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1° $\lim\limits_{n\to\infty} \frac{1}{n} = 0$

2° $\lim\limits_{n\to\infty} \sqrt[n]{n} = 1$

3° $\lim\limits_{n\to\infty} \sqrt[n]{a} = 1, \quad a>0$

$\frac{5^3}{6^4} < 0$

4° $\lim \frac{n^k}{a^n} = 0, \quad a>0$

5° $\lim\limits_{n\to\infty} \frac{n^a}{n!} = 0, \quad a\in R$

6° $\lim\limits_{n\to\infty} \frac{a^n}{n!} = 0$

7° $\lim q^n = \begin{cases} 0 & |q|<1 \\ 1 & q=1 \\ +\infty & q>1 \end{cases}$

1) $\lim\limits_{n\to\infty} \frac{5n^2+2n}{n^3+1} = \lim\limits_{n\to\infty} \frac{n^2(5+\frac{2}{n})}{n^3(1+\frac{1}{n^3})} =$

$= \lim\limits_{n\to\infty} \frac{1}{n} \cdot \frac{5+\frac{2}{n}}{1+\frac{1}{n^3}} = 0$

2) $\lim\limits_{x\to\infty} \frac{(2n+1)(n+1)\cdot n}{n^3+3n^2+3n+1} = \lim\limits_{x\to\infty} \frac{(2n+1)(n^2+n)}{n^3+3n^2+3n+1} =$

$= \lim\limits_{x\to\infty} \frac{2n^3+3n^2+n}{n^3+3n^2+1} = \lim\limits_{n\to\infty} \frac{n^3(2+\frac{3}{n}+\frac{1}{n^2})}{n^3(1+\frac{3}{n}+\frac{3}{n^2}+\frac{1}{n^2})} = 2$

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

$$= \lim_{n\to\infty} \frac{n^2+n}{2n^2} = \lim_{n\to\infty} \frac{\cancel{n^2}(1+\cancel{\frac{1}{n}}^{0})}{2\cancel{n^2}} = \frac{1}{2}$$

(4) $$\lim_{n\to\infty} \frac{1\cdot 2 + 2\cdot 3 + \dots + n(n+1)}{n^3} =$$

$n(n+1) = n^2+n$

$n=1 \quad 1\cdot 2 = 1^2+1$

$n=2 \quad 2\cdot 3 = 2^2+2$

$n=3 \quad 3\cdot 4 = 3^2+3$

$$\lim_{n\to\infty} \frac{1^2+1+2^2+2+3^3+3+\dots n^2+n}{n^3}$$

$$\lim_{n\to\infty} \frac{1+2+\dots+n+1^2+2^2+\dots+n^2}{n^3} =$$

$$= \lim_{n\to\infty} \frac{\frac{n(n+1)}{2} + \frac{n(n+1)(2n+1)}{6}}{n^3}$$

$$\lim_{n\to\infty} \frac{3n^2+3n+2n^3+3n^2+n}{6n^3} = \lim_{n\to\infty} \frac{2n^3+6n^2+4n}{6n^3} =$$

$$= \lim_{n\to\infty} \frac{\cancel{n^3}(2+\cancel{\frac{6}{n}}+\cancel{\frac{4}{n^2}})^{0}}{6\cancel{n^3}} = \lim_{n\to\infty} = \frac{1}{3}$$

$$a^3-b^3=(a-b)\cdot(a^2+ab+b^2)$$

5. $$\lim_{n\to\infty}\left(n-2-\sqrt{n^2-n+1}\right)=\lim_{n\to\infty}\left(n-2-\sqrt{n^2-n+1}\right)\cdot\frac{n-2+\sqrt{n^2-n+1}}{n-2+\sqrt{n^2-n+1}}$$

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

$$=\lim_{n\to\infty}\frac{3\cancel{n}\left(\cancel{\frac{1}{n}}^{0}-1\right)}{\cancel{n}\left(1-\cancel{\frac{2}{n}}^{0}+\sqrt{1-\cancel{\frac{1}{n}}+\cancel{\frac{1}{n^2}}}^{0}\right)}=-\frac{3}{2}$$

