

Multiple-Choice Test

Chapter 02.03

Differentiation of Discrete Functions

1. The definition of the first derivative of a function $f(x)$ is

(A) $f'(x) = \frac{f(x + \Delta x) + f(x)}{\Delta x}$

(B) $f'(x) = \frac{f(x + \Delta x) - f(x)}{\Delta x}$

(C) $f'(x) = \lim_{\Delta x \rightarrow 0} \frac{f(x + \Delta x) + f(x)}{\Delta x}$

(D) $f'(x) = \lim_{\Delta x \rightarrow 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$

2. Using the forward divided difference approximation with a step size of 0.2, the derivative of the function at $x = 2$ is given as

x	1.8	2.0	2.2	2.4	2.6
$f(x)$	6.0496	7.3890	9.0250	11.023	13.464

- (A) 6.697
(B) 7.389
(C) 7.438
(D) 8.180
3. A student finds the numerical value of $f'(x) = 20.220$ at $x = 3$ using a step size of 0.2. Which of the following methods did the student use to conduct the differentiation if $f(x)$ is given in the table below?

x	2.6	2.8	3.0	3.2	3.4	3.6
$f(x)$	$e^{2.6}$	$e^{2.8}$	e^3	$e^{3.2}$	$e^{3.4}$	$e^{3.6}$

- (A) Backward divided difference
(B) Calculus, that is, exact
(C) Central divided difference
(D) Forward divided difference

4. The upward velocity of a body is given as a function of time as

t, s	10	15	20	22
$v, m/s$	22	36	57	10

To find the acceleration at $t = 17 s$, a scientist finds a second order polynomial approximation for the velocity, and then differentiates it to find the acceleration. The estimate of the acceleration in m/s^2 at $t = 17 s$ is most nearly

- (A) 4.060
 (B) 4.200
 (C) 8.157
 (D) 8.498
5. The velocity of a rocket is given as a function of time as

t, s	0	0.5	1.2	1.5	1.8
$v, m/s$	0	213	223	275	300

Allowed to use the forward divided difference, backward divided difference or central divided difference approximation of the first derivative, your best estimate for the

acceleration $\left(a = \frac{dv}{dt}\right)$ of the rocket in m/s^2 at $t = 1.5$ seconds is

- (A) 83.33
 (B) 128.33
 (C) 173.33
 (D) 183.33
6. In a circuit with an inductor of inductance L , a resistor with resistance R , and a variable voltage source $E(t)$,

$$E(t) = L \frac{di}{dt} + Ri$$

The current, i , is measured at several values of time as

Time, t (secs)	1.00	1.01	1.03	1.1
Current, i (amperes)	3.10	3.12	3.18	3.24

If $L = 0.98$ henries and $R = 0.142$ ohms, the most accurate expression for $E(1.00)$ is

- (A) $0.98 \left(\frac{3.24 - 3.10}{0.1} \right) + (0.142)(3.10)$
 (B) 0.142×3.10
 (C) $0.98 \left(\frac{3.12 - 3.10}{0.01} \right) + (0.142)(3.10)$
 (D) $0.98 \left(\frac{3.12 - 3.10}{0.01} \right)$

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