Yıldız Technical University, Department of Mechatronics Engineering
MKT 3841 - Numerical Methods Gr2 Quiz 1 09.11.2026

Student Number: **ANSWERS**	Name:	Signature

Select and fill in a circle corresponding to your answer to each multiple-choice question:

1. a **b** c d	**2.** a b **c** d	**3.** **a** b c d	**4.** a b c **d**
5. a b c **d**	**6.** a **b** c d	**7.** a b **c** d	**8.** **a** b c d
9. a b **c** d	**10.** a b **c** d		

Multiple-Choice Questions (10 points each):

1. For a data value of 6.0 and a corresponding theoretical value of 5.5, what is the relative error?

A) 0.083 **B) 0.091** C) 0.5 D) 0.92

$\varepsilon_r = \frac{0.5}{5.5} = 0.091$

2. The theoretical data set is (2.0 , 5.0 , 9.0) for an experimental data set (1.8 , 5.4 , 9.6). Considering also the error directions (positive or negative), what is the maximum relative error in this experiment?

A) 0.067 B) 0.080 **C) -0.100** D) 0.6

$\varepsilon_r = \left\{ \frac{-0.2}{2.0}, \frac{0.4}{5.0}, \frac{0.6}{9.0} \right\}$

$\varepsilon_r = \{ -0.1, 0.08, 0.067 \}$

3. The 2nd order Taylor expansion of a function is

$$P_2(x) = \sum_{n=0}^{2} \frac{f^{(n)}(x_0)}{n!} (x - x_0)^n$$

If you approximate $f(x) = e^x$ around $x_0 = 0$, which one will be $P_2(0.6)$?

A) 1.78 B) 3.24 C) 1.18 D) 1.82

$P_2(x) \approx f(x_0) + f'(x_0) \cdot h + f''(x_0) \cdot \frac{h^2}{2}$, $h = x - x_0$

$f(x) = e^x$, $x_0 = 0$, $f'(x) = f''(x) = e^x$

$P_2(x) \approx e^{x_0} + e^{x_0} \cdot h + e^{x_0} \cdot \frac{h^2}{2}$

$P_2(0.6) = e^0 + e^0 \cdot 0.6 + e^0 \cdot \frac{0.6^2}{2} = 1.06 + \frac{0.6^2}{2} = 1.78$

4. Consider the data set below, with a randomized order.

x	7	-6	4
y	21	54	954

Let its interpolated polynomial in Newton form be $P(x) = a_0 + a_1(x - 4) + a_2(x - 4)(x + 6)$. After changing the order of the data set with respect to this polynomial, what will a_0 be?

A) 21 B) 54 C) 343 **D) 954**

5. Consider a linear curve fitting ($y = a + bx$) for the given data set. b=14.5714 is determined. What is a?

x	3	4	8
y	40	70	118

A) -3.7143 B) 11.7143 C) 1.4286 **D) 3.1429**

$\bar{y} = a + b \cdot \bar{x}$

$\bar{y} = a + 14.5714 \cdot \bar{x}$

$\bar{x} = \frac{3+4+8}{3} = 5$

$\bar{y} = \frac{40+70+118}{3} = 76$

$a = 76 - 14.5714 \cdot 5$

$a = 3.1429$

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6. Which one is Secant formula? (Hint: Newton Raphson formula, $x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$.)

$f'(x_i) = \frac{f(x_i) - f(x_{i-1})}{x_i - x_{i-1}}$

A) $x_{i+1} = x_i - \frac{(x_i + x_{i-1})}{f(x_i) + f(x_{i-1})}$

B) $x_{i+1} = x_i - \frac{(x_i - x_{i-1})}{f(x_i) - f(x_{i-1})} f(x_i)$

C) $x_{i+1} = x_i - \frac{(x_i + x_{i-1})}{f(x_i) + f(x_{i-1})} f(x_i)$

D) $x_{i+1} = x_i - \frac{(x_i - x_{i-1})}{f(x_i) - f(x_{i-1})}$

7. For the data set below, what is the approximate integral $I \approx \int_0^6 f(x)$ by using only the Trapezoidal rule?

$h = \Delta x = 2$

$I = \int_0^6 f(x)dx \approx \frac{2}{2} \cdot (1 + 2 \cdot 2 + 2 \cdot 3 + 4)$

$I \approx 15$

x	0	2	4	6
f(x)	1	2	3	4

A) 5 B) 10 **C) 15** D) 20

8. Which of the following conditions is required to apply the composite Simpson's 3/8 rule in its standard form to a data set with unique intervals?

A) The number of intervals must be a multiple of three.

B) The number of intervals must be even.

C) The number of intervals must be a power of two.

D) The number of intervals must be odd.

9. The position of a moving object is available at discrete time intervals. Which numerical method can be used to estimate the object's instantaneous velocity at a particular time?

A) Trapezoidal integration only.

B) Simpson's 1/3 integration rule only.

C) A finite difference approximation to *ds/dt*.

D) Gaussian quadrature only.

10. For the position data set of an autonomous vehicle, what is the acceleration at $t = 4\ s$?

t (seconds)	0	2	4	6
x (meters)	3	5	6	15

(Select the correct formula from the correct table.)

	$f(x-2h)$	$f(x-h)$	$f(x)$	$f(x+h)$	$f(x+2h)$
$2hf'(x)$		−1	0	1	
$h^2 f''(x)$		1	−2	1	
$2h^3 f'''(x)$	−1	2	0	−2	1
$h^4 f^{(4)}(x)$	1	−4	6	−4	1

Coefficients of central finite difference approximations of $\mathcal{O}(h^2)$

	$f(x)$	$f(x+h)$	$f(x+2h)$	$f(x+3h)$	$f(x+4h)$	$f(x+5h)$
$2hf'(x)$	−3	4	−1			
$h^2 f''(x)$	2	−5	4	−1		
$2h^3 f'''(x)$	−5	18	−24	14	−3	
$h^4 f^{(4)}(x)$	3	−14	26	−24	11	−2

Coefficients of forward finite difference approximations of $\mathcal{O}(h^2)$

	$f(x-5h)$	$f(x-4h)$	$f(x-3h)$	$f(x-2h)$	$f(x-h)$	$f(x)$
$2hf'(x)$				1	−4	3
$h^2 f''(x)$			−1	4	−5	2
$2h^3 f'''(x)$		3	−14	24	−18	5
$h^4 f^{(4)}(x)$	−2	11	−24	26	−14	3

Coefficients of backward finite difference approximations of $\mathcal{O}(h^2)$

A) -0.25 m/s^2 B) 1.25 m/s^2 **C) 2 m/s^2** D) 4 m/s^2

First central Appr.

$h^2 f''(x) = f(x-h) - 2 \cdot f(x) + f(x+h)$ $\quad h = 2$

$f''(4) = \frac{5 - 2 \cdot 6 + 15}{2^2} = \frac{8}{4} = 2\ m/s^2$

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