

# MathQuest: Differential Equations

## Separation of Variables

1. Which of the following DE's is/are separable?

- (a)  $dy/dx = xy$
- (b)  $dy/dx = x + y$
- (c)  $dy/dx = \cos(xy)$
- (d) Both (a) and (b)
- (e) Both (a) and (c)
- (f) All of the above

2. Which of the following differential equations is not separable?

- (a)  $y' = 3 \sin x \cos y$
- (b)  $y' = x^2 + 3y$
- (c)  $y' = e^{2x+y}$
- (d)  $y' = 4x + 7$
- (e) More than one of the above

3. Which of the following differential equations is not separable?

- (a)  $\frac{dx}{dt} = xt^2 - 4x$
- (b)  $\frac{dx}{dt} = 3x^2t^3$
- (c)  $\frac{dx}{dt} = \sin(2xt)$
- (d)  $\frac{dx}{dt} = t^4 \ln(5x)$

4. Which of the following differential equations is separable?

- (a)  $uu' = 2x + u$
- (b)  $3ux = \sin(u')$
- (c)  $\frac{2x^3}{5u'+u} = 1$
- (d)  $e^{2u'x^2} = e^{u^3}$

5. If we separate the variables in the differential equation  $3z't = z^2$ , what do we get?

- (a)  $3z^{-2}dz = t^{-1}dt$
- (b)  $3tdt = z^2dt$
- (c)  $3z'tdz = z^2dt$
- (d)  $z = \sqrt{3z't}$
- (e) This equation cannot be separated.

6. If we separate the variables in the differential equation  $y' = 2y + 3$ , what do we get?

- (a)  $\frac{dy}{2y} = 3dx$
- (b)  $dy = 2y = 3dx$
- (c)  $\frac{dy}{y} = 5dx$
- (d)  $\frac{dy}{2y+3} = dx$
- (e) This equation cannot be separated.

7. What is the solution to the differential equation:  $\frac{dy}{dx} = 2xy$ .

- (a)  $y = e^{x^2} + C$
- (b)  $y = Ce^{x^2}$
- (c)  $y = e^{2x} + C$
- (d)  $y = Ce^{2x}$

8. The general solution to the equation  $dy/dt = ty$  is

- (a)  $y = t^2/2 + C$
- (b)  $y = \sqrt{t^2 + C}$
- (c)  $y = e^{t^2/2} + C$
- (d)  $y = Ce^{t^2/2}$
- (e) Trick question, equation is not separable

9. The general solution to the equation  $\frac{dR}{dy} + R = 1$  is

- (a)  $R = 1 - \sqrt{\frac{1}{C-y}}$
- (b)  $R = 1 - Ce^y$
- (c)  $R = 1 - Ce^{-y}$

(d) Trick question, equation is not separable

10. A plant grows at a rate that is proportional to the square root of its height  $h(t)$  – use  $k$  as the constant of proportionality. If we separate the variables in the differential equation for its growth, what do we get?

(a)  $kh^{1/2}dt = dh$

(b)  $\sqrt{hdh} = kdt$

(c)  $h^{1/2}dh = kdt$

(d)  $h^{-1/2}dh = kdt$

(e) None of the above