\[
\begin{align*}
\text{\texttt{restart;}} \\
N := 5 : X := 1 : h := \frac{X}{N - 1} : f := 1250 \cdot x + 125 \cdot \Pi \cdot \sin(5 \cdot \Pi \cdot x) : \\
\text{for i from 1 to N do } x[i] := (i - 1) \cdot h \text{ od;} \\
p[1] := \text{piecewise}\left(x[1] \leq x \leq x[3], \frac{(x[2] - x) \cdot (x[3] - x)}{2 \cdot h^2}, 0\right) : \\
\text{plot}(p[1], x = 0..X) : \\
p[2] := \text{piecewise}\left(x[1] \leq x \leq x[3], \frac{(x[3] - x) \cdot (x - x[1])}{h^2}, 0\right) : \\
\text{plot}(p[2], x = 0..X) : \\
p[3] := \text{piecewise}\left(x[1] \leq x \leq x[3], \frac{(x - x[2]) \cdot (x - x[1])}{2 \cdot h^2}, 0\right), x[3] \leq x \leq x[5], \\
\frac{(x[4] - x) \cdot (x[5] - x)}{2 \cdot h^2} : \\
\text{plot}(p[3], x = 0..X) : \\
p[4] := \text{piecewise}\left(x[3] \leq x \leq x[5], \frac{(x[5] - x) \cdot (x - x[3])}{2 \cdot h^2}, 0\right) : \\
\text{plot}(p[4], x = 0..X) : \\
p[5] := \text{piecewise}\left(x[3] \leq x \leq x[5], \frac{(x - x[4]) \cdot (x - x[3])}{2 \cdot h^2}, 0\right) : \\
\text{plot}(p[5], x = 0..X) : \\
\text{uh} := \text{sum}(U[n] \cdot p[n], n = 1..N) : \\
\text{dudx} := \text{diff}(\text{uh}, x) : \\
\text{for i from 1 to N do } v[i] := p[i] \text{ od;} \\
\text{for i from 1 to N do } dvhdx[i] := \text{diff}(v[i], x) \text{ od;} \\
\text{for j from 2 to N - 1 do eq}[j] := \text{int}(\text{dudx} \cdot dvhdx[j], x = 0..1) = \text{int}(f \cdot v[j], x = 0..1) \text{ od;} \\
\text{solve}(\{ \text{eq}[idx] \text{\$idx = 2..N - 1}, \{U[\text{idx}] \text{\$idx = 2..N - 1}\} \}) : \\
\text{assign}(\%) ; \\
\text{uh}; \\
\left( \frac{1015 \pi + 64}{64} \right) \left\{ \begin{array}{lc}
16 \left(\frac{1}{2} - x\right) x & 0 \leq x \text{ and } x \leq \frac{1}{2} \\
0 & \text{otherwise}
\end{array} \right\} + \frac{665}{8} \\
\left\{ \begin{array}{lc}
8 \left(x - \frac{1}{4}\right) x & 0 \leq x \text{ and } x \leq \frac{1}{2} \\
8 \left(\frac{3}{4} - x\right) (1 - x) & \frac{1}{2} \leq x \text{ and } x \leq 1
\end{array} \right\}
\end{align*}
\]

(1)
\[ \frac{(4295 \pi + 192)}{64} \left\{ \begin{array}{ll} 16 (1-x) \left(-\frac{1}{2} + x\right) & \frac{1}{2} \leq x \text{ and } x \leq 1 \\ 0 & \text{otherwise} \end{array} \right\} \]

\[ > \text{plot}(uh, x = 0 .. 1); \]

\[ > uex := \frac{1250}{6} \cdot (x - x^3) + 5 \cdot \sin(5 \cdot \text{Pi} \cdot x); \]

\[ > \text{plot}(\{uex, uh\}, x = 0 .. 1); \]
\[ B := \int \left( (\text{dedx})^2, x = 0..1 \right) : C := \int \left( (\text{duexdx})^2, x = 0..1 \right) : \text{RelativeEe} = \text{evalf} \left( \sqrt{\frac{B}{C}} \right) ; \]

\[ \text{RelativeEe} = 0.2765932709 \]

(2)