Multiple-Choice Test – Bisection Method
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1. The bisection method of finding roots of nonlinear equations falls under the category of a (an) _________ method.
   (A) open
   (B) bracketing
   (C) random
   (D) graphical

2. If $f(x)$ is a real continuous function in $[a,b]$, and $f(a)f(b)<0$, then for $f(x)=0$, there is (are) ____________ in the domain $[a,b]$.
   (A) one root
   (B) an undeterminable number of roots
   (C) no root
   (D) at least one root

3. Assuming an initial bracket of $[1,5]$, the second (at the end of 2 iterations) iterative value of the root of $te^{-t}-0.3=0$ using the bisection method is
   (A) 0
   (B) 1.5
   (C) 2
   (D) 3

4. To find the root of $f(x)=0$, a scientist is using the bisection method. At the beginning of an iteration, the lower and upper guesses of the root are x_l and x_u. At the end of the iteration, the absolute relative approximate error in the estimated value of the root would be
   (A) $\left|\frac{x_u}{x_u+x_\ell}\right|$
   (B) $\left|\frac{x_\ell}{x_u+x_\ell}\right|$
   (C) $\left|\frac{x_u-x_\ell}{x_u+x_\ell}\right|$
   (D) $\left|\frac{x_u+x_\ell}{x_u-x_\ell}\right|$

5. For an equation like $x^2 = 0$, a root exists at $x = 0$. The bisection method cannot be adopted to solve this equation in spite of the root existing at $x = 0$ because the function $f(x) = x^2$

   (A) is a polynomial
   (B) has repeated roots at $x = 0$
   (C) is always non-negative
   (D) has a slope equal to zero at $x = 0$

6. The ideal gas law is given by

$$pv = RT$$

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