In exercises 1-6, use the Factor Theorem to determine whether the first polynomial is a factor of the second polynomial.

1. $x-1;\ x^3-x^2+x-1$ yes

2. $x-3;\ x^3-x^2-x-15$ yes

3. $x-2;\ x^3+3x-4$ no

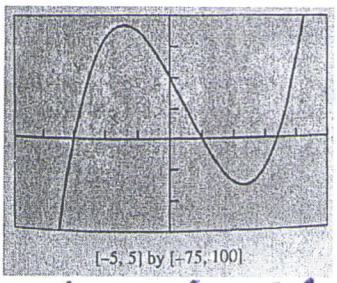
4. $x-2;\ x^3-3x-2$ yes

5. $x+2;\ 4x^3+9x^2-3x-10$ yes

6. $x+1;\ 2x^{10}-x^9+x^8+x^7+2x^6-3$ no

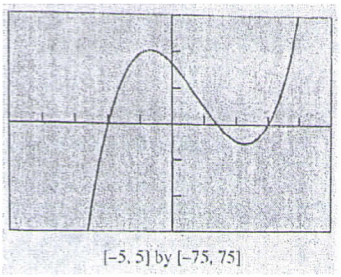
In exercises 7-8, use the graph to guess possible linear factors of $f(x)$. Then completely factor $f(x)$.

7. $f(x)=5x^3-7x^2-49x+51$



$f(x)=(x+3)(x-1)(5x-17)$

8. $f(x)=5x^3-12x^2-23x+42$



$f(x)=(x+2)(x-3)(5x-7)$

In exercises 9-11, use the Rational Root Theorem to write a list of all potential rational zeros. Then determine which ones, if any, are zeros.

9. $f(x)=6x^3-5x-1$ possible: $\pm1, \pm\frac{1}{2}, \pm\frac{1}{3}, \pm\frac{1}{6}$ actual: 1

10. $f(x)=3x^3-7x^2+6x-14$ possible: $\pm1, \pm2, \pm7, \pm14, \pm\frac{1}{3}, \pm\frac{2}{3}, \pm\frac{7}{3}, \pm\frac{14}{3}$
actual: $\frac{7}{3}$

11. $f(x)=2x^3-x^2-9x+9$ possible: $\pm1, \pm3, \pm9, \pm\frac{1}{2}, \pm\frac{3}{2}, \pm\frac{9}{2}$ actual: $\frac{3}{2}$

In exercises 12-14, find all of the real zeros of the function, finding exact values whenever possible. Identify each zero as rational or irrational.

12. $f(x)=2x^3-3x^2-4x+6$ Zeros: $\underbrace{\frac{3}{2}}_{\text{rational}}, \underbrace{\sqrt{2}, -\sqrt{2}}_{\text{irrational}}$

13. $f(x)=x^3+x^2-8x-6$ Zeros: $\underbrace{-3}_{\text{rational}}, \underbrace{1\pm\sqrt{3}}_{\text{irrational}}$

14. $f(x)=2x^4-7x^3-2x^2-7x-4$ Zeros: $\underbrace{-\frac{1}{2}, 4}_{\text{rational}}$ (no irrational)