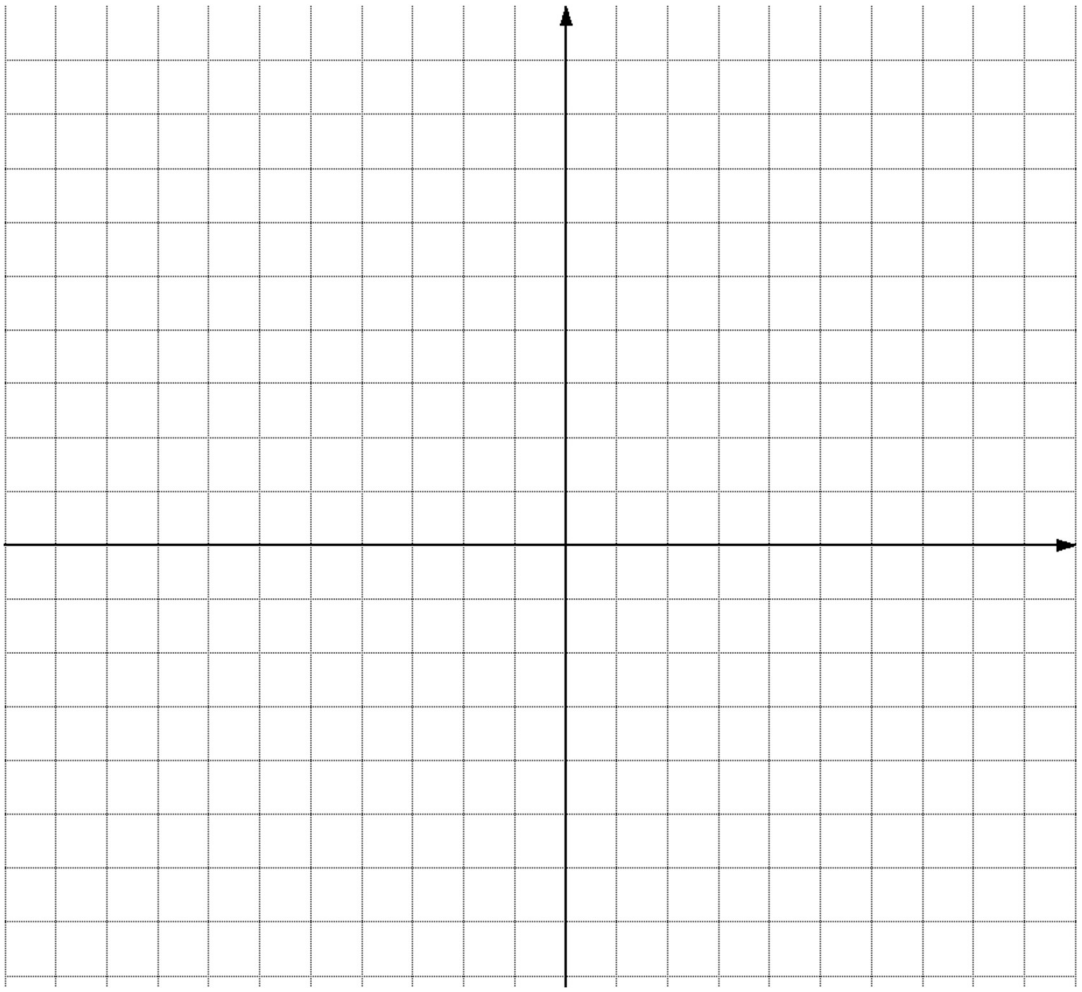
3.2	Solve for A if: $A = \frac{2^{3x} \times 3}{2^{3x} + 3.2^{3x+1}}$	(4)
3.3 Given: $z = 2\ cis\ 315^{\circ}$		
3.3.1	Express z in the form $z = a + bi$.	(3)

