BRAC UNIVERSITY	Marks obtained ↓
Department of Computer Science and Engineering	
CSE330: Numerical Methods **Assignment 4**	
Summer 2026 Section: 12	
Total Marks: **10**	
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Instructions: Show all steps in the spaces provided. Round all values to **4 decimal places**.

Question 1 *[5 marks]*

Consider $f(x) = x^3 + 2$ on $[a, b] = [1, 3]$. Approximate the integral using the **Trapezoidal Rule**:

$$I_1(f) \;=\; \frac{b-a}{2}\left[f(a) + f(b)\right]$$

Step 1. Identify a, b, and evaluate the function at the endpoints.

	x	$f(x) = x^3 + 2$
a	1	3.0000
b	3	29.0000

[1.5 marks]

Step 2. Compute $b - a$:

$b - a \;=$ 2.0000 *[0.5 mark]*

Step 3. Substitute into the Trapezoidal Rule formula:

$$I_1(f) \;=\; \frac{2}{2}\Big[\,3 + 29\,\Big]$$

[1.5 marks]

Step 4. Final approximation:

$I_1(f) \;=$ 32.0000 *[0.5 mark]*

Step 5. Exact value: $I(f) = \displaystyle\int_1^3 (x^3 + 2)\,dx = 24$. Compute the % relative error:

$E_{\%} \;=\; \dfrac{|I(f) - I_1(f)|}{|I(f)|} \times 100 \;=$ 33.3333% *[0.5 mark]*

Question 2 *[5 marks]*

Consider $f(x) = \sqrt{x} + 1$ on $[0, 4]$. Approximate the integral using the **Composite Newton–Cotes formula** $C_{1,4}(f)$ with $m = 4$ segments.

Step 1. Compute the step size $h = \dfrac{b-a}{m}$.

$h \;=$ 1.0000 *[0.5 mark]*

Step 2. Fill in the table of node values.

i	x_i	$f(x_i) = \sqrt{x_i} + 1$
0	0	1.0000
1	1	2.0000
2	2	2.4142
3	3	2.7321
4	4	3.0000

[1.5 marks]

Step 3. Apply the Composite Trapezoidal Rule ($C_{1,m}$):

$$C_{1,4}(f) \;=\; \frac{h}{2}\Big[f(x_0) + 2f(x_1) + 2f(x_2) + 2f(x_3) + f(x_4)\Big]$$

Substituting values:

$$C_{1,4}(f) \;=\; \frac{1}{2}\Big[\,1 + 2(2) + 2(2.4142) + 2(2.7321) + 3\,\Big]$$

[1.5 marks]

Step 4. Final approximation:

$$C_{1,4}(f) \;=\; 9.1463$$

[0.5 mark]

Step 5. Exact value: $I(f) = \displaystyle\int_0^4 (\sqrt{x}+1)\,dx = \frac{28}{3} \approx 9.3333.$ Compute the % relative error:

$$E_{\%} \;=\; \frac{|I(f) - C_{1,4}(f)|}{|I(f)|} \times 100 \;=\; 2.0036\%$$

[0.5 mark]