Solution 21.1

(a) Analytical solution:

$$\int_{0}^{\pi/2} (6+3\cos x) \, dx = \left[6x + 3\sin x\right]_{0}^{\pi/2} = 6(\pi/2) + 3\sin(\pi/2) - 0 = 12.42478$$

(b) Trapezoidal rule (n = 1):

$$I = (1.570796 - 0)\frac{9 + 6}{2} = 11.78097$$

$$\varepsilon_t = \left| \frac{12.42478 - 11.78097}{12.42478} \right| \times 100\% = 5.182\%$$

(c) Trapezoidal rule (n = 2):

$$I = (1.570796 - 0) \frac{9 + 2(8.12132) + 6}{4} = 12.26896 \quad \varepsilon_t = 1.254\%$$

Trapezoidal rule (n = 4):

$$I = (1.570796 - 0)\frac{9 + 2(8.771639 + 8.12132 + 7.14805) + 6}{8} = 12.38613 \qquad \varepsilon_t = 0.311\%$$

(d) Simpson's 1/3 rule:

$$I = (1.570796 - 0) \frac{9 + 4(8.12132) + 6}{6} = 12.43162 \quad \varepsilon_t = 0.055\%$$

(e) Simpson's rule (n = 4):

$$I = (1.570796 - 0)\frac{9 + 4(8.771639 + 7.14805) + 2(8.12132) + 6}{12} = 12.42518 \qquad \varepsilon_t = 0.0032\%$$

(f) Simpson's 3/8 rule:

$$I = (1.570796 - 0)\frac{9 + 3(8.598076 + 7.5) + 6}{8} = 12.42779 \quad \varepsilon_t = 0.024\%$$

(g) Simpson's rules (n = 5):

$$\begin{split} I = &(0.628319 - 0)\frac{9 + 4(8.85317) + 8.427051}{6} \\ &+ (1.570796 - 0.628319)\frac{8.427051 + 3(7.763356 + 6.927051) + 6}{8} \\ &= 5.533364 + 6.891665 = 12.42503 \qquad \varepsilon_t = 0.002\% \end{split}$$

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