

Aktosun, Fall 2026, Math 3319, Exam 1

Questions 1-15: True/False. Questions 16-30: Multiple-Choice.

1. The function $y = 0$ is always a solution to a linear nonhomogeneous ODE. **FALSE**
2. The ODE $\frac{dy}{dx} = e^{x+y+5}$ is separable. **TRUE**
3. If $y(x)$ is a solution to a seventh-order ODE and contains seven arbitrary constants, then it must be the general solution to that ODE. **TRUE**
4. The order of the ODE $\left(\frac{d^3y}{dx^3}\right)^2 + xy^4 = 5y^6$ is equal to six. **FALSE**
5. The ODE $y' = \frac{(2x+3y)^2}{x^2 - 7xy + 4y^2}$ is a first-order homogeneous equation. **TRUE**
6. The ODE $P(x, y) dx + Q(x, y) dy = 0$ is exact if and only if $\frac{\partial P(x, y)}{\partial y} = \frac{\partial Q(x, y)}{\partial x}$. **TRUE**
7. For any fifth-order linear ODE, a constant multiple of any solution is also a solution. **FALSE**
8. The zero function is always a solution to a third-order linear homogeneous ODE. **TRUE**
9. The ODE $3x^{-5} \frac{d^5y}{dx^5} + 13y = 0$ is a Cauchy-Euler equation and has one solution of the form $y = x^r$ for some constant r . **FALSE**
10. The function $e^{2 \cos x}$ is an integrating factor for the ODE $y' + 2(\sin x)y = x \cos x$. **FALSE**
11. $\left(\frac{y}{z}\right)' = \frac{y'z - yz'}{z^2}$ is a differential equation rather than a differential identity. **FALSE**
12. The ODE $\frac{dy}{dx} = \frac{x}{y} \sin\left(\frac{y}{x}\right)$ is a first-order homogeneous equation. **TRUE**
13. The ODE $\frac{dy}{dx} + 13\sqrt{x}y = 5 \frac{\sqrt{x}}{y}$ is a Bernoulli differential equation. **TRUE**
14. The ODE $\frac{dy}{dx} = \frac{-6x^2y + 15y^3}{xy^2 + 3x^3}$ can be transformed into a separable ODE in x and z by using the substitution $y = xz$. **TRUE**

15. The cooling of an object of temperature T in a medium of constant temperature T_m is modeled by the first-order ODE $\frac{dT}{dt} = k(T - T_m)^2$, where k is a positive constant. **FALSE**

16. The general solution to $e^{x+y} dy - e^{2x} dx = 0$ has the form

- (a) $y = \ln |c + e^{-x}|$ (b) $y = \ln |c + e^x|$ (c) $y = -\ln |c + e^{-x}|$
(d) $y = -\ln |c + e^x|$

17. Which of the following is not a linear ODE?

- (a) $e^x \frac{d^2 y}{dx^2} = (\sin x) y$ (b) $\frac{d^2 y}{dx^2} - \frac{y}{x} = \sin x$ (c) $\frac{x}{e^x} \frac{d^2 y}{dx^2} - \frac{\sin x}{x} = y$
(d) $\frac{d^2 y}{dx^2} = (\sin y) x$

18. The general solution to $y' - y = e^{2x}$ has the form

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

19. The general solution to $y' = y^4$ has the form

- (a) $y = \sqrt[3]{3x + c}$ (b) $y = -\sqrt[3]{3x + c}$ (c) $y = \frac{1}{\sqrt[3]{3x + c}}$ (d) $y = \frac{-1}{\sqrt[3]{3x + c}}$

20. An integrating factor for $y' - \frac{1}{4x^2} y = e^x$ is given by

- (a) $e^{x/4}$ (b) $e^{-x/4}$ (c) $e^{1/(4x)}$ (d) $e^{-1/(4x)}$

21. Which of the following is not an exact ODE?

- (a) $2(x+y) dx + 2x dy = 0$ (b) $4y dx + 4x dy = 0$ (c) $y^3 dx + (3xy^2 + e^y) dy = 0$
(d) $e^{\sin y} dx + e^{\cos x} dy = 0$

22. The general solution to $\frac{dy}{dx} = \frac{x}{e^y}$ has the form

- (a) $y = \ln |x^2 + c|$ (b) $y = -\ln |x^2 + c|$ (c) $y = \ln \left| \frac{x^2}{2} + c \right|$ (d) $y = -\ln \left| \frac{x^2}{2} + c \right|$

23. The general solution to $\frac{dy}{dx} - \frac{y}{x} = x$ has the form

- (a) $y = (x+c)x$ (b) $y = -(x+c)x$ (c) $y = (x+c)x^2$ (d) $y = -(x+c)x^2$

24. The general solution to $\frac{dy}{dx} = \frac{5}{\sqrt{(4x+8)^3}}$ has the form

(a) $y = \frac{5}{4} \sqrt{x+2} + c$ (b) $y = -\frac{5}{4} \sqrt{x+2} + c$ (c) $y = \frac{5}{4\sqrt{x+2}} + c$

(d) $y = \frac{-5}{4\sqrt{x+2}} + c$

25. The equation $y^3 = \frac{c}{x^5}$ constitutes an implicit general solution to the ODE given by

(a) $3xy' + 5y = 0$ (b) $3xy' - 5y = 0$ (c) $5xy' - 3y = 0$ (d) $5xy' + 3y = 0$

26. The general solution to $\frac{dy}{dx} - 2xy = -2x$ has the form

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

27. The general solution to $x^2 \frac{dy}{dx} - 2xy = 3$ has the form

(a) $y = \frac{3}{2} + \frac{c}{x^2}$ (b) $y = -\frac{3}{2} + \frac{c}{x^2}$ (c) $y = \frac{1}{x} + cx^2$ (d) $y = -\frac{1}{x} + cx^2$

28. The solution to $\frac{dy}{dx} + y = 5$ satisfying $y(0) = 3$ is given by

(a) $y = 2e^x + 1$ (b) $y = 5 - 2e^{-x}$ (c) $y = 5e^x - 2$ (d) $y = 5 - 2e^x$

29. The general solution to $3x \frac{dy}{dx} - y = 12x$ is given by

(a) $y = 6x + c\sqrt[3]{x}$ (b) $y = -6x + c\sqrt[3]{x}$ (c) $y = 6x + \frac{c}{\sqrt[3]{x}}$ (d) $y = -6x + \frac{c}{\sqrt[3]{x}}$

30. The general solution to $(x^5 + y^3)dx + 3xy^2dy = 0$ is given by

(a) $y = \sqrt[3]{\frac{x^5}{6} + \frac{c}{x}}$ (b) $y = -\sqrt[3]{\frac{x^5}{6} + \frac{c}{x}}$ (c) $y = \sqrt{\left(\frac{x^5}{6} + \frac{c}{x}\right)^3}$

(d) $y = -\sqrt[3]{\left(\frac{x^5}{6} + \frac{c}{x}\right)^2}$