

4. The Graphing Calculator

Use the rational root theorem to list the possible roots & determine the actual roots.

1.  $p(x) = 2x^3 - 3x^2 - 2x + 2$

$\frac{p}{q} = \frac{\pm 1, \pm 2}{\pm 1, \pm 2}$   
 $\frac{1}{1}, \frac{1}{2}, \frac{-1}{1}, \frac{-1}{2}, \frac{2}{1}, \frac{2}{2}$

Use Synthetic Division to find the actual roots.  
 Divide  $2x^3 - 3x^2 - 2x + 2$  by  $x - 1$   
 $(x - 1) \overline{) 2x^3 - 3x^2 - 2x + 2}$   
 $\underline{2x^3 - 2x^2 - 2x + 2}$   
 $\phantom{2x^3 - } -x^2 - 2x + 0$   
 $\underline{-x^2 - 2x + 0}$   
 $\phantom{-x^2 - } 0x^2 + 0x + 0$   
 $\phantom{-x^2 - } 0x + 0$   
 $\phantom{-x^2 - } 0$

Actual roots:  $x = 1, x = -1, x = 1$   
 (Note:  $x = 1$  is a double root)

2.  $p(x) = 3x^3 - 2x^2 + 3x + 2$

$\frac{p}{q} = \frac{\pm 1, \pm 2}{\pm 1, \pm 3}$   
 $\frac{1}{1}, \frac{1}{3}, \frac{-1}{1}, \frac{-1}{3}, \frac{2}{1}, \frac{2}{3}$

Use Synthetic Division to find the actual roots.  
 Divide  $3x^3 - 2x^2 + 3x + 2$  by  $x + 1$   
 $(x + 1) \overline{) 3x^3 - 2x^2 + 3x + 2}$   
 $\underline{3x^3 + 3x^2 + 3x + 2}$   
 $\phantom{3x^3 + } -5x^2 + 0x + 0$   
 $\underline{-5x^2 - 5x - 5}$   
 $\phantom{-5x^2 - } 5x + 5$   
 $\underline{5x + 5}$   
 $\phantom{5x + } 0$

Actual roots:  $x = -1, x = -1, x = \frac{2}{3}$   
 (Note:  $x = -1$  is a double root)

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

$\frac{p}{q} = \frac{\pm 1, \pm 2}{\pm 1, \pm 2}$   
 $\frac{1}{1}, \frac{1}{2}, \frac{-1}{1}, \frac{-1}{2}, \frac{2}{1}, \frac{2}{2}$

Use Synthetic Division to find the actual roots.  
 Divide  $2x^3 - 3x^2 - 4x + 2$  by  $x - 1$   
 $(x - 1) \overline{) 2x^3 - 3x^2 - 4x + 2}$   
 $\underline{2x^3 - 2x^2 - 4x + 2}$   
 $\phantom{2x^3 - } -x^2 - 4x + 0$   
 $\underline{-x^2 - 4x + 0}$   
 $\phantom{-x^2 - } 0x^2 + 0x + 2$   
 $\phantom{-x^2 - } 0x + 2$   
 $\phantom{-x^2 - } 2$

Actual roots:  $x = 1, x = -2, x = 1$   
 (Note:  $x = 1$  is a double root)

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

$\frac{p}{q} = \frac{\pm 1, \pm 2}{\pm 1, \pm 2}$   
 $\frac{1}{1}, \frac{1}{2}, \frac{-1}{1}, \frac{-1}{2}, \frac{2}{1}, \frac{2}{2}$

Use Synthetic Division to find the actual roots.  
 Divide  $2x^3 - 3x^2 + 3x + 2$  by  $x + 1$   
 $(x + 1) \overline{) 2x^3 - 3x^2 + 3x + 2}$   
 $\underline{2x^3 + 2x^2 + 3x + 2}$   
 $\phantom{2x^3 + } -5x^2 + 0x + 0$   
 $\underline{-5x^2 - 5x - 5}$   
 $\phantom{-5x^2 - } 5x + 5$   
 $\underline{5x + 5}$   
 $\phantom{5x + } 0$

Actual roots:  $x = -1, x = -1, x = \frac{2}{3}$   
 (Note:  $x = -1$  is a double root)

What if none of the roots are rational?

$p(x) = x^3 - 3x^2 + 25x - 24 = 0$   
 $\frac{p}{q} = \frac{\pm 1, \pm 2, \pm 3, \pm 4, \pm 6, \pm 8, \pm 12, \pm 24}{\pm 1}$



Graphing Calculator Directions

1. Graph the function
2. Press the calc key (2nd trace)
3. Choose zero
4. Move the cursor to the left of the zero
5. Move the cursor to the right of the zero
6. Repeat until done
7. The root will be at the bottom of the screen