FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS AND APPLIED MATHEMATICS **B ENG TECH IN** **CHEMICAL ENGINEERING, CIVIL ENGINEERING, CONSTRUCTION, ELECTRICAL ENGINEERING, INDUSTRIAL ENGINEERING, MECHANICAL ENGINEERING, EXTRACTION METALLURGY & PHYSICAL METALLURGY** **MODULE:** **MAE1A1** **COURSE:** **ENGINEERING MATHEMATICS V 1A** **CAMPUS:** **DFC** **EXAM:** **SUPPLEMENTARY ONLINE EXAMINATION, FIRST SEMESTER 2021**	

DATE: **12 JULY 2021**

TIME: **11:30**

EXAMINER: **DR R. DURANDT, DR S. HERBST, MR M. SELOANE, MR T. PAEPAE & MR F. ZOTTOR**

INTERNAL MODERATOR: **MR I.K. LETLHAGE**

DURATION: **3 HOURS**   **MARKS: 60**

STUDENT NUMBER	
SURNAME	
INITIALS	
CONTACT NUMBER	

NUMBER OF PAGES: **3 PAGES INCLUDING FRONT PAGE.**

INSTRUCTIONS:

- Write the <u>complete solutions</u> of the questions on paper, in your <u>own</u> handwriting.
- All pages must be together, in <u>sequential order</u>, and please <u>number questions and pages clearly</u>.
- Use the following file name when you upload your document: surname_studentnumber_examination (e.g. Durandt_20200001_examination).
- Submit as <u>one pdf file</u> on uLink, click on the link "Supplementary Examination".

Question 1 [5]

Given $f(x) = \frac{x+3}{5-x}$ and $g(x) = \frac{5x+3}{x+1}$ calculate,

1.1 $(fog)(x)$. (2)

1.2 $(gof)(x)$. (2)

1.3 Use questions 1.1 and 1.2 above to conclude if $f(x)$ is the inverse of $g(x)$.

(1)

Question 2 [4]

Find the domain of $f(x) = \frac{x-6}{\sqrt{1-2x}} + \frac{3}{\sqrt{2+x}}$.

Question 3 [7]

Given $y = \frac{x}{x-2}$:

3.1 Find both the horizontal and vertical asymptotes of the given function. (2)

3.2 Find both the x-and y-intercept(s) of the given function. (2)

3.3 Use questions 3.1 and 3.2 and any other information to draw a neat sketch of

$y = \frac{x}{x-2}$. (3)

Question 4 [4]

What must be subtracted from the polynomial $x^4 + 9x^3 - 36x + 3$ to make it divisible by $x^2 - 3$.

Question 5 [5]

Use De Moivre's theorem to evaluate $\left[\frac{e^{0,1j}(j-5)^5}{[3(\cos 4 - j \sin 4)]^4}\right]$ and give the final answer in rectangular form.

Question 6 [5]

Solve for x in the following equation:

$$\cot x = 3 \sec x - \tan x \qquad 0 \leq x \leq \pi$$

Question 7 [5]

Solve for x in the following equation:

$$\ln(x + 5) = \ln(x - 1) + \ln(x + 1)$$

Question 8 [5]

Use Crammer's rule to solve the following linear system for x only.

$$\frac{3x}{5} - y + \frac{2z}{5} = 2$$
$$x + 8y + 3z = -31$$
$$\frac{6x}{5} - \frac{4y}{5} + \frac{2z}{5} = -2$$

Question 9 [4]

Find the equation of the tangent line to the curve $y = (2 + x)e^{-x}$ at the point $(0,2)$.

Question 10 **[6]**
10.1   Use differentiation rules to find the derivative of the function: (3)
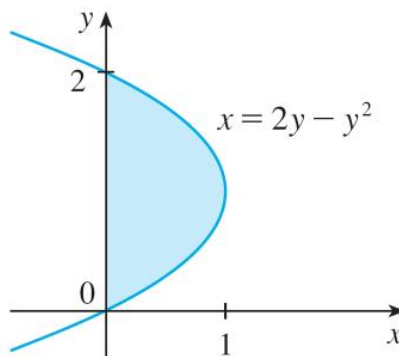$$g(x) = sin[ln(2x)]$$
10.2   Evaluate the indefinite integral: (3)
$$\int \frac{\cos\left(\frac{\pi}{x}\right)}{x^2} dx$$

Question 11 **[4]**
Determine the area, A, of the shaded region, as indicated on the sketch. Show clear calculations.

Question 12 **[3]**
Sketch the graph of a function that satisfies the given conditions, a) to g), for the interval $[-3,3]$:
   a) $f(0) = 0$
   b) $f'(-2) = f'(1) = 0$
   c) $f'(x) > 0$ on $(-2,1)$
   d) $f'(x) < 0$ on $(-3,-2)$ and $(1,3)$
   e) $f''(x) > 0$ on $(-3,0)$
   f) $f''(x) < 0$ on $(0,3)$
   g) $f(x) = 0$ at $x = \pm 3$

Question 13 **[3]**
The function $v(t) = t^2 - 2t - 8$ represents the velocity, in metres per second, for a particle moving along a line. Find the displacement of the particle during the time interval 2 and 5 seconds.