6. $$\lim_{n\to\infty}\sqrt[3]{n^2}\cdot\left(\sqrt[3]{n-1}-\sqrt[3]{n+1}\right)=$$

$$=\lim_{n\to\infty}\sqrt[3]{n^2}\cdot\left(\sqrt[3]{n-1}-\sqrt[3]{n+1}\right)\cdot\frac{\sqrt[3]{(n-1)^2}+\sqrt[3]{n^2-1}+\sqrt[3]{(n+1)^2}}{\sqrt[3]{(n-1)^2}+\sqrt[3]{n^2-1}+\sqrt[3]{(n+1)^2}}=$$

$$=\lim\frac{\sqrt[3]{n^2}\quad n-1-(n+1)}{\sqrt[3]{n^2}\left(\sqrt[3]{1-\cancel{\frac{2}{n}}+\cancel{\frac{1}{n^2}}}^{0}+\sqrt[3]{1-\cancel{\frac{1}{n^2}}}^{0}+\sqrt[3]{1+\frac{2}{n}+\frac{1}{n^2}}\right)}=-\frac{2}{3}$$

7. $$\lim_{n\to\infty}\frac{(-2)^n+5^n}{(-2)^{n+1}+5^{n+1}}=\lim_{n\to\infty}\frac{5^n\left(\left(-\frac{2}{5}\right)^n+1\right)}{5^{n+1}\left(\left(-\frac{2}{5}\right)^{n+1}+1\right)}=$$

$$=\lim_{n\to\infty}\frac{1}{5}\cdot\frac{\cancel{\left(-\frac{2}{5}\right)^n}^{0}+1}{\cancel{\left(-\frac{2}{5}\right)^{n+1}}^{0}+1}=\frac{1}{5}$$

8. $$\lim_{n\to\infty}\frac{1+2+2^2+\cdots+2^n}{1+3+3^2+\cdots+3^n}=\lim_{n\to\infty}\frac{1\cdot\frac{2^{n+1}-1}{2-1}}{1\cdot\frac{3^{n+1}-1}{3-1}}=$$

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

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$$2\cdot\lim_{n\to\infty}\left(\frac{2}{3}\right)^{n+1}\cdot\lim_{n\to\infty}\frac{1-\frac{1}{2^{n+1}}}{1-\frac{1}{3^{n+1}}}=0$$

9. $$\lim_{n\to\infty}\sqrt{2}\cdot\sqrt[4]{2}\cdot\sqrt[8]{2}\cdots\sqrt[2^n]{2}=$$

$$\lim_{n\to\infty}2^{\frac{1}{2}}\cdot 2^{\frac{1}{2^2}}\cdot 2^{\frac{1}{2^3}}\cdots 2^{\frac{1}{2^n}}=$$

$$\lim_{n\to\infty}2^{\frac{1}{2}+\frac{1}{2^2}+\frac{1}{2^3}+\cdots\frac{1}{2^n}}=$$

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

10. Одредити граничну вриједност низа чији је општи члан $a_n=\frac{1}{1\cdot 2}+\frac{1}{2\cdot 3}\ldots+\frac{1}{n(n+1)}$

$$a_n=\frac{1}{1\cdot 2}+\frac{1}{2\cdot 3}\ldots+\frac{1}{n(n+1)}$$

$$a_1=\frac{1}{2}$$

$$a_2=\frac{1}{1\cdot 2}+\frac{1}{2\cdot 3}$$

$$a_3=\frac{1}{1\cdot 2}+\frac{1}{2\cdot 3}+\frac{1}{3\cdot 4}$$

$\vdots$

$$\frac{1}{n(n+1)} = \frac{A}{n} + \frac{B}{n+1}$$

$$\frac{1}{n(n+1)} = \frac{An + A + Bn}{n(n+1)}$$

$$An + A + Bn = 1$$

$$(A+B)n + A = 1 \Rightarrow \left.\begin{array}{l} A = 1 \\ A+B = 0 \end{array}\right\} \Rightarrow \begin{array}{l} A = 1 \\ B = -1 \end{array}$$

