Multiple-Choice Test

Chapter 08.01
Background

1. The differential equation $2\frac{dy}{dx}+x^2y=2x+3,\ y(0)=5$ is
   (A) linear
   (B) nonlinear
   (C) linear with fixed constants
   (D) undeterminable to be linear or nonlinear

2. A differential equation is considered to be ordinary if it has
   (A) one dependent variable
   (B) more than one dependent variable
   (C) one independent variable
   (D) more than one independent variable

3. Given

$$2\frac{dy}{dx}+3y=\sin 2x,\ y(0)=6$$

   $y(2)$ most nearly is
   (A) 0.17643
   (B) 0.29872
   (C) 0.32046
   (D) 0.58024

4. The form of the exact solution to

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

   is
   (A) $Ae^{-1.5x}+Be^{-x}$
   (B) $Ae^{-1.5x}+Bxe^{-x}$
   (C) $Ae^{1.5x}+Be^{-x}$
   (D) $Ae^{1.5x}+Bxe^{-x}$

5. The following nonlinear differential equation can be solved exactly by separation of variables.

$$\frac{d\theta}{dt} = -10^{-6}\left(\theta^2 - 81\right),\ \theta(0) = 1000$$

The value of $\theta(100)$ most nearly is

(A) -99.99
(B) 909.10
(C) 1000.32
(D) 1111.10

6. A solid spherical ball taken out of a furnace at 1200 K is allowed to cool in air. Given the following,

radius of the ball $= 2$ cm
density of the ball $= 7800\ \text{kg/m}^3$
specific heat of the ball $= 420\ \text{J/kg}\cdot\text{K}$
emmittance $= 0.85$
Stefan-Boltzman constant $= 5.67\times 10^{-8}\ \text{J/s}\cdot\text{m}^2\cdot\text{K}^4$
ambient temperature $= 300\ \text{K}$
convection coefficient to air $= 350\ \text{J/s}\cdot\text{m}^2\cdot\text{K}$

the differential equation governing the temperature θ of the ball as a function of time t is given by

(A) $\frac{d\theta}{dt} = -2.2067\times 10^{-12}\left(\theta^4 - 81\times 10^8\right)$
(B) $\frac{d\theta}{dt} = -1.6026\times 10^{-2}(\theta - 300)$
(C) $\frac{d\theta}{dt} = 2.2067\times 10^{-12}\left(\theta^4 - 81\times 10^8\right) + 1.6026\times 10^{-12}(\theta - 300)$
(D) $\frac{d\theta}{dt} = -2.2067\times 10^{-12}\left(\theta^4 - 81\times 10^8\right) - 1.6026\times 10^{-2}(\theta - 300)$

Complete Solution