1. Assume that $a > 0$, $b > 0$. 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 $-a/b < P < 0$
   (d) decreasing if $-a/b < P < 0$
   (e) decreasing if $P < -a/b$

2. The autonomous differential equation $\frac{dx}{dt} = x^2(x - 4)$ has a solution that is

   Select the correct answer.

   (a) increasing everywhere
   (b) decreasing everywhere
   (c) increasing if $0 < x < 4$
   (d) decreasing if $x > 4$
   (e) increasing if $x > 4$

3. In the autonomous differential equation $\frac{dx}{dt} = x^2(1 - x)$, the critical point

   Select the correct answer.

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

4. The differential equation $2xydx + (x^2 + y^3)dy = 0$ is

   Select the correct answer.

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

5. The differential equation $y' + y = xy^2$ is

   Select the correct answer.

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

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

   Select the correct answer.

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

7. The solution of the differential equation $y' = x^2y$ is

   Select the correct answer.

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

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

11. The differential equation $(y^3 + 6xy^4)dx + (3xy^2 + 12x^2y^3)dy = 0$ is
Select the correct answer.

   (a) exact with solution $y^4/4 + 6xy^5/5 + 3x^2y^2/2 + 4x^3y^3 + c$
   (b) exact with solution $y^4/4 + 6xy^5/5 + 3x^2y^2/2 + 4x^3y^3 = c$
   (c) exact with solution $xy^3 + 3x^2y^4 = c$
   (d) exact with solution $xy^3 + 3x^2y^4 + c$
   (e) not exact

12. The differential equation $(-xy\sin x + 2y\cos x)dx + 2x\cos x dy = 0$ is
Select the correct answer.

   (a) exact with solution $-xy\cos x + y\sin x + 2xy\cos x = c$
   (b) exact with solution $-xy\cos x + y\sin x + 2xy\cos x + c$
   (c) exact with solution $-2xy\cos x + y\sin x + 2xy\cos x = c$
   (d) not exact but having an integrating factor xy
   (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) $u=xy$
(b) $u=y/x$
(c) $u=x-2y$
(d) $u=y$
(e) it cannot be solved using a substitution

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

(a) $\ln(y-x)-x/(y-x)=c$
(b) $\ln(y-x)-x/(y-x)+c$
(c) $\ln x+\ln(y-x)=c$
(d) $\ln((y-x)/x)=c$
(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 $y' = (2x + 4y + 5)^2$ has the solution
Select the correct answer.

(a) $y = -(2x + 3)^3/6 + c$
(b) $y = (2x + 4y + 5)^3/6 + c$
(c) $y = (2x + 4y + 5)^3/3 + c$
(d) $y = \tan(2\sqrt{2}x + c)/\sqrt{2}$
(e) $2x + 4y + 5 = \tan(2\sqrt{2}x + c)/\sqrt{2}$

18. The differential equation $y' = \sqrt{2x - y + 1} + 2$ has the solution
Select the correct answer.

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

19. Solve the problem $y' = xy$, $y(1) = 2$ numerically for $y(1.2)$ using $h = 0.1$.
Select the correct answer.

(a) 2.1
(b) 2.442
(c) 2.242
(d) 2.421
(e) 2.4

20. Solve the problem $y' = xy^2$, $y(1) = 1$ numerically for $y(1.2)$ using $h = 0.1$.
Select the correct answer.

(a) 1.1
(b) 1.121
(c) 1.2331
(d) 1.23
(e) 1.221