$$\frac{1}{n(n+1)} = \frac{1}{n} - \frac{1}{n+1}$$

$$n = 1 \quad \frac{1}{1\cdot 2} = \frac{1}{1} - \frac{1}{2}$$

$$n = 2 \quad \frac{1}{2\cdot 3} = \frac{1}{2} - \frac{1}{3}$$

$$n = 3 \quad \frac{1}{3\cdot 4} = \frac{1}{3} - \frac{1}{4}$$

$$n = 4 \quad \frac{1}{4\cdot 5} = \frac{1}{4} - \frac{1}{5}$$

$$a_n = 1 - \cancel{\frac{1}{2}} + \cancel{\frac{1}{2}} - \cancel{\frac{1}{3}} + \cancel{\frac{1}{3}} - \cancel{\frac{1}{4}} + \dots + \cancel{\frac{1}{n}} - \frac{1}{n+1}$$

$$a_n = 1 - \frac{1}{n+1}$$

$$\lim_{n\to\infty} a_n = \lim_{n\to\infty} \left(1 - \cancelto{0}{\frac{1}{n+1}}\right) = 1$$

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⑪ Примјеном теореме о уклијештењу доказати конвергенцију и наћи граничну вриједност низа, чији је општи члан:

a) $x_n = \frac{1}{\sqrt{n^2+1}} + \frac{1}{\sqrt{n^2+2}} + \dots + \frac{1}{\sqrt{n^2+n}}$

R:

$a_n \leq x_n \leq b_n, \ \forall n \in N$

$$\left.\begin{array}{l} \lim\limits_{n\to\infty} a_n = l \\ \lim\limits_{n\to\infty} b_n = l \end{array}\right\} \Rightarrow \lim_{n\to\infty} x_n = l$$

$$x_n = \frac{1}{\sqrt{n^2+1}} + \frac{1}{\sqrt{n^2+2}} + \dots + \frac{1}{\sqrt{n^2+n}} \leq$$

$$\leq \frac{1}{\sqrt{n^2+1}} + \frac{1}{\sqrt{n^2+1}} + \dots + \frac{1}{\sqrt{n^2+1}} =$$

$$n \cdot \frac{1}{\sqrt{n^2+1}}$$

$$x_n \geq \frac{1}{\sqrt{n^2+n}} + \frac{1}{\sqrt{n^2+n}} + \dots + \frac{1}{\sqrt{n^2+n}} = n \cdot \frac{1}{\sqrt{n^2+n}}$$

Нека је $a_n = \frac{n}{\sqrt{n^2+n}}$ $\quad b_n = \frac{n}{\sqrt{n^2+1}}$

Тада је

1° $a_n \le x_n \le b_n, \ \forall n \in N$

2° $\lim\limits_{n\to\infty} a_n = \lim\limits_{n\to\infty} \frac{n}{\sqrt{n^2+n}} = \lim\limits_{n\to\infty} \frac{n}{\sqrt{n^2(1+\frac{1}{n})}} = \lim\limits_{n\to\infty} \frac{\cancel{n}}{\cancel{n}\cdot\sqrt{1+\underbrace{\frac{1}{n}}_{0}}}$
$= \underline{1}$

3° $\lim\limits_{n\to\infty} b_n = \lim\limits_{n\to\infty} \frac{n}{\sqrt{n^2+1}} = \lim\limits_{n\to\infty} \frac{n}{n\cdot\sqrt{1+\frac{1}{n^2}}} = 1$

Из $1^\circ, 2^\circ, 3^\circ$ на основу теореме о укљештењу следи да низ (x_n) конвергира и да је $\lim\limits_{n\to\infty} x_n = 1$

б) $x_n = \sum\limits_{k=1}^{n} \frac{5n}{3n^2-2k}$

$\underline{\underline{R}}$ $x_n = \frac{5n}{3n^2-2} + \frac{5n}{3n^2-4} + \frac{5n}{3n^2-6} + \dots \frac{5n}{3n^2-2n}$

$x_n \le \frac{5n}{3n^2-2n} + \frac{5n}{3n^2-2n} + \dots + \frac{5n}{3n^2-2n} =$

$n \cdot \frac{5n}{3n^2-2n} = \frac{5n}{3n^2-2n}$

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$$X_n \geq \frac{5n}{3n^2-2} + \frac{5n}{3n^2-2} + \cdots + \frac{5n}{3n^2-2} = n \cdot \frac{5n}{3n^2-2} = \frac{5n^2}{3n^2-2n}$$

