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

$$f(x) = 7x^4 + 6x^3 + 4x^2 + 4x + 5$$

A. $\pm 1, \pm 5$

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

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

D. $\pm 1, \pm 7$

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

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2. 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.*

$$f(x) = 15x^3 - 49x^2 + 44x - 12$$

A. $z_1 \in [-2.1, -1]$, $z_2 \in [-1.14, -0.19]$, and $z_3 \in [-1.08, -0.56]$

B. $z_1 \in [-0.1, 0.9]$, $z_2 \in [0.07, 0.97]$, and $z_3 \in [1.54, 2.39]$

C. $z_1 \in [-2.1, -1]$, $z_2 \in [-2.02, -1.81]$, and $z_3 \in [-0.39, -0.08]$

D. $z_1 \in [-2.1, -1]$, $z_2 \in [-1.73, -1.51]$, and $z_3 \in [-1.6, -1.14]$

E. $z_1 \in [1, 2.5]$, $z_2 \in [1.49, 1.7]$, and $z_3 \in [1.54, 2.39]$

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

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

A. $\pm 1, \pm 2$

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

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

D. $\pm 1, \pm 3$

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

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

$$\frac{16x^3 + 32x^2 - 4x - 12}{x + 2}$$

A. $a \in [-32, -31], \ b \in [-32, -26], \ c \in [-72, -63], \text{ and } r \in [-151, -145].$

B. $a \in [-32, -31], \ b \in [95, 101], \ c \in [-200, -193], \text{ and } r \in [376, 387].$

C. $a \in [16, 18], \ b \in [-17, -15], \ c \in [43, 45], \text{ and } r \in [-147, -143].$

D. $a \in [16, 18], \ b \in [60, 66], \ c \in [124, 131], \text{ and } r \in [235, 239].$

E. $a \in [16, 18], \ b \in [-1, 3], \ c \in [-15, 2], \text{ and } r \in [-6, -1].$

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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.

$$\frac{4x^3 - 10x^2 - 16x + 38}{x - 2}$$

A. $a \in [2.9, 4.7], \ b \in [-5.6, 0.9], \ c \in [-21.9, -18.1], \text{ and } r \in [-3, 0].$

B. $a \in [2.9, 4.7], \ b \in [-7, -4.7], \ c \in [-22.3, -20.4], \text{ and } r \in [12, 26].$

C. $a \in [4.3, 9.4], \ b \in [5.5, 7.2], \ c \in [-4.9, -1.2], \text{ and } r \in [25, 34].$

D. $a \in [4.3, 9.4], \ b \in [-29, -25.9], \ c \in [35.5, 41], \text{ and } r \in [-35, -32].$

E. $a \in [2.9, 4.7], \ b \in [-18.6, -17.5], \ c \in [18.1, 23.6], \text{ and } r \in [-3, 0].$

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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.

$$\frac{10x^3 - 70x - 63}{x - 3}$$

A. $a \in [9, 11], b \in [12, 24], c \in [-32, -28],$ and $r \in [-125, -117]$.

B. $a \in [9, 11], b \in [-31, -28], c \in [18, 24],$ and $r \in [-125, -117]$.

C. $a \in [30, 35], b \in [88, 93], c \in [198, 202],$ and $r \in [537, 540]$.

D. $a \in [9, 11], b \in [28, 32], c \in [18, 24],$ and $r \in [-7, -2]$.

E. $a \in [30, 35], b \in [-93, -88], c \in [198, 202],$ and $r \in [-665, -660]$.

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7. Factor the polynomial below completely, knowing that $x - 2$ 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.*

$$f(x) = 12x^4 + 25x^3 - 114x^2 - 48x + 160$$

A. $z_1 \in [-3.5, -1.7],\ z_2 \in [-0.43, -0.4], z_3 \in [3.99, 4.05],$ and $z_4 \in [4, 9]$

B. $z_1 \in [-5.9, -2.3],\ z_2 \in [-0.78, -0.74], z_3 \in [0.79, 0.85],$ and $z_4 \in [1, 3]$

C. $z_1 \in [-3.5, -1.7],\ z_2 \in [-0.82, -0.79], z_3 \in [0.72, 0.76],$ and $z_4 \in [4, 9]$

D. $z_1 \in [-5.9, -2.3],\ z_2 \in [-1.38, -1.3], z_3 \in [1.23, 1.25],$ and $z_4 \in [1, 3]$

E. $z_1 \in [-3.5, -1.7],\ z_2 \in [-1.32, -1.23], z_3 \in [1.33, 1.38],$ and $z_4 \in [4, 9]$

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8. 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.*

$$f(x) = 6x^3 + 41x^2 + 45x - 50$$

A. $z_1 \in [-5.23, -4.91],\ z_2 \in [-0.6, -0.1],$ and $z_3 \in [1.2, 1.6]$

B. $z_1 \in [-0.68, -0.37],\ z_2 \in [1.92, 2.62],$ and $z_3 \in [3.9, 6.2]$

C. $z_1 \in [-5.23, -4.91],\ z_2 \in [-3.38, -2.35],$ and $z_3 \in [0.4, 1.4]$

D. $z_1 \in [-1.59, -1.34]$, $z_2 \in [0.25, 0.49]$, and $z_3 \in [3.9, 6.2]$

E. $z_1 \in [-0.49, -0.12]$, $z_2 \in [4.57, 5.85]$, and $z_3 \in [3.9, 6.2]$

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

$$\frac{20x^3 - 84x^2 + 62}{x - 4}$$

A. $a \in [79, 83], b \in [-406, -397], c \in [1615, 1618]$, and $r \in [-6403, -6399]$.

B. $a \in [79, 83], b \in [225, 245], c \in [942, 956]$, and $r \in [3838, 3846]$.

C. $a \in [20, 27], b \in [-11, 3], c \in [-20, -12]$, and $r \in [-2, 1]$.

D. $a \in [20, 27], b \in [-28, -17], c \in [-75, -71]$, and $r \in [-155, -152]$.

E. $a \in [20, 27], b \in [-167, -161], c \in [651, 660]$, and $r \in [-2562, -2555]$.

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10. 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.*

$$f(x) = 10x^4 - 89x^3 + 238x^2 - 123x - 180$$

A. $z_1 \in [-0.6, 0.4]$, $z_2 \in [1.1, 3.5], z_3 \in [2.77, 3.1]$, and $z_4 \in [3.12, 4.1]$

B. $z_1 \in [-1.67, -0.67]$, $z_2 \in [-0.8, 0.9], z_3 \in [2.77, 3.1]$, and $z_4 \in [3.12, 4.1]$

C. $z_1 \in [-6, -2]$, $z_2 \in [-4.3, -1.2], z_3 \in [-0.41, -0.36]$, and $z_4 \in [1.43, 2.5]$

D. $z_1 \in [-6, -2]$, $z_2 \in [-4.3, -1.2], z_3 \in [-3.11, -2.35]$, and $z_4 \in [-0.23, 1.2]$

E. $z_1 \in [-6, -2]$, $z_2 \in [-4.3, -1.2], z_3 \in [-0.85, -0.44]$, and $z_4 \in [2.73, 3.26]$