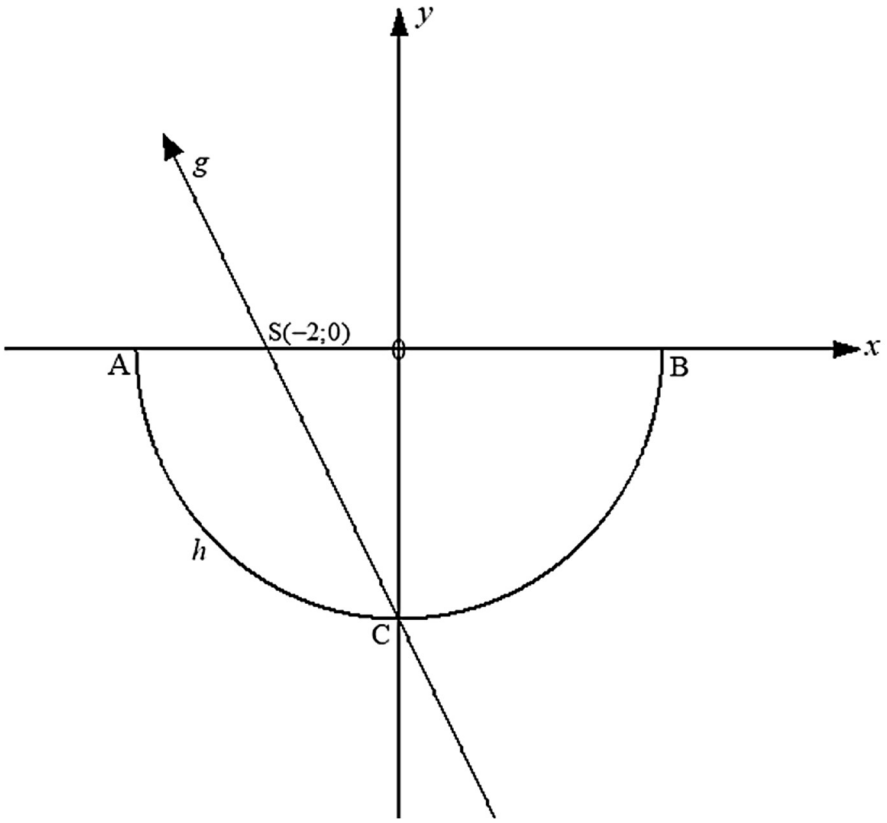
3.3.2	In which quadrant of the complex plane does z lie?	
		(1)
3.3.3	Write down the value of the modulus of z.	
		(1)
3.4	Solve for $x \; and \; y$ if: $(x - yi) = i(4i - 3)$	
		(4)
		[18]