Нека је $a_n = \frac{5n^2}{3n^2-2n}$ и $b_n = \frac{5n^2}{3n^2-2n}$

Тада је

1° $a_n \leq X_n \leq b_n$, $\forall n \in N$

2° $\lim\limits_{n\to\infty} a_n = \lim\limits_{n\to\infty} \frac{5n^2}{3n^2-2} = \frac{5}{3}$

3° $\lim\limits_{n\to\infty} b_n = \lim\limits_{n\to\infty} \frac{5n^2}{3n^2-2n} = \frac{5}{3}$

Из $1^\circ, 2^\circ, 3^\circ$ следи да низ (X_n) конвергира и $\lim\limits_{n\to\infty} X_n = \frac{5}{3}$

Начин

$$X_n = \sum_{k=1}^{n} \frac{5n}{3n^2-2k}$$

$$X_n \leq \sum_{k=1}^{n} \frac{5n}{3n^2-2n} = n \cdot \frac{5n}{3n^2-2n}$$

$$X_n \geq \sum_{k=1}^{n} \frac{5n}{3n^2-2} = n \cdot \frac{5n}{3n^2-2}$$

6) $$a_n = \frac{n+(-1)^1}{\sqrt[5]{n^{10}+1}} + \frac{n+(-1)^2}{\sqrt[5]{n^{10}+2}} + \dots + \frac{n+(-1)^n}{\sqrt[5]{n^{10}+n}}$$

$$a_n \leq \frac{n+1}{\sqrt[5]{n^{10}+1}} + \frac{n+1}{\sqrt[5]{n^{10}+1}} + \dots + \frac{n+1}{\sqrt[5]{n^{10}+1}} = n \cdot \frac{n+1}{\sqrt[5]{n^{10}+1}}$$

$$a_n \geq \frac{n-1}{\sqrt[5]{n^{10}+n}} + \frac{n-1}{\sqrt[5]{n^{10}+n}} + \dots + \frac{n-1}{\sqrt[5]{n^{10}+n}} = n \cdot \frac{n-1}{\sqrt[5]{n^{10}+n}}$$

$$x_n = n \cdot \frac{n-1}{\sqrt[5]{n^{10}+n}}$$

$$y_n = n \cdot \frac{n+1}{\sqrt[5]{n^{10}+1}}$$

Vaga je

1° $x_n \leq a_n \leq y_n$

2° $$\lim_{n\to\infty} x_n = \lim_{n\to\infty} \frac{n^2-n}{\sqrt[5]{n^{10}\left(1+\frac{1}{n^9}\right)}} = \lim_{n\to\infty} \frac{\cancel{n^2}\left(1-\frac{1}{n}\right)}{\cancel{n^2}\cdot\sqrt[5]{1+\frac{1}{n^9}}} = \underline{1}$$

3° $$\lim_{n\to\infty} y_n = \lim_{n\to\infty} \frac{n^2+n}{\sqrt[5]{n^{10}\left(1+\frac{1}{n^{10}}\right)}} = \lim_{n\to\infty} \frac{\cancel{n^2}\left(1+\frac{1}{n}\right)}{\cancel{n^2}\cdot\sqrt[5]{1+\frac{1}{n^{10}}}} = \underline{1}$$

Из $1^\circ, 2^\circ, 3^\circ$ слиједи да је $\lim a_n = \underline{1}$

(12) Примјени теорему о монотоном и ограниченом низу доказати конвергенцију низа.

a) $a_n = \frac{1}{3+1} + \frac{1}{3^2+1} + \dots + \frac{1}{3^n+1}$

R//

$$a_{n+1} - a_n = \cancel{\frac{1}{3+1}} + \cancel{\frac{1}{3^2+1}} + \dots + \cancel{\frac{1}{3^n+1}} + \frac{1}{3^{n+1}+1}$$

$$- \cancel{\frac{1}{3+1}} - \cancel{\frac{1}{3^2+1}} - \dots - \cancel{\frac{1}{3^n+1}}$$

$$a_{n+1} - a_n = \frac{1}{3^{n+1}+1} > 0 \quad , \forall n \in N$$

$a_{n+1} - a_n > 0 \quad , \forall n \in N$

$a_{n+1} > a_n \quad , \forall n \in N \Rightarrow$ низ (a_n) строго монотоно расте.

