

Compute

$$\lim_{n \rightarrow \infty} \sum_{i=0}^{n-1} \frac{2}{n} \left(\left(\frac{2i}{n} \right)^2 - 1 \right)$$

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$$\lim_{n \rightarrow \infty} \sum_{i=0}^{n-1} \frac{2}{n} \left(\left(\frac{2i}{n} \right)^2 - 1 \right)$$

$$= \int_0^2 f(x) dx$$

$$= \int_0^2 x^2 - 1 dx$$

$$= \left. \frac{x^3}{3} - x \right|_0^2$$

$$= \frac{8}{3} - 2$$

$$= \frac{2}{3}$$

$$\Delta x = \frac{2}{n} \Rightarrow b-a=2$$

$$f\left(\frac{2i}{n}\right) = \left(\frac{2i}{n}\right)^2 - 1$$

$$\Rightarrow f(x) = x^2 - 1$$