Multiple-Choice Test

Chapter 03.04
Newton-Raphson Method

1. The Newton-Raphson method of finding roots of nonlinear equations falls under the category of _____________ methods.
   (A) bracketing
   (B) open
   (C) random
   (D) graphical

2. The Newton-Raphson method formula for finding the square root of a real number \( R \) from the equation \( x^2 - R = 0 \) is,
   (A) \( x_{i+1} = \frac{x_i}{2} \)
   (B) \( x_{i+1} = \frac{3x_i}{2} \)
   (C) \( x_{i+1} = \frac{1}{2} \left( x_i + \frac{R}{x_i} \right) \)
   (D) \( x_{i+1} = \frac{1}{2} \left( 3x_i - \frac{R}{x_i} \right) \)

3. The next iterative value of the root of \( x^2 - 4 = 0 \) using the Newton-Raphson method, if the initial guess is 3, is
   (A) 1.5
   (B) 2.067
   (C) 2.167
   (D) 3.000

4. The root of the equation \( f(x) = 0 \) is found by using the Newton-Raphson method. The initial estimate of the root is \( x_0 = 3 \), \( f(3) = 5 \). The angle the line tangent to the function \( f(x) \) makes at \( x = 3 \) is 57° with respect to the \( x \)-axis. The next estimate of the root, \( x_i \), most nearly is
   (A) -3.2470
   (B) -0.2470
   (C) 3.2470
   (D) 6.2470
5. The root of \( x^3 = 4 \) is found by using the Newton-Raphson method. The successive iterative values of the root are given in the table below.

<table>
<thead>
<tr>
<th>Iteration Number</th>
<th>Value of Root</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2.0000</td>
</tr>
<tr>
<td>1</td>
<td>1.6667</td>
</tr>
<tr>
<td>2</td>
<td>1.5911</td>
</tr>
<tr>
<td>3</td>
<td>1.5874</td>
</tr>
<tr>
<td>4</td>
<td>1.5874</td>
</tr>
</tbody>
</table>

The iteration number at which I would first trust at least two significant digits in the answer is

(A) 1
(B) 2
(C) 3
(D) 4

6. The ideal gas law is given by

\[ p v = R T \]

where \( p \) is the pressure, \( v \) is the specific volume, \( R \) is the universal gas constant, and \( T \) is the absolute temperature. This equation is only accurate for a limited range of pressure and temperature. Vander Waals came up with an equation that was accurate for larger ranges of pressure and temperature given by

\[ \left( p + \frac{a}{v^2} \right) (v - b) = RT \]

where \( a \) and \( b \) are empirical constants dependent on a particular gas. Given the value of \( R = 0.08, \ a = 3.592, \ b = 0.04267, \ p = 10 \) and \( T = 300 \) (assume all units are consistent), one is going to find the specific volume, \( v \), for the above values. Without finding the solution from the Vander Waals equation, what would be a good initial guess for \( v \)?

(A) 0
(B) 1.2
(C) 2.4
(D) 3.6

For a complete solution, refer to the links at the end of the book.