12.1: 4, 8, 10, 12, 15, 18–28 even, 32, 36

4. $\frac{2}{2}, \frac{3}{5}, \frac{4}{8}, \frac{5}{11}, \frac{6}{14}$

8. $a_1 = 4$, $a_2 = \frac{4}{4-1} = \frac{4}{3}$,

$a_3 = \frac{4}{3} / (\frac{4}{3} - 1) = \frac{4}{3} / \frac{1}{3} = 4.$

$a_4 = \frac{4}{4-1} = \frac{4}{3}$, $a_5 = 4$.

10. $a_n = \left(\frac{1}{3}\right)^{n-1}.$

12. $a_n = (-1)^{n-1} \cdot \frac{n}{(n+1)^2}$

15. $a_1 = \frac{1}{3}$, $a_2 = \frac{2}{5}$, $a_3 = \frac{3}{7}$,

$a_4 = \frac{4}{9}$, $a_5 = \frac{5}{11}$.

Seems to be approaching $\frac{1}{2}$.

$\lim_{n\to\infty} \frac{n}{2n+1} \cdot \frac{1/n}{1/n} = \lim_{n\to\infty} \frac{1}{2 + 1/n}$

$= \frac{1}{2}.$

18. $a_n = \frac{n^3}{n^3+1}$

$\lim_{n\to\infty} \frac{n^3}{n^3+1} \cdot \frac{1/n^3}{1/n^3} = \lim_{n\to\infty} \frac{1}{1 + 1/n^3} = 1.$

20. $\lim_{n\to\infty} \frac{n^3}{n+1} \cdot \frac{1/n}{1/n}$

$= \lim_{n\to\infty} \frac{n^2}{1 + 1/n} = \left(\lim_{n\to\infty} n^2\right) / 1 = \infty$

22. $\lim_{n\to\infty} \frac{3^{n+2}}{5^n} = \lim_{n\to\infty} \left(\frac{3^2 3^n}{5^n}\right)$

$= 9 \lim_{n\to\infty} \left(\frac{3}{5}\right)^n = 0.$

24. $\lim_{n\to\infty} \sqrt{\frac{n+1}{9n+1}}$

$= \sqrt{\lim_{n\to\infty} \frac{n+1}{9n+1} \cdot \frac{1/n}{1/n}}$

$= \sqrt{\lim_{n\to\infty} \frac{1 + 1/n}{9 + 1/n}} = \sqrt{\frac{1}{9}} = \frac{1}{3}$

26. $\lim_{n\to\infty} \frac{(-1)^n n^3}{n^3 + 2n^2 + 1} \cdot \frac{\frac{1}{n^3}}{\frac{1}{n^3}}$

$= \lim_{n\to\infty} \frac{(-1)^n}{1 + 2/n + 1/n^3} = \lim_{n\to\infty} (-1)^n$

DIVERGENT.

28. $\lim_{n\to\infty} \cos(2/n) = \cos\left(\lim_{n\to\infty} \frac{2}{n}\right)$

$= \cos(0) = 1$

32. $\lim_{n\to\infty} \frac{\ln n}{\ln 2n} \left(\frac{\infty}{\infty}\right)$

$= \lim_{n\to\infty} \left(\frac{1}{n}\right) / \left(\frac{2}{2n}\right) = \lim_{n\to\infty} \frac{n}{n} = 1.$

36. $\lim_{n\to\infty} \ln(n+1) - \ln(n)$

$= \lim_{n\to\infty} \ln\left(\frac{n+1}{n}\right) = \ln\left(\lim_{n\to\infty} \frac{n+1}{n}\right)$

$= \ln(1) = 0.$