MU 2021 LaTeX Problem Set

April 22, 2022

1 Starter Questions

Problem 1.1 LaTeX the following question from MATH1011:
Let R be the region bounded by $y = \sqrt{x}, x = 1$ and $y = 0$. Sketch R.

Problem 1.2 LaTeX the following question from the Australian Mathematics Competition:
Consider the set $X = \{1, 2, 3, 4, 5, 6\}$. How many subsets of X, with at least one number, do not contain two consecutive integers?

Problem 1.3 LaTeX the following question from MATH1011:
Let $f : \mathbb{R} \to \mathbb{R}^2$ be defined by

$$f(x, y) = e^{2x} + \cos(xy) + xy^2$$

What are f_x, f_y, f_{xx}, f_{yy} and f_{xy}

Problem 1.4 LaTeX the following question from MATH1011 (Note the use of bracket size):
Describe the shape of the surface

$$\mathbf{S}(u, v) = \Big\{ \big(\cos(u), \sin(u), v \big) | 0 \leq u \leq 2\pi, 1 \leq v \leq 2 \Big\}$$

Problem 1.5 LaTeX the following question from MATH1012:
Find the limit of the sequence $\{a_n\}_{n=1}^{\infty}$ defined by

$$a_n = \frac{\sin^2(n)}{\sqrt{n}}$$

or show that the limit does not exist

Problem 1.6 LaTeX the following question from MATH1011:
Evaluate the following limit, if it exists:

$$\lim_{t \to 1} \frac{3t^4 + 2t - 5}{12 - 7t^2 - 5t^3}$$

2 Intermediate questions

Problem 2.1 LaTeX the following excerpt from a MATH1012 solution:

$$\begin{aligned} x_1 &= \frac{-5x_2 - 6x_3 - 3x_4}{2} \\ &= \frac{\frac{50}{11}x_3 - 6x_3 + \frac{35}{11}x_4 - 3x_4}{2} \\ &= \frac{-\frac{16}{11}x_3 + \frac{2}{11}x_4}{2} \\ &= -\frac{8}{11}x_3 + \frac{1}{11}x_4 \end{aligned}$$

Problem 2.2 LaTeX the following question from MATH1011:

Use an appropriate substitution to find

$$\int_0^2 \frac{x}{\sqrt{x^2+16}}dx$$

Problem 2.3 LaTeX the following question from MATH1012:

Determine all $x \in \mathbb{R}$ for which the series

$$\sum_{n=0}^{\infty} \frac{(x-1)^2}{n}$$

is (i) absolutely convergent, (ii) conditionally convergent, (iii) divergent.

Problem 2.4 LaTeX the following question from MATH1011:

Let $f(x,y)$ be a continuously differentiable function in $\mathbb{R}^2$ and let

$$g(s,t) = f(t^2 - s^2, s^2 - t^2), \quad (s,t) \in \mathbb{R}^2$$

That is, $g(s,t) = f\big(x(s,t), y(s,t)\big)$ where $x(s,t) = t^2 - s^2$ and $y(s,t) = s^2 - t^2$. Use the chain rule to show that

$$t\frac{\partial g}{\partial s}(s,t) + s\frac{\partial g}{\partial t}(s,t) = 0$$

for all $(s,t) \in \mathbb{R}^2$

3 Arrays

Problem 3.1 Produce the following array:

$$\left(\begin{array}{cc|c} 1 & 2 & 0 \\ 3 & 4 & 0 \end{array}\right).$$

Problem 3.2 Produce the following array:

$$\begin{bmatrix} 2 & 2 \\ 3 & 4 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 4 \\ 2 \end{bmatrix}$$

Problem 3.4 Produce the following array:

$$\begin{vmatrix} 4-\lambda & x & 0 \\ 0 & 2-\lambda & 0 \\ 2x & 0 & -\lambda \end{vmatrix}$$

4 Tables

Problem 4.1 Produce the following table:

	A	B
P1	1	2
P2	3	4
P3	5	6

Problem 4.2 Produce the following table:

Product	A	B	C
Price	1	2	-
Amount	100	400	10
Δ	2.3	-1.5	8.0

Table 1: Problem 4.2

Problem 4.3 Produce the following table using `\usepackage{multicol}` and the `\multicolumn{}{}{}` command:

	Test Score	
Sample	μ	σ
T1	2.7	0.1
T2	3.4	0.4
T3	2.5	0.2

Table 2: Caption