Holistic Numerical Methods Institute
committed to bringing numerical methods to undergraduates

Multiple-Choice Test
Euler's Method
Ordinary Differential Equations

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 traveled by the body from $t = 2$ to $t = 12$ seconds is estimated most nearly as

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

5. Euler's method can be derived from using first two terms of 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) $y_{i+1} = y_i + \frac{1}{2}\left(e^{-5x_i} - 3y_i\right)h - \left(\frac{5}{2}e^{-5x_i}\right)\frac{h^2}{2}$

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

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

6. A homicide victim is found at 6:00PM in an office building that is maintained at 72˚F. When the victim was found, his body temperature was at 85 ˚F. Three hours later at 9:00PM, his body temperature was recorded at 78˚F. Assume the temperature of the body at the time of death is your typical normal temperature of 98.6˚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, ˚F
θ_a = ambient temperature, ˚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