1. If $a > 0$ and $b > 0$, the autonomous differential equation $\frac{dP}{dt} = P(a - bP)$ has a solution that is

   Select the correct answer.

   (a) increasing everywhere
   (b) decreasing everywhere
   (c) increasing if $0 < P < a/b$
   (d) decreasing if $0 < P < a/b$
   (e) increasing if $P > a/b$

2. The autonomous differential equation $\frac{dx}{dt} = x(x - 1)(x + 1)$ has a solution that is

   Select the correct answer.

   (a) increasing everywhere
   (b) decreasing everywhere
   (c) increasing if $0 < x < 1$
   (d) decreasing if $-1 < x < 0$
   (e) increasing if $x > 1$

3. In the autonomous differential equation $\frac{dx}{dt} = x(1 - x)$, the critical point

   Select the correct answer.

   (a) $x = 0$ is an attractor
   (b) $x = 0$ is semistable
   (c) $x = 1$ is an attractor
   (d) $x = 1$ is a repeller
   (e) $x = 1$ is semistable

4. The differential equation $(x^2 + y^2)y' = xy$ is

   Select the correct answer.

   (a) linear
   (b) homogeneous
   (c) separable
   (d) exact
   (e) Bernoulli

5. The differential equation $y' = xe^y/y$ is

   Select the correct answer.

   (a) linear
   (b) homogeneous
   (c) separable
   (d) exact
   (e) Bernoulli

6. The differential equation $xy' = 2y + \sin x$ is

   Select the correct answer.

   (a) linear
   (b) homogeneous
   (c) separable
   (d) exact
   (e) Bernoulli

7. The solution of the differential equation $y' = xy$ is

   Select the correct answer.

   (a) $y = ce^x$
   (b) $y = ce^{x^2}$
   (c) $y = c + e^x$
   (d) $y = ce^{x^2/2}$
   (e) $y = c + e^{x^2/2}$

8. The solution of the differential equation $y' - y = x$ is

   Select the correct answer.

   (a) $y = x - 1 + ce^{-x}$
   (b) $y = x^2/2 + e^x$
   (c) $y = x^2/2 + e^{-x}$
   (d) $y = x - 1 + ce^x$
   (e) $y = -x - 1 + ce^x$

9. An integrating factor for the linear differential equation $xy' + y = x$ is
   Select the correct answer.

   (a) 0
   (b) 1
   (c) x
   (d) $1/x$
   (e) e^x

10. An integrating factor for the linear differential equation $y' - y/x = x$ is
    Select the correct answer.

    (a) x
    (b) x^2
    (c) $1/x$
    (d) $1/x^2$
    (e) e^{-x}

11. The differential equation $2xydx + (x^2 + 1)dy = 0$ is
    Select the correct answer.

    (a) exact with solution $x^2y + y + c$
    (b) exact with solution $x^2y + y = c$
    (c) exact with solution $2xy + y + c$
    (d) exact with solution $2xy + y = c$
    (e) not exact

12. The differential equation $xydx + (x^2 + y^2)dy = 0$ is
    Select the correct answer.

    (a) exact with solution $x^2y/2 + y^3/3 = c$
    (b) exact with solution $x^2y/2 + y^2/2 = c$
    (c) exact with solution $x^2y/2 + y^3/3 + c$
    (d) not exact but having an integrating factor x
    (e) not exact but having an integrating factor y

13. The differential equation $(x + 2y)dx + ydy = 0$ can be solved using the substitution
Select the correct answer.

(a) $u = x + 2y$
(b) $u = y$
(c) $u = xy$
(d) $u = y/x$
(e) it cannot be solved using a substitution

14. The solution of $(x + 2y)dx + ydy = 0$ is
Select the correct answer.

(a) $\ln x + \ln(y + x) = c$
(b) $\ln((y + x)/x) = c$
(c) $\ln(y + x) + x/(y + x) = c$
(d) $\ln(y + x) + x/(y + x) + c$
(e) it cannot be solved

15. The differential equation $y' - y/x = y^2$ can be solved using the substitution
Select the correct answer.

(a) $u = y$
(b) $u = y^2$
(c) $u = y^3$
(d) $u = y^{-1}$
(e) $u = y^{-2}$

16. The solution of the differential equation $y' - y/x = y^2$ is
Select the correct answer.

(a) $y = c/x - x/2$
(b) $y = 1/(c/x - x/2)$
(c) $y = (cx - x \ln x)$
(d) $y = 1/(cx - x \ln x)$
(e) $y = 1 + ce^x$

17. The differential equation $y' = (4x + 2y + 3)^2$ has the solution
Select the correct answer.

(a) $y = -(4x + 3)^3/12 + c$
(b) $y = (4x + 2y + 3)^3/12 + c$
(c) $y = (4x + 2y + 3)^3/3 + c$
(d) $y = \sqrt{2}\tan(2\sqrt{2}x + c)$
(e) $4x + 2y + 3 = \sqrt{2}\tan(2\sqrt{2}x + c)$

18. The differential equation $y' = \sqrt{x + y + 1} - 1$ has the solution
Select the correct answer.

(a) $y = ((x + c)/2)^2$
(b) $y = 2(x + y + 1)^{3/2}/3 + c$
(c) $x + y + 1 = ((x + c)/2)^2$
(d) $y = 2(x + y + 1)^{3/2}/3 - x + c$
(e) $x + y = ((x + c)/2)^2$

19. Solve the problem $y' = (x + 1)y$, $y(0) = 1$ numerically for $y(0.2)$ using $h = 0.1$.
Select the correct answer.

(a) 1.1
(b) 1.11
(c) 1.2
(d) 1.21
(e) 1.221

20. Solve the problem $y' = x^2y^2$, $y(0) = 1$ numerically for $y(0.2)$ using $h = 0.1$
Select the correct answer.

(a) 1.0
(b) 1.001
(c) 1.01
(d) 1.02
(e) 1.002