Note: Each question carry 3 marks for correct answer and carry a **negative marking of 1 mark for wrong answer**. Questions (1-4) may have more than one correct options. Encircle/Tick all the **correct** answer/s.

1. **Which of the following is/are NOT correct ?**
   (A) Every non-empty bounded subset of $\mathbb{R}$ has a supremum in $\mathbb{R}$.
   (B) Every non-empty bounded subset of $\mathbb{Q}$ has a supremum in $\mathbb{Q}$.
   (C) Every non-empty bounded subset of $\mathbb{Q}$ has a supremum in $\mathbb{R}$.
   (C) Every non-empty bounded subset of $\mathbb{Z}$ has a supremum in $\mathbb{Z}$.

Ans. (B)

2. **Which of the following statements is/are correct ?**
   A) $\lim_{x\to 0} \sqrt{x}\sin\frac{1}{x}$ does not exist.
   (B) $\lim_{x\to 0^+} \sqrt{x}\sin\frac{1}{x}$ exists.
   (C) $\lim_{x\to 0^-} \sqrt{x}\sin\frac{1}{x}$ exists.

Ans. (B)

3. **Let $a, b \in \mathbb{R}, a < b$. Suppose $f : [a, b] \to \mathbb{R}$ is continuous, then**
   (A) f is bounded.
   (B) f has a local maximum.
   (C) f has intermediate value property.
   (D) f does not have a fixed point.

Ans. (A), (C).

4. **The interval/s on which function $f(x) = \dfrac{x}{x+1},\ x \neq -1$ is convex**
   (A) $(-\infty, -1)$.
   (B) $(-\infty, \infty)$.
   (C) $(0, \infty)$.
   (D) $(-1, \infty)$.

Ans. (A)

$$f'(x) = \frac{1}{x+1} - \frac{x}{(x+1)^2} = \frac{1}{(x+1)^2}, \quad f''(x) = \frac{-2}{(x+1)^3} > 0; \quad x < -1.$$

5. **Any Newton sequence for $f(x) = x^5 - x - 1$, with its initial point $x_0 \in [1, 2]$ will converge to the unique root of $f(x) = 0$ in $[1, 2]$. TRUE/ FALSE _____.**

Ans. TRUE.
Note that $f(1) < 0, f(2) > 0$. As f is a polynomial so its infinitely times differentiable everywhere. Now $f'(x) = 5x^4 - 1$ is nonzero on $[1, 2]$ and $f''(x) = 20x^3 > 0$ on $[1, 2]$.