

3.1. Which of the following sets are compact?

- (a) $A = \{(x, y) \in \mathbb{R}^2 \mid x^2 + y^2 < 2019\}$;
- (b) $B = \{(a, b, c) \in \mathbb{R}^3 \mid a, b, c \text{ are integers and } a^2 + b^2 + c^2 < 2019\}$;
- (c) $C = \{(x, f(x)) \in \mathbb{R}^2 \mid x \in (0, 1], f(x) = \sin(\frac{1}{x})\}$;
- (d) $D = \{(\cos \theta, \sin \theta) \in \mathbb{R}^2 \mid \theta \text{ is a rational number}\}$;
- (e) $E = \{(x, y, z) \in \mathbb{R}^3 \mid x^2 + y^2 + z^2 \leq 2\}$.

3.2. Which of the following functions are continuous?

- (a) $f_1(x, y) = \ln(|xy| + 1), (x, y) \in \mathbb{R}^2$;
- (b) $f_2(x, y) = \ln(xy), (x, y) \in \{(x, y) \in \mathbb{R}^2 \mid xy > 0\}$;
- (c) $f_3(x, y) = \inf\{x^k + y^k \mid k \text{ is a positive integer}\}, (x, y) \in \mathbb{R}^2$;
- (d) $f_4(x, y) = \int_x^y \sin(t)dt, (x, y) \in \{(x, y) \in \mathbb{R}^2 \mid x < y\}$.