Како је низ строго монотоно растући, то је $a_1 \leq a_n \, , \forall n \in N$

$$\frac{1}{4} \leq a_n \quad \forall n \in N$$

$$a_n = \frac{1}{3+1} + \frac{1}{3^2+1} + \dots + \frac{1}{3^n+1} \leq \frac{1}{3} + \frac{1}{3^2} + \dots + \frac{1}{3^n} =$$

$$= \frac{1}{3} \cdot \frac{1-\left(\frac{1}{3}\right)^2}{1-\frac{1}{3}} = \cancel{\frac{1}{3}} \cdot \frac{\cancel{3}}{2} \cdot \left(1-\left(\frac{1}{3}\right)^n\right)$$

$$a_n \leq \frac{1}{2}\left(1-\left(\frac{1}{3}\right)^n\right) \leq \frac{1}{2} \cdot 1 = \frac{1}{2}$$

$\frac{1}{4} \leq a_n \leq \frac{1}{2}$ низ (a_n) је ограничен

1°) (a_n) је монотон низ
2°) (a_n) је ограничен $\Big\}$ низ (a_n) конвергентан

б) $$a_n = \left(1-\frac{1}{2}\right)\cdot\left(1-\frac{1}{4}\right)\dots\left(1-\frac{1}{2^{n+1}}\right)$$

$$\frac{a_{n+1}}{a_n} = \frac{\cancel{\left(1-\frac{1}{2}\right)}\cancel{\left(1-\frac{1}{4}\right)}\dots\cancel{\left(1-\frac{1}{2^{n+1}}\right)}\cdot\left(1-\frac{1}{2^{n+2}}\right)}{\cancel{\left(1-\frac{1}{2}\right)}\cancel{\left(1-\frac{1}{4}\right)}\dots\cancel{\left(1-\frac{1}{2^{n+1}}\right)}}$$

$$\frac{a_{n+1}}{a_n} = 1 - \frac{1}{2^{n+2}}, \quad \forall n \in N$$

$\frac{a_{n+1}}{a_n} < 1, \forall n \in N$
$a_n > 0, \forall n \in N$ $\Big\} \Rightarrow a_{n+1} < a_n, \quad \forall n \in N$
$\Rightarrow$ низ (a_n) је строго монотоно опадајући

Како је низ (a_n) строго опадајући то је

$a_n \leq a_1, \forall n \in N$

$$a_1 = \left(1-\frac{1}{2}\right)\left(1-\frac{1}{4}\right) = \frac{3}{8}$$

$a_n \leq \frac{3}{8}, \forall n \in N$

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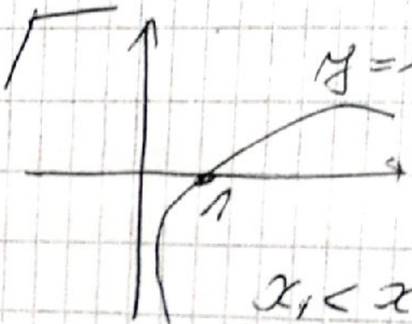
$0 < a_n \le \frac{3}{8}$, $\forall n \in N \Rightarrow (a_n)$ је ограничен

$\left.\begin{array}{l} 1^\circ \ (a_n) \text{ монотон} \\ 2^\circ \ (a_n) \text{ ограничен} \end{array}\right\} \Rightarrow (a_n)$ је конвергентан

б) $x_n = \frac{\ln(1+1)}{1\cdot 2} + \frac{\ln(1+\frac{1}{2})}{2\cdot 3} + \dots + \frac{\ln(1+\frac{1}{n})}{n(n+1)}$

$x_n \le \frac{\ln 2}{1\cdot 2} + \frac{\ln 2}{2\cdot 3} + \dots + \frac{\ln 2}{n(n+1)} =$



$x_1 < x_2$

$\ln x_1 < \ln x_2$

$= \ln 2 \cdot \left(\frac{1}{1\cdot 2} + \frac{1}{2\cdot 3} + \dots + \frac{1}{n(n+1)}\right) =$

