Mathematics for Chemistry: Assignment 5

June 15, 2017

1. The differential equation below

$$\frac{\mathrm{d}y}{\mathrm{d}x} = xy + y^2$$

is an example of a
a) homogeneous linear ODE
b) homogeneous nonlinear ODE
c) nonhomogeneous linear ODE
d) nonhomogeneous nonlinear ODE

Answer (d)

2. The differential equation below

$$y' + y = 3\tan xe^x$$

is an example of a
a) homogeneous linear ODE
b) homogeneous nonlinear ODE
c) nonhomogeneous linear ODE
d) nonhomogeneous nonlinear ODE

Answer (c)

3. Consider a reaction kinetics scheme that involves concentrations c_A,c_B and c_P changing with time t as given below

$$\frac{\mathrm{d}c_A}{\mathrm{d}t} = -k_1c_A + k_2c_B$$

$$\frac{\mathrm{d}c_B}{\mathrm{d}t} = k_1c_A - k_2c_B - k_3c_B$$

$$\frac{\mathrm{d}c_P}{\mathrm{d}t} = k_3c_B$$

The above system of equations is an example of a system of
a) homogeneous linear ODEs
b) homogeneous nonlinear ODEs
c) nonhomogeneous linear ODEs
d) nonhomogeneous nonlinear ODEs

Answer (a)

4. Consider a reaction kinetics scheme that involves concentrations c_A,c_B,c_D and c_P changing with time t as given below

$$\frac{\mathrm{d}c_A}{\mathrm{d}t} = -k_1c_A + k_2c_Bc_D$$

$$\frac{\mathrm{d}c_B}{\mathrm{d}t} = k_1c_A - k_2c_Bc_D - k_3c_B$$

$$\frac{\mathrm{d}c_D}{\mathrm{d}t} = k_1c_A - k_2c_Bc_D$$

$$\frac{\mathrm{d}c_P}{\mathrm{d}t} = k_3 c_B$$

The above system of equations is an example of a system of
a) homogeneous linear ODEs
b) homogeneous nonlinear ODEs
c) nonhomogeneous linear ODEs
d) nonhomogeneous nonlinear ODEs

Answer (a)

5. The number of arbitrary constants in the general solution of a 3rd Order ODE and the particular solution of a 1st order ODE are, respectively,
a) 0 and 0 b) 3 and 0 c) 3 and 1 d) 0 and 1

Answer (b)

6. The solution of the first order ODE $y' + 3xy = 0$ subject to the boundary condition $y(0) = 1$ is
(a) $y = 1 + xe^{-3x}$ (b)$y = e^{-3x}$ (c) $y = e^{-3x^2/2}$ (d) $y = 1 + xe^{-3x^2/2}$

Answer (c)

7. For the differential equation $(3x^2 + y)dx + (-4xy + x)dy = 0$, which is the correct statement regarding the integrating factor ?

   (a) The differential is exact and there is no need for an integrating factor.
   (b) We can find an integrating factor that depends only on x.
   (c) We can find an integrating factor that depends only on y.
   (d) It is not possible to find an integrating factor that depends only on x or only on y.

Answer (d)

8. The differential equation $(2y + 3x)dx + (2x + y)dy = 0$ is solved by (where c is an arbitrary constant)

   (a) $y^2 + x^2 = c$
   (b) $y^2 + 3x^2 = c$
   (c) $y^2 + 3x^2 + 4x = c$
   (d) $y^2 + 3x^2 + 4xy = c$

Answer (d)

9. The equation $y' + y = \sin x$ has a general solution of the form (where A is an arbitrary constant)

   (a) $y = Ae^{-x} + \frac{1}{2}\cos x$
   (b) $y = Ae^{-x} - \frac{1}{2}\sin x$
   (c) $y = Ae^{-x} + \frac{1}{2}(\sin x - \cos x)$
   (d) $y = Ae^{-x} + \sin x - \cos x$

Answer (c)

10. The differential equation $y' + 2y = 3e^{-2x}$ has a general solution of the form (where A is an arbitrary constant)

    (a) $y = Ae^{-2x} + 3xe^{-2x}$
    (b) $y = Ae^{-2x} - 3e^{-2x}$
    (c) $y = Ae^{-2x} + e^{-x}$
    (d) $y = Ae^{-2x} + (3/2)e^{-x}$

Answer (a)