This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

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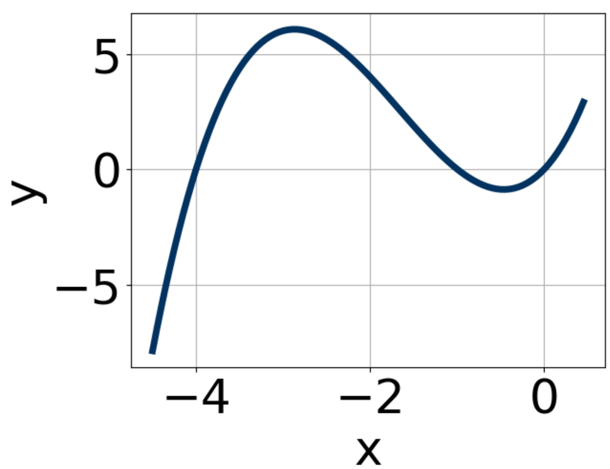
1. Which of the following equations *could* be of the graph presented below?



The solution is $11x^{11}(x+4)^7(x+1)^5$, which is option A.

A. $11x^{11}(x+4)^7(x+1)^5$

* This is the correct option.

B. $17x^6(x+4)^4(x+1)^9$

The factors 0 and -4 have have been odd power.

C. $9x^4(x+4)^7(x+1)^7$

The factor 0 should have been an odd power.

D. $-15x^6(x+4)^7(x+1)^{11}$

The factor x should have an odd power and the leading coefficient should be the opposite sign.

E. $-9x^9(x+4)^5(x+1)^5$

This corresponds to the leading coefficient being the opposite value than it should be.

General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

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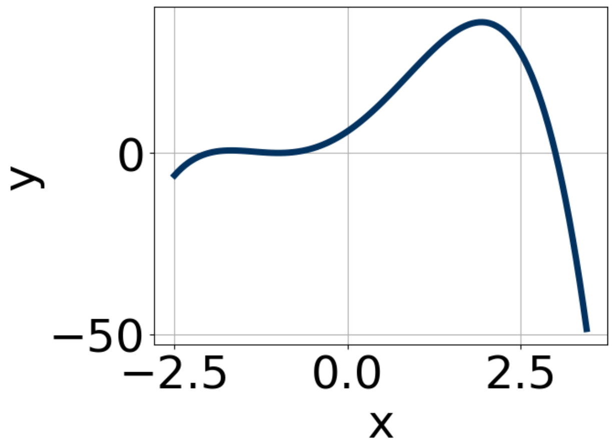
2. Which of the following equations *could* be of the graph presented below?



The solution is $-19(x+1)^4(x+2)^7(x-3)^7$, which is option E.

A. $-13(x+1)^8(x+2)^{10}(x-3)^9$

The factor $(x+2)$ should have an odd power.

B. $11(x+1)^{10}(x+2)^9(x-3)^8$

The factor $(x-3)$ should have an odd power and the leading coefficient should be the opposite sign.

C. $8(x+1)^6(x+2)^7(x-3)^5$

This corresponds to the leading coefficient being the opposite value than it should be.

D. $-20(x+1)^7(x+2)^4(x-3)^5$

The factor -1 should have an even power and the factor -2 should have an odd power.

E. $-19(x+1)^4(x+2)^7(x-3)^7$

* This is the correct option.

General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

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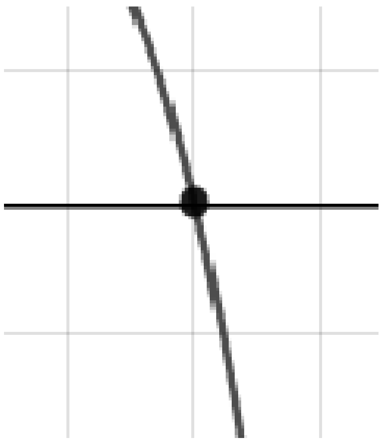
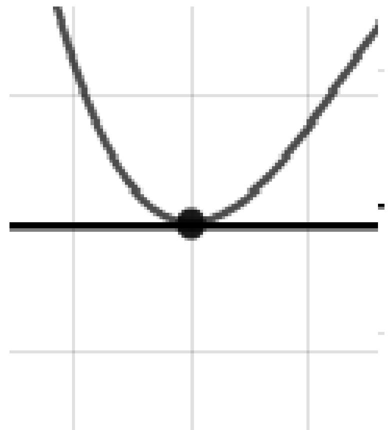
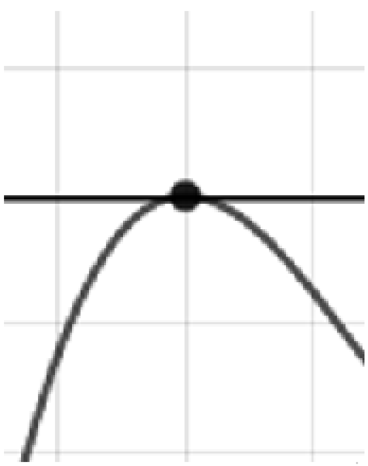
3. Describe the zero behavior of the zero $x=-8$ of the polynomial below.

