

For #1-4, describe the end behavior of the given polynomial function.

1.  $f(x) = 2x^4 - 3x + 1$   $\uparrow\uparrow$

2.  $f(x) = -\frac{7}{8}(x^3 + 5x^2 - 7x + 1)$   $\uparrow\downarrow$

3.  $f(x) = 5 - \frac{7}{2}x - 3x^2$   $\downarrow\downarrow$

4.  $f(x) = \frac{6x^5 - 2x^4 + 4x^2 - 5x}{3}$   $\downarrow\uparrow$

For #5-8, find all the real zeros of the polynomial function. Then, determine the multiplicity of each zero.

5.  $f(x) = x^2 - 25$

$(x-5)(x+5)$

$x=5, x=-5$

$\uparrow$  1 cross  $\uparrow$  1 cross

6.  $f(x) = x^2 - 6x + 9$

$(x-3)(x-3)$

$x=3$

2 bounce

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

$x(x^2 - 4x + 4)$

$x(x-2)(x-2)$

cross  $\rightarrow$   $x=0$   $x=2$  2 bounce

8.  $f(x) = x^4 - x^3 - 20x^2$

$x^2(x^2 - x - 20) = 0$

$x^2 = 0$

$(x-5)(x+4) = 0$

2 bounce  $x=0$

$x=5$   $x=-4$

1 cross 1 cross

For #9-12, find a polynomial function with the given zeros, multiplicities, and degree.

9. Zero: -2, multiplicity: 2

Zero: -1, multiplicity: 1

Degree: 3

$(x+2)^2(x+1)$

10. Zero: -4, multiplicity: 2

Zero: 3, multiplicity: 2

Degree: 4

$(x+4)^2(x-3)^2$

11. Zero: 3, multiplicity: 1

Zero: 2, multiplicity: 3

Degree: 4

$(x-3)(x-2)^3$

12. Zero: 5, multiplicity: 3

Zero: 0, multiplicity: 2

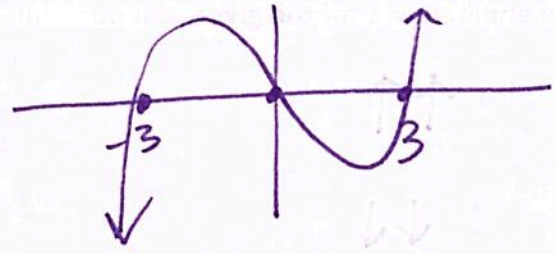
Degree: 5

$x^2(x-5)^3$

For #13-16, sketch the graph of the function. Be sure to include zeros and multiplicities on your graph.

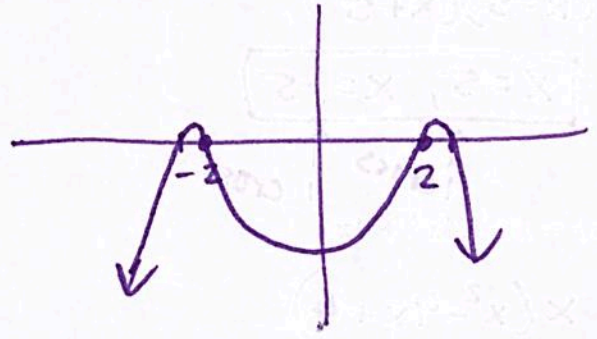
13.  $f(x) = x^3 - 9x$

$\downarrow \uparrow$   
 $x(x^2 - 9)$   
 $x(x-3)(x+3)$   
 $x=0$     $x=3$     $x=-3$   
 cross   cross   cross



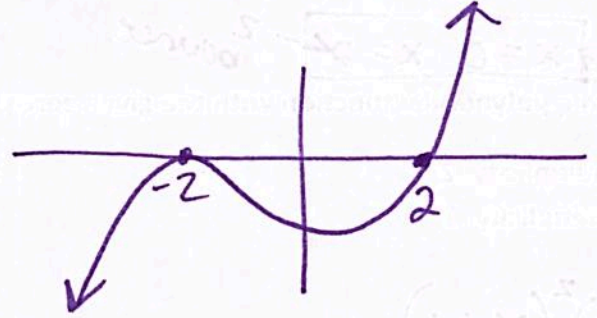
14.  $f(x) = -x^4 + 9x^2 - 20$

$\downarrow \downarrow$   
 $(-x^2 + 5)(x^2 - 4)$   
 $x^2 = 5$     $(x+2)(x-2)$   
 $x = \pm\sqrt{5}$     $x = -2$     $x = 2$   
 cross cross   cross cross  
 (~ 2.236)



15.  $f(x) = (x^5 - 4x^3) + (8x^2 - 32)$

$\downarrow \uparrow$   
 $x^3(x^2 - 4) + 8(x^2 - 4)$   
 $(x^3 + 8)(x^2 - 4)$   
 $(x+2)(x^2 - 2x + 4)$     $x=2$     $x=-2$   
 $x=-2$    cross   ~~cross~~  
 bounce



16.  $f(x) = x^3(x-4)^2$     $x^5$

$\downarrow \uparrow$   
 $x=0$     $x=4$   
 twist   bounce

