EXERCISE SET 2.3

1. (a) $-\infty$
(b) $+\infty$

2. (a) 2
(b) 0

3. (a) 0
(b) -1

4. (a) does not exist
(b) 0

5. (a) -12 (b) 21 (c) -15 (d) 25
(e) 2 (f) $-3/5$ (g) 0
(h) The limit doesn't exist because the denominator tends to zero but the numerator doesn't.

6. (a) 20 (b) 0 (c) $+\infty$ (d) $-\infty$
(e) $(-42)^{1/3}$ (f) $-6/7$ (g) 7 (h) $-7/12$

7. $-\infty$ **8.** $+\infty$ **9.** $+\infty$ **10.** $+\infty$ **11.** $3/2$

12. $5/2$ **13.** 0 **14.** 0 **15.** 0 **16.** $5/3$

17. $-5^{1/3}/2$ **18.** $\sqrt[3]{3/2}$ **19.** $-\sqrt{5}$ **20.** $\sqrt{5}$ **21.** $1/\sqrt{6}$

22. $-1/\sqrt{6}$ **23.** $\sqrt{3}$ **24.** $\sqrt{3}$ **25.** $-\infty$ **26.** $+\infty$

27. $-1/7$ **28.** $4/7$

29. It appears that $\lim_{t\to+\infty} n(t) = +\infty$, and $\lim_{t\to+\infty} e(t) = c$.

30. (a) It is the initial temperature of the potato (400° F).
(b) It is the ambient temperature, i.e. the temperature of the room.

31. (a) $+\infty$ (b) -5 **32.** (a) 0 (b) -6

33. $$\lim_{x\to+\infty}(\sqrt{x^2+3}-x)\frac{\sqrt{x^2+3}+x}{\sqrt{x^2+3}+x} = \lim_{x\to+\infty}\frac{3}{\sqrt{x^2+3}+x} = 0$$

34. $$\lim_{x\to+\infty}(\sqrt{x^2-3x}-x)\frac{\sqrt{x^2-3x}+x}{\sqrt{x^2-3x}+x} = \lim_{x\to+\infty}\frac{-3x}{\sqrt{x^2-3x}+x} = -3/2$$

35. $$\lim_{x\to+\infty}\left(\sqrt{x^2+ax}-x\right)\frac{\sqrt{x^2+ax}+x}{\sqrt{x^2+ax}+x} = \lim_{x\to+\infty}\frac{ax}{\sqrt{x^2+ax}+x} = a/2$$

36. $$\lim_{x\to+\infty}\left(\sqrt{x^2+ax}-\sqrt{x^2+bx}\right)\frac{\sqrt{x^2+ax}+\sqrt{x^2+bx}}{\sqrt{x^2+ax}+\sqrt{x^2+bx}} = \lim_{x\to+\infty}\frac{(a-b)x}{\sqrt{x^2+ax}+\sqrt{x^2+bx}} = \frac{a-b}{2}$$

37. $\lim_{x\to+\infty} p(x) = (-1)^n\infty$ and $\lim_{x\to-\infty} p(x) = +\infty$

38. If $m > n$ the limits are both zero. If $m = n$ the limits are both 1. If $n > m$ the limits are $(-1)^{n+m}\infty$ and $+\infty$, respectively.

39. If $m > n$ the limits are both zero. If $m = n$ the limits are both equal to a_m, the leading coefficient of p. If $n > m$ the limits are $\pm\infty$ where the sign depends on the sign of a_m and whether n is even or odd.

40. (a) $p(x) = q(x) = x$ (b) $p(x) = x$, $q(x) = x^2$
(c) $p(x) = x^2$, $q(x) = x$ (d) $p(x) = x + 3$, $q(x) = x$

41. If $m > n$ the limit is 0. If $m = n$ the limit is -3. If $m < n$ and $n - m$ is odd, then the limit is $+\infty$; if $m < n$ and $n - m$ is even, then the limit is $-\infty$.

42. If $m > n$ the limit is zero. If $m = n$ the limit is c_m/d_m. If $n > m$ the limit is $+\infty$ if $c_m d_m > 0$ and $-\infty$ if $c_m d_m < 0$.