1. The point marked is both a local and a global maximum. The global minimum is $y = 2$, and it occurs at $x = 1$. $y = 6$ is a local minimum, occurring at the other endpoint $x = 5$.

2. The two highest points marked at both local and global maxima; they share this distinction. The other marked point is a local and global maximum. Both endpoints are local minima.

3. A parabola with the vertex at $x = 3$ would have this property.

4. We need a cubic polynomial-type shape.

5. The function shown has these properties.

6. $f(x) = e^x$ has no extrema.
For 7 through 10, see the graphs below.

11. The graph is shown below. Using the trace function on the calculator, we find the following.

(a) $f$ appears to have a local maximum of $-0.729$ around $x = -0.459$. $f$ appears to have a local minimum of about $-1.73$ around $x = 0.91$. This is also the global minimum since the endpoint $x = -1$ gives $y \approx -1.368$. The global maximum is about 9.402, occurring at the right endpoint $x = 4$.

(b) We still have a local maximum of $-0.729$ and a local minimum of $-1.73$. At the endpoints, we have $f(-3) \approx -27.050$ for a local and global minimum, and $f(2) = 2^3 - e^2 \approx 0.611$ for a local and global maximum.
12. \( f'(x) = 10x^9 - 10 = 10(x^9 - 1) \). The only critical number is \( x = 1 \).
   (a) \( f''(x) = 90x^8 \) and \( f''(1) = 90 > 0 \). By the second derivative test, \( f \) has a local minimum at \( x = 1 \).
   (b) We must check the values of \( f \) at each critical number and at the endpoints. \( f(0) = 0, f(1) = -9, \) and \( f(2) = 1004 \). Thus, \( -9 \) is the global minimum and \( 1004 \) is the global maximum.

13. \( f'(x) = 1 - \frac{1}{x} \). This is zero if \( \frac{1}{x} = 1 \), or \( x = 1 \), so \( x = 1 \) is the only critical number.
   (a) \( f''(x) = \frac{1}{x^2} \) and \( f''(1) = 1 > 0 \), so by the second derivative test, \( f(1) = 1 \) is a local minimum.
   (b) We must check the values of \( f \) at each critical number and at the endpoints. \( f(0.1) = 0.1 - \ln(0.1) \approx 2.403, f(1) = 1, f(2) = 2 - \ln(2) \approx 1.307 \). Thus \( 1 \) is the global minimum and \( 0.1 - \ln(0.1) \approx 2.403 \) is the global maximum.

17. We have \( E = 0.25F + 1.7F^{-2} \), so \( E' = 0.25 - 3.4F^{-3} \). This is zero if \( 0.25 = 3.4F^{-3} \), or \( 0.25 = \frac{3.4}{F^3} \).
   Thus \( F^3 = \frac{3.4}{0.25} = 13.6 \), so \( F = \sqrt[3]{13.6} \approx 2.39 \). Since \( E'' = 10.2F^{-4} = \frac{10.2}{F^4} \), we see that \( E''(2.39) = \frac{10.2}{2.39^4} \approx 0.314 > 0 \), so we have a local minimum.

21. (a) \( q(0) = 20(e^0 - e^0) = 0 \).
   (b) We need \( q'(t) = 20(-e^{-t} + 2e^{-2t}) \). This is zero if \( 2e^{-2t} = e^{-t} \), or \( 2 = e^t \). Thus \( t = \ln(2) \approx 0.693 \) hours. The maximum value at this time is \( q(\ln(2)) = 20(e^{-\ln(2)} - e^{-2\ln(2)}) = 5 \) mg.
   (c) Over time, the quantity in the bloodstream approaches zero since \( e^{-t} \) and \( e^{-2t} \) both approach zero as \( t \to \infty \).