1. Factor the polynomial below completely. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 6x^3 + x^2 - 20x - 12$$

A. $z_1 \in [-2.2, -1.8]$, $z_2 \in [0.07, 0.47]$, and $z_3 \in [2.8, 3.8]$

B. $z_1 \in [-1.6, -0.4]$, $z_2 \in [-1.31, -0.3]$, and $z_3 \in [1.6, 2.3]$

C. $z_1 \in [-2.2, -1.8]$, $z_2 \in [0.49, 0.9]$, and $z_3 \in [1, 1.9]$

D. $z_1 \in [-1.6, -0.4]$, $z_2 \in [-1.31, -0.3]$, and $z_3 \in [1.6, 2.3]$

E. $z_1 \in [-2.2, -1.8]$, $z_2 \in [0.49, 0.9]$, and $z_3 \in [1, 1.9]$

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2. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{9x^3 + 27x^2 + 8x - 24}{x + 2}$$

A. $a \in [8, 12]$, $b \in [-3, 5]$, $c \in [8, 11]$, and $r \in [-49, -46]$.

B. $a \in [-20, -11]$, $b \in [58, 70]$, $c \in [-119, -115]$, and $r \in [211, 215]$.

C. $a \in [8, 12]$, $b \in [41, 50]$, $c \in [94, 101]$, and $r \in [172, 179]$.

D. $a \in [8, 12]$, $b \in [8, 12]$, $c \in [-10, -9]$, and $r \in [-6, 0]$.

E. $a \in [-20, -11]$, $b \in [-14, -7]$, $c \in [-10, -9]$, and $r \in [-46, -43]$.

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3. What are the *possible Rational* roots of the polynomial below?

$$f(x) = 5x^4 + 4x^3 + 3x^2 + 2x + 7$$

A. $\pm 1, \pm 7$

B. All combinations of: $\dfrac{\pm 1, \pm 7}{\pm 1, \pm 5}$

C. $\pm 1, \pm 5$

D. All combinations of: $\dfrac{\pm 1, \pm 5}{\pm 1, \pm 7}$

E. There is no formula or theorem that tells us all possible Rational roots.

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4. Factor the polynomial below completely. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 12x^3 + 53x^2 - 45x - 50$$

A. $z_1 \in [-1.32, -1.24]$, $z_2 \in [0.55, 1.16]$, and $z_3 \in [4.1, 6.1]$

B. $z_1 \in [-0.87, -0.32]$, $z_2 \in [1.26, 1.75]$, and $z_3 \in [4.1, 6.1]$

C. $z_1 \in [-5.27, -4.64]$, $z_2 \in [0.07, 0.66]$, and $z_3 \in [4.1, 6.1]$

D. $z_1 \in [-5.27, -4.64]$, $z_2 \in [-1.52, -1.4]$, and $z_3 \in [0.4, 1.1]$

E. $z_1 \in [-5.27, -4.64]$, $z_2 \in [-1.1, -0.47]$, and $z_3 \in [0.9, 1.7]$

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5. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{9x^3 - 27x - 22}{x - 2}$$

A. $a \in [6, 13], b \in [-18, -10], c \in [5, 11]$, and $r \in [-43, -34]$.

B. $a \in [17, 22], b \in [32, 43], c \in [45, 46]$, and $r \in [64, 72]$.

C. $a \in [6, 13], b \in [6, 12], c \in [-18, -17]$, and $r \in [-43, -34]$.

D. $a \in [17, 22], b \in [-42, -33], c \in [45, 46]$, and $r \in [-113, -108]$.

E. $a \in [6, 13], b \in [15, 19], c \in [5, 11]$, and $r \in [-6, 1]$.

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6. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{4x^3 + 34x^2 + 80x + 48}{x + 5}$$