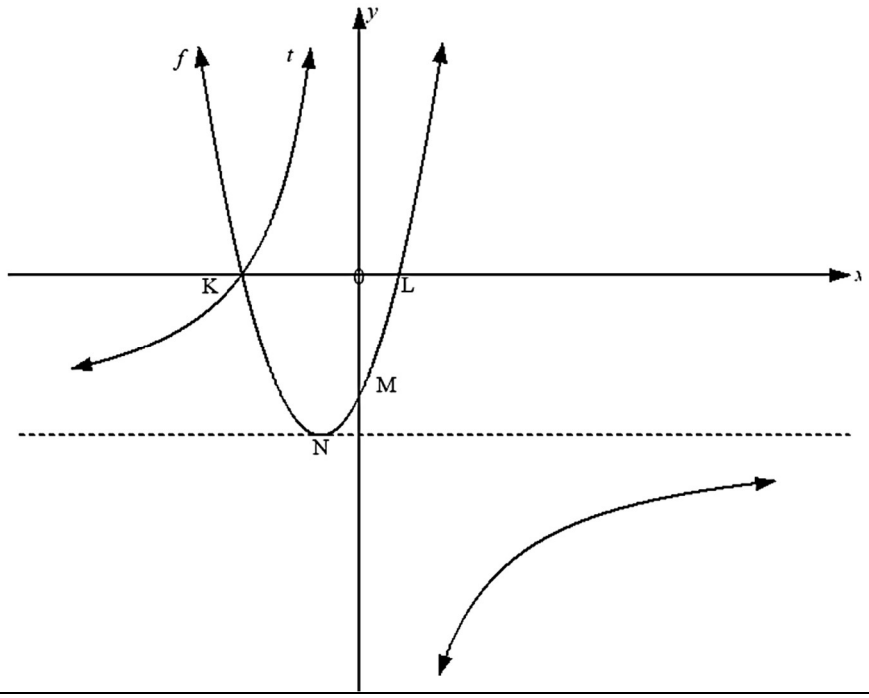
QUESTION 4

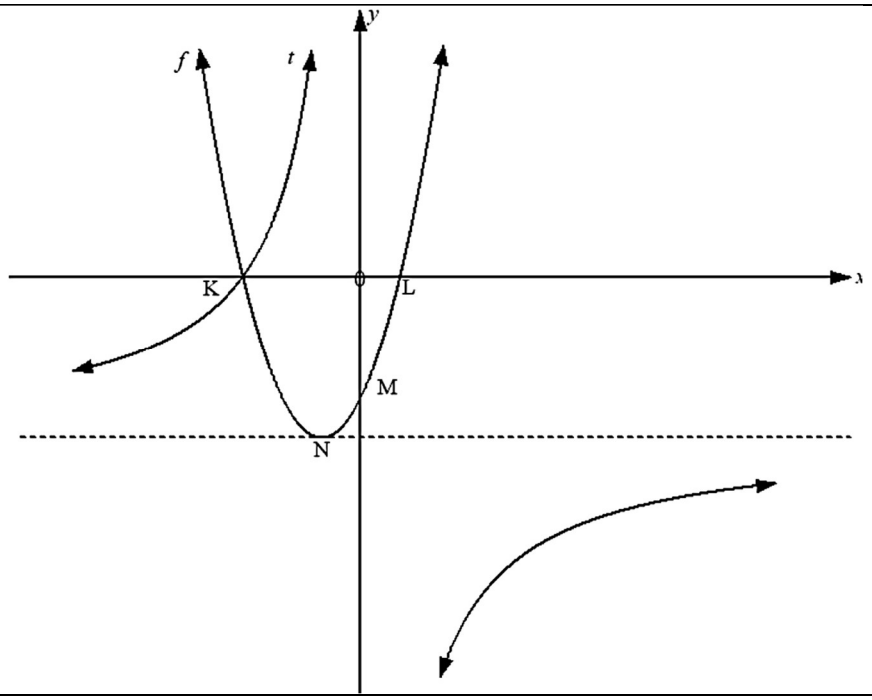
4.1	Given: $f(x) = 2^x - 8$	
4.1.1	Write down the equation of the asymptote of f.	
		(1)
4.1.2	Determine the *x*- and *y*-intercepts of *f*.	
		(4)

4.1.3	Sketch the graph of f on the set of axes provided. Show ALL intercepts with the axes and the asymptotes.	(4)



4.2	The graphs below represent functions defined by: $g(x) = -2x + d$ and $h(x) = -\sqrt{r^2 - x^2}$ • C and $S(-2\,;0)$ are the intercepts of *g*. • A, B, and C are the intercepts of *h*  	
4.2.1	Determine the numerical value of *d*.	(2)
4.2.2	Write down:	
	(a) The coordinates of C	(2)

	(b)	The equation of h	
			(1)
	(c)	The domain of h	
			(2)
4.3	Sketched below are the graphs of the functions defined by: $f(x) = (x + 6)(x - 2)$ and $t(x) = \frac{a}{x} - q$ • K, L, and M are the intercepts of f. • K is also the x-intercept of t. • N is the turning point of f and lies on the horizontal asymptote of t.  	
4.3.1	Determine the coordinates of K and L.		
			(2)



4.3.2	Determine the coordinates of N.		
			(4)
4.3.3	Write down:		
	(a)	The coordinates of M	
			(2)

	(b)	The range of f	(1)
	(c)	The equation(s) of the asymptotes of t	(2)
4.3.4		Determine the numerical value of a.	(3)
4.3.5		Determine the value(s) of x for which $t(x) > 0$.	(2)
4.3.6		State the value(s) of x for which $f(x) > t(x)$.	(2)
			[34]

QUESTION 5

5.1	John borrowed R150 000 to start a business. He must repay the loan in 2 years at 18% interest, compounded monthly.	
5.1.1	Determine the amount of money that John needs to pay back.	(4)
5.1.2	Determine the effective interest rate on the loan.	(3)
5.2	School ABC buys sport equipment to the value of R100 000. The value of the equipment decreases by 2% per year on the straight-line method. Calculate the value of the equipment 10 years after it was bought.	(3)

5.3	Mr Smith deposited R6 000 into a savings account to use for a holiday. The interest rate is 9,6%, compounded quarterly. After 2 years the interest rate changed to 10,6%, compounded semi-annually. What is the amount of money in the account after 6 years?	
		(5)
		[15]

QUESTION 6

6.1	Determine $f'(x)$ using FIRST PRINCIPLES if $f(x) = -3x + 5$.	(4)
6.2	Determine the following:	
6.2.1	$f'(x)$ if $f(x) = 4\sqrt{x} + 2(3x^{-3})^0$	(3)

