Multiple-Choice Test

Chapter 08.02
Euler's Method

1. To solve the ordinary differential equation

$$3\frac{dy}{dx}+5y^2=\sin x,\; y(0)=5$$

by Euler's method, you need to rewrite the equation as

(A) $\frac{dy}{dx}=\sin x-5y^2,\; y(0)=5$

(B) $\frac{dy}{dx}=\frac{1}{3}\left(\sin x-5y^2\right),\; y(0)=5$

(C) $\frac{dy}{dx}=\frac{1}{3}\left(-\cos x-\frac{5y^3}{3}\right),\; y(0)=5$

(D) $\frac{dy}{dx}=\frac{1}{3}\sin x,\; y(0)=5$

2. Given

$$3\frac{dy}{dx}+5y^2=\sin x,\; y(0.3)=5$$

and using a step size of $h=0.3$, the value of $y(0.9)$ using Euler's method is most nearly

(A) -35.318
(B) -36.458
(C) -658.91
(D) -669.05

3. Given

$$3\frac{dy}{dx}+\sqrt{y}=e^{0.1x},\; y(0.3)=5$$

and using a step size of $h=0.3$, the best estimate of $\frac{dy}{dx}(0.9)$ using Euler's method is most nearly

(A) -0.37319
(B) -0.36288
(C) -0.35381
(D) -0.34341

4. The velocity (m/s) of a body is given as a function of time (seconds) by

$$v(t) = 200\ln(1+t) - t,\ t \geq 0$$

Using Euler's method with a step size of 5 seconds, the distance in meters traveled by the body from $t = 2$ to $t = 12$ seconds is most nearly

(A) 3133.1
(B) 3939.7
(C) 5638.0
(D) 39397

5. Euler's method can be derived by using the first two terms of the Taylor series of writing the value of y_{i+1}, that is the value of y at x_{i+1}, in terms of y_i and all the derivatives of y at x_i. If $h = x_{i+1} - x_i$, the explicit expression for y_{i+1} if the first three terms of the Taylor series are chosen for the ordinary differential equation

$$2\frac{dy}{dx} + 3y = e^{-5x}, y(0) = 7$$

would be

(A) $y_{i+1} = y_i + \frac{1}{2}\left(e^{-5x_i} - 3y_i\right)h$

(B) $y_{i+1} = y_i + \frac{1}{2}\left(e^{-5x_i} - 3y_i\right)h - \frac{1}{2}\left(\frac{5}{2}e^{-5x_i}\right)h^2$

(C) $y_{i+1} = y_i + \frac{1}{2}\left(e^{-5x_i} - 3y_i\right)h + \frac{1}{2}\left(-\frac{13}{4}e^{-5x_i} + \frac{9}{4}y_i\right)h^2$

(D) $y_{i+1} = y_i + \frac{1}{2}\left(e^{-5x_i} - 3y_i\right)h - \frac{3}{2}y_i h^2$

6. A homicide victim is found at 6:00 PM in an office building that is maintained at 72 $^{\circ}\mathrm{F}$. When the victim was found, his body temperature was at 85 $^{\circ}\mathrm{F}$. Three hours later at 9:00 PM, his body temperature was recorded at 78 $^{\circ}\mathrm{F}$. Assume the temperature of the body at the time of death is the normal human body temperature of 98.6 $^{\circ}\mathrm{F}$.

The governing equation for the temperature θ of the body is

$$\frac{d\theta}{dt} = -k(\theta - \theta_a)$$

where,

θ = temperature of the body, $^{\circ}\mathrm{F}$

θ_a = ambient temperature, $^{\circ}\mathrm{F}$

t = time, hours

k = constant based on thermal properties of the body and air.

The estimated time of death most nearly is

(A) 2:11 PM
(B) 3:13 PM
(C) 4:34 PM
(D) 5:12 PM

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