A. $a \in [-23, -19]$, $b \in [131.5, 135.1]$, $c \in [-593, -583]$, and $r \in [2997, 3001]$.

B. $a \in [1, 7]$, $b \in [11.2, 15.1]$, $c \in [4, 15]$, and $r \in [-2, 1]$.

C. $a \in [1, 7]$, $b \in [51, 55.2]$, $c \in [346, 353]$, and $r \in [1794, 1801]$.

D. $a \in [-23, -19]$, $b \in [-66.4, -64.7]$, $c \in [-250, -246]$, and $r \in [-1203, -1201]$.

E. $a \in [1, 7]$, $b \in [7.1, 11.1]$, $c \in [17, 23]$, and $r \in [-77, -63]$.

---

7. What are the *possible Rational* roots of the polynomial below?

$$f(x) = 2x^4 + 4x^3 + 6x^2 + 4x + 6$$

A. All combinations of: $\dfrac{\pm 1, \pm 2}{\pm 1, \pm 2, \pm 3, \pm 6}$

B. $\pm 1, \pm 2, \pm 3, \pm 6$

C. All combinations of: $\dfrac{\pm 1, \pm 2, \pm 3, \pm 6}{\pm 1, \pm 2}$

D. $\pm 1, \pm 2$

E. There is no formula or theorem that tells us all possible Rational roots.

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8. Factor the polynomial below completely, knowing that $x + 3$ is a factor. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3 \leq z_4$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 6x^4 - 7x^3 - 43x^2 + 84x - 36$$

A. $z_1 \in [-3.15, -2.72]$, $z_2 \in [-2.12, -1.91]$, $z_3 \in [-0.4, -0.11]$, and $z_4 \in [2.3, 4.1]$

B. $z_1 \in [-2.21, -1.48]$, $z_2 \in [-1.99, -1.44]$, $z_3 \in [-0.76, -0.63]$, and $z_4 \in [2.3, 4.1]$

C. $z_1 \in [-2.21, -1.48]$, $z_2 \in [-1.99, -1.44]$, $z_3 \in [-0.76, -0.63]$, and $z_4 \in [2.3, 4.1]$

D. $z_1 \in [-3.15, -2.72]$, $z_2 \in [0.04, 0.94], z_3 \in [1.03, 1.69]$, and $z_4 \in [1.1, 2.1]$

E. $z_1 \in [-3.15, -2.72]$, $z_2 \in [0.04, 0.94], z_3 \in [1.03, 1.69]$, and $z_4 \in [1.1, 2.1]$

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9. Factor the polynomial below completely, knowing that $x+5$ is a factor. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3 \leq z_4$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 12x^4 + 119x^3 + 390x^2 + 525x + 250$$

A. $z_1 \in [1.1, 1.3]$, $z_2 \in [1.38, 1.76], z_3 \in [1.6, 3.4]$, and $z_4 \in [3.4, 5.5]$

B. $z_1 \in [-5.12, -4.81]$, $z_2 \in [-2.07, -1.82], z_3 \in [-1.7, -1.1]$, and $z_4 \in [-2.3, -0.7]$

C. $z_1 \in [0.36, 0.55]$, $z_2 \in [1.82, 2.42], z_3 \in [3.7, 6.2]$, and $z_4 \in [3.4, 5.5]$

D. $z_1 \in [-5.12, -4.81]$, $z_2 \in [-2.07, -1.82], z_3 \in [-1.6, -0.1]$, and $z_4 \in [-0.8, 0.5]$

E. $z_1 \in [0.5, 0.89]$, $z_2 \in [0.52, 0.87], z_3 \in [1.6, 3.4]$, and $z_4 \in [3.4, 5.5]$

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10. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{20x^3 + 65x^2 - 48}{x + 3}$$

A. $a \in [-60, -59], b \in [242, 246], c \in [-735, -734]$, and $r \in [2155, 2161]$.

B. $a \in [-60, -59], b \in [-115, -110], c \in [-346, -344]$, and $r \in [-1087, -1081]$.

C. $a \in [14, 22], b \in [2, 6], c \in [-20, -11]$, and $r \in [-9, -1]$.

D. $a \in [14, 22], b \in [120, 128], c \in [369, 376]$, and $r \in [1075, 1086]$.

E. $a \in [14, 22], b \in [-20, -11], c \in [59, 66]$, and $r \in [-288, -282]$.