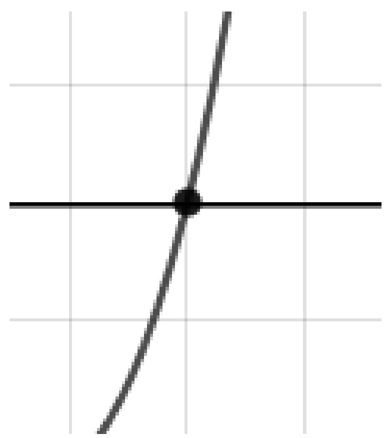
$$f(x) = 4(x-8)^9(x+8)^{10}(x+6)^7(x-6)^{10}$$

The solution is the graph below, which is option C.

A. 

C. 

B. 

D. 

E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

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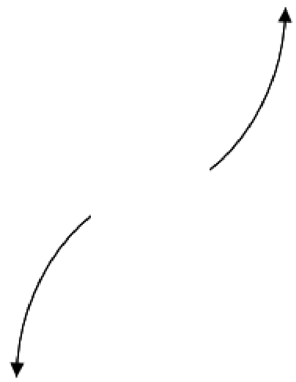
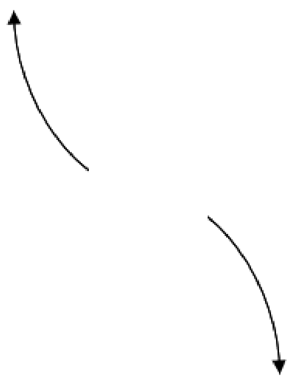
4. Describe the end behavior of the polynomial below.

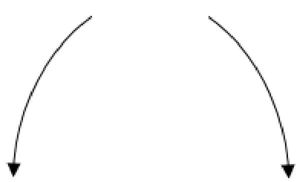
$$f(x) = 2(x+2)^5(x-2)^{10}(x-9)^2(x+9)^2$$

The solution is the graph below, which is option D.

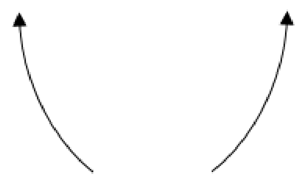




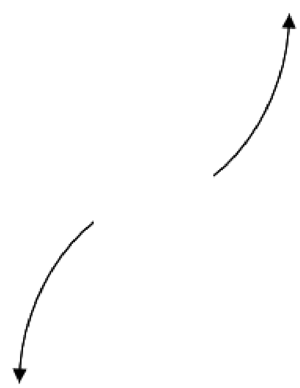
A.



B.



C.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

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5. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-7}{3}, -6, \text{ and } \frac{5}{4}$$

The solution is $12x^3 + 85x^2 + 43x - 210$, which is option D.

A. $a \in [7, 13], b \in [-121, -109], c \in [289, 294]$, and $d \in [-211, -202]$

$12x^3 - 115x^2 + 293x - 210$, which corresponds to multiplying out $(3x + 3)(x + 1)(4x - 4)$.

B. $a \in [7, 13], b \in [85, 94], c \in [34, 46],$ and $d \in [209, 218]$

$12x^3+85x^2+43x+210$, which corresponds to multiplying everything correctly except the constant term.

C. $a \in [7, 13], b \in [-85, -83], c \in [34, 46],$ and $d \in [209, 218]$

$12x^3 - 85x^2 + 43x + 210$, which corresponds to multiplying out $(3x - 7)(x - 6)(4x + 5)$.