$= \ln 2 \left(1 - \frac{1}{2} + \frac{1}{2} - \frac{1}{3} + \dots + \frac{1}{n} - \frac{1}{n+1}\right) =$

$= \ln 2 \left(1 - \frac{1}{n+1}\right)$

$x_n \le \ln 2 \cdot \left(1 - \frac{1}{n+1}\right)$

$x_n \le \ln 2 \cdot 1$, $\forall n \in N$

$0 < x_n \le \ln$ $\forall n \in N \Rightarrow (x_n)$ - ограничен

$x_{n+1} - x_n = \frac{\ln\left(1 + \frac{1}{n+1}\right)}{(n+1)(n+2)} > 0$, $\forall n \in N$

$x_{n+1} > x_n$, $\forall n \in N$

Низ (x_n) је строго монотоно расте
1° (x_n) монотон
2° (x_n) ограничен $\Big\} \Rightarrow (x_n)$ је конвергентан низ

(13) Наћи граничну вриједност низа чији је општи члан

$$x_n = \sqrt[n]{4^n + 3^n - \sin(n!)}$$

R: $x_n = \sqrt[n]{4^n \cdot \left(1 + \left(\frac{3}{4}\right)^n - \frac{\sin(n!)}{4^n}\right)} = 4 \cdot \sqrt[n]{1 + \left(\frac{3}{4}\right)^n - \frac{\sin(n!)}{4^n}}$

$$x_n \leq 4 \cdot \sqrt[n]{1 + \frac{3}{4} + \frac{1}{4}}$$

$$\boxed{x_n \leq 4 \cdot \sqrt[n]{2}}$$

$$x_n \geq 4 \cdot \sqrt[n]{1 + 0 - \frac{1}{4}} = 4 \cdot \sqrt[n]{\frac{3}{4}}$$

1° $4 \cdot \sqrt[n]{\frac{3}{4}} < x_n \leq 4 \cdot \sqrt[n]{2}$

2° $\lim\limits_{n \to \infty} 4 \sqrt[n]{2} = 4 \cdot 1 = 4$

3° $\lim\limits_{n \to \infty} 4 \sqrt[n]{\frac{3}{4}} = 4 \cdot 1 = 4$

Из $1^\circ, 2^\circ, 3^\circ$ слиједи да је низ конвергентан

и $\lim\limits_{n \to \infty} x_n = 4$.

① $\lim\limits_{n\to\infty} \left(\frac{n}{n+1}\right)^n = \lim\limits_{n\to\infty} \left(\left(\frac{n+1}{n}\right)^{-1}\right)^n = \lim\limits_{n\to\infty} \left(\left(1+\frac{1}{n}\right)^n\right)^{-1} =$

$e^{-1} = \frac{1}{e}$ $\qquad \lim\limits_{n\to\infty} \left(1+\frac{1}{n}\right)^n = e$

② $\lim\limits_{n\to\infty} \left(\frac{n+1}{n-1}\right)^n \overset{1^\infty}{=} \lim \left(1+\frac{n+1}{n-1}-1\right)^n =$

$= \lim\limits_{n\to\infty} \left(1+\frac{2}{n-1}\right)^n = \lim\limits_{n\to\infty} \left(1+\frac{2}{n-1}\right)^{\frac{n-1}{2}\cdot\frac{2}{n-1}\cdot n}$

$= \lim\limits_{n\to\infty} \left(\left(1+\frac{2}{n-1}\right)^{\frac{n-1}{2}}\right)^{\frac{2n}{n-1}} \overset{(*)}{=} e^{\lim\limits_{n\to\infty} \frac{2n}{2n-1}} =$

$= e^{\lim\limits_{n\to\infty} \frac{2n}{n(2-\frac{1}{n})}} = e^{\frac{2}{2}} = ($

$(*)$: $\lim\limits_{n\to\infty} \left(1+\frac{2}{n-1}\right)^{\frac{n-1}{2}}$ $\quad \left\lceil \frac{n-1}{2} = u \right.$

$n\to\infty \Rightarrow u\to\infty \rfloor$

$\lim\limits_{n\to\infty} \left(1+\frac{1}{u}\right)^u = e$

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