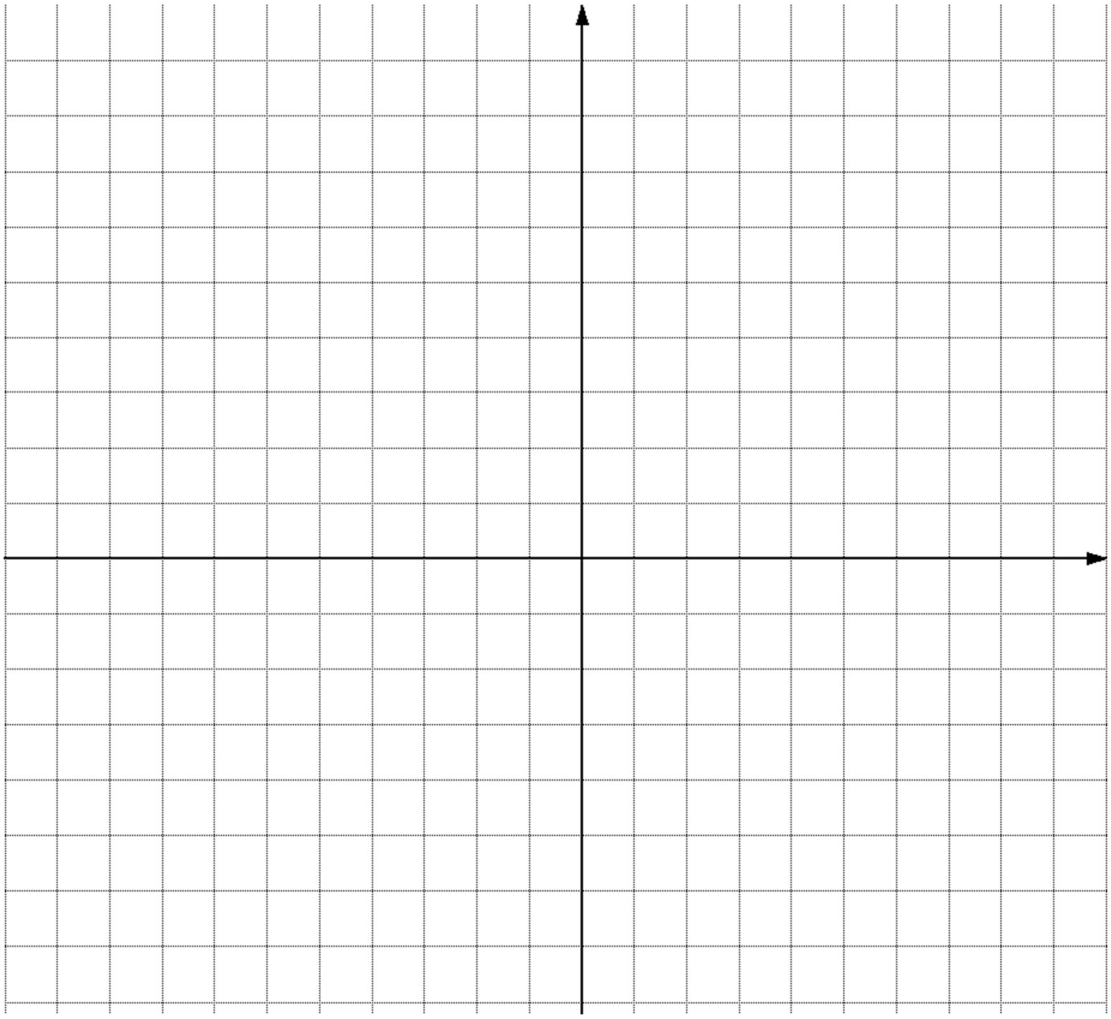
6.2.2	$D_x\left[\frac{(x\ +2\ )^2}{x}\right]$	(3)
6.2.3	$\frac{d}{dx}\left[\ 7x^3+3\pi^2\ -\frac{1}{x^4}\right]$	(2)
6.3	Given: $g(x)=x^2-8x+20$ Determine the coordinates of the point on the curve of g where the gradient of the curve is 4.	(4)
		[16]