D. $a \in [7, 13], b \in [85, 94], c \in [34, 46],$ and $d \in [-211, -202]$

* $12x^3 + 85x^2 + 43x - 210$, which is the correct option.

E. $a \in [7, 13], b \in [27, 37], c \in [-225, -220],$ and $d \in [209, 218]$

$12x^3 + 29x^2 - 223x + 210$, which corresponds to multiplying out $(3x + 3)(x - 1)(4x - 4)$.

General Comment: To construct the lowest-degree polynomial, you want to multiply out $(3x + 7)(x + 6)(4x - 5)$

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6. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-7}{3}, \frac{-5}{2}, \text{ and } -5$$

The solution is $6x^3 + 59x^2 + 180x + 175$, which is option E.

A. $a \in [3, 13], b \in [-2, 3], c \in [-114, -105],$ and $d \in [172, 177]$

$6x^3 + x^2 - 110x + 175$, which corresponds to multiplying out $(3x + 3)(2x + 2)(x - 1)$.

B. $a \in [3, 13], b \in [-61, -58], c \in [176, 187],$ and $d \in [-181, -166]$

$6x^3 - 59x^2 + 180x - 175$, which corresponds to multiplying out $(3x - 7)(2x - 5)(x - 5)$.

C. $a \in [3, 13], b \in [29, 32], c \in [-38, -26],$ and $d \in [-181, -166]$

$6x^3 + 31x^2 - 30x - 175$, which corresponds to multiplying out $(3x + 3)(2x - 2)(x - 1)$.

D. $a \in [3, 13], b \in [53, 69], c \in [176, 187],$ and $d \in [-181, -166]$

$6x^3+59x^2+180x-175$, which corresponds to multiplying everything correctly except the constant term.

E. $a \in [3, 13], b \in [53, 69], c \in [176, 187],$ and $d \in [172, 177]$

* $6x^3 + 59x^2 + 180x + 175$, which is the correct option.

General Comment: To construct the lowest-degree polynomial, you want to multiply out $(3x + 7)(2x + 5)(x + 5)$

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7. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$5 - 3i \text{ and } 3$$

The solution is $x^3 - 13x^2 + 64x - 102$, which is option A.

A. $b \in [-16, -10], c \in [56, 67],$ and $d \in [-110, -98]$

* $x^3 - 13x^2 + 64x - 102$, which is the correct option.

B. $b \in [7, 16], c \in [56, 67],$ and $d \in [99, 103]$

$x^3 + 13x^2 + 64x + 102$, which corresponds to multiplying out $(x - (5 - 3i))(x - (5 + 3i))(x + 3)$.

C. $b \in [-1, 2], c \in [-14, -7],$ and $d \in [12, 18]$

$x^3 + x^2 - 8x + 15$, which corresponds to multiplying out $(x - 5)(x - 3)$.

D. $b \in [-1, 2], c \in [0, 8],$ and $d \in [-10, -6]$

$x^3 + x^2 - 9$, which corresponds to multiplying out $(x + 3)(x - 3)$.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

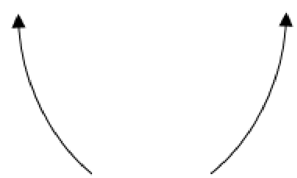
General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (5 - 3i))(x - (5 + 3i))(x - (3))$.

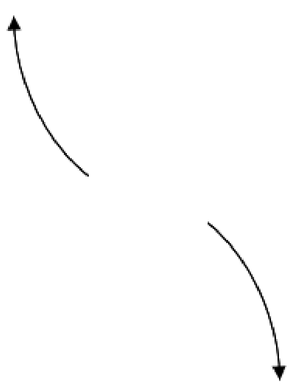
---

8. Describe the end behavior of the polynomial below.

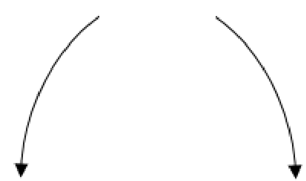
$$f(x) = 5(x + 4)^5(x - 4)^8(x + 3)^2(x - 3)^3$$

The solution is the graph below, which is option C.