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QUESTION 7

The function $f(x) = 3x^3 + 7x^2 - 4$ is given. It is also given that $(3x - 2)$ and $(x + 2)$ are factors of f.		
7.1	Determine the third factor of f.	(1)
7.2	Hence, or otherwise, determine the x-intercepts of f.	(3)

7.3	Determine the coordinates of the y-intercept of f.	(2)
7.4	Determine the coordinates of the turning points of f.	(5)

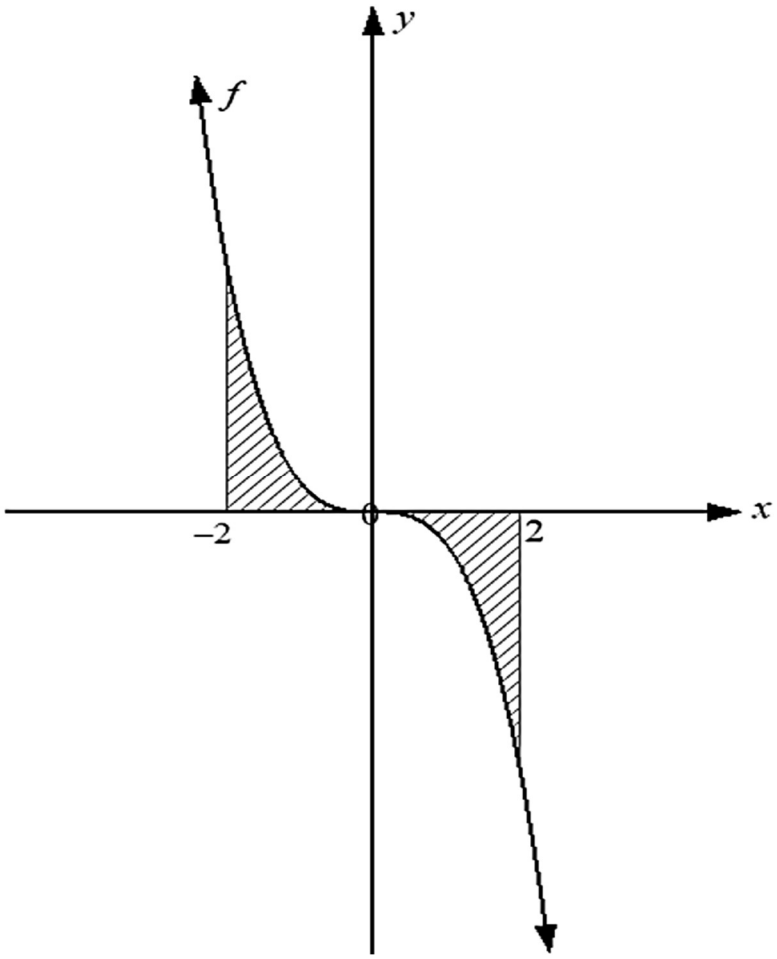
7.5	Sketch the graph of f below. Clearly show all the turning points and the intercepts with the axes. 	(4)
7.6	Hence, give the values of x where the graph of f is decreasing.	(2)
		[17]

QUESTION 8

A soft drink company produces aluminium cans in the shape of a cylinder. Each can is designed to hold 864 *ml* of liquid. Let the radius of the cylinder be r.		
8.1	Determine h in terms of r, where $Volume = \pi r^2 h$.	(1)
8.2	Show that the total surface area of the cylinder (S) is given by $S = \frac{1728}{r} + 2\pi r^2$, where $SA = 2\pi r^2 + 2\pi rh$.	(2)
8.3	Calculate r (in terms of π) if the total surface area of aluminium sheeting needs to be minimised.	(5)
		[8]

QUESTION 9

Determine the following integrals:		
9.1.1	$\int dx$	(2)
9.1.2	$\int \left[x\left(x+\frac{2}{x}\right)+\frac{3}{x}\right]dx$	(4)

9.2	The sketch below represents the graph of the function defined by $f(x) = -x^3$.  	
9.2.1	Determine: $\int(-x^3)dx$	(1)

9.2.2	Hence, determine the total area enclosed between the curve $f(x) = -x^3$ and the x-axis over the interval $-2 \leq x \leq 2$.	
		(7)
		[14]

ADDITIONAL SPACE		

ADDITIONAL SPACE		

TOTAL: 150

END

INFORMATION SHEET: TECHNICAL MATHEMATICS

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

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

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

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

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

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

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

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

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

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

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

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

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

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TECHNICAL MATHEMATICS: Paper 1

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