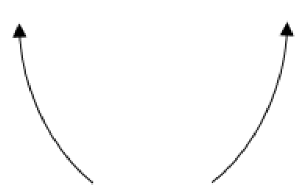




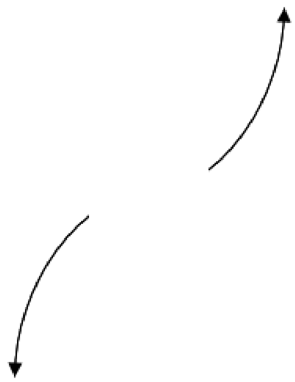
A.



B.



C.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

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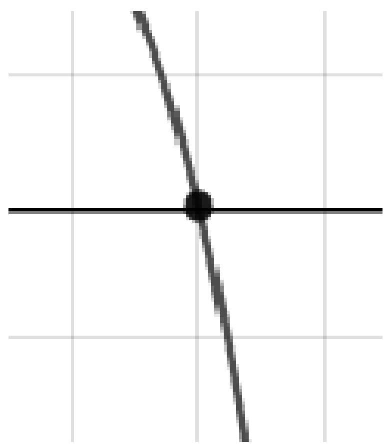
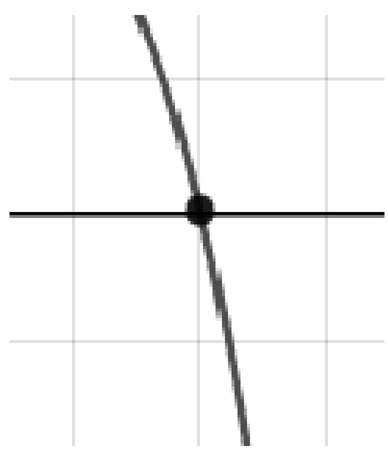
9. Describe the zero behavior of the zero $x = 8$ of the polynomial below.

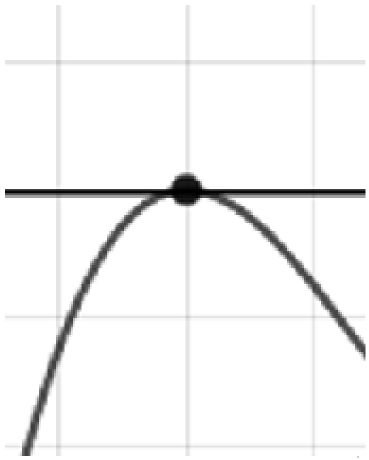
$$f(x) = -7(x+5)^{12}(x-5)^{8}(x+8)^{12}(x-8)^{9}$$

The solution is the graph below, which is option A.

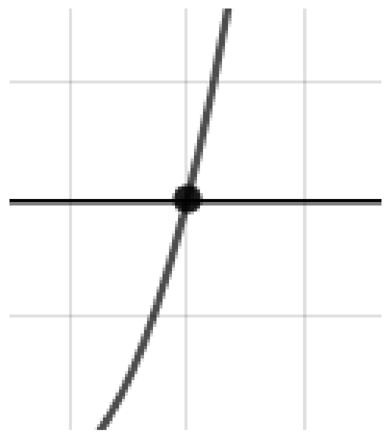




A.

B. 

C. 

D. 

E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

---

10. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$4 - 2i \text{ and } -4$$

The solution is $x^3 - 4x^2 - 12x + 80$, which is option D.

A. $b \in [-3, 3.2], c \in [-4, 5],$ and $d \in [-21, -7]$

$x^3 + x^2 - 16$, which corresponds to multiplying out $(x - 4)(x + 4)$.

B. $b \in [1.5, 4.4], c \in [-12, -8],$ and $d \in [-82, -75]$

$x^3 + 4x^2 - 12x - 80$, which corresponds to multiplying out $(x - (4 - 2i))(x - (4 + 2i))(x - 4)$.

C. $b \in [-3, 3.2], c \in [1, 8],$ and $d \in [6, 13]$

$x^3 + x^2 + 6x + 8$, which corresponds to multiplying out $(x + 2)(x + 4)$.

D. $b \in [-5.7, -2.5], c \in [-12, -8],$ and $d \in [80, 83]$

* $x^3 - 4x^2 - 12x + 80$, which is the correct option.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a+bi$ is $a-bi$. Since these zeros always come in pairs, we need to multiply out $(x-(4-2i))(x-(4+2i))(x-(-4))$.