

GRADE XII
Question Bank (MATHEMATICS)
Chapter-9 Differential Equations

1 Marks:

1. Degree of the differential equation $\sin x + \cos\left(\frac{dy}{dx}\right) = y^2$ is **[BOARD 2023]**
a) 2 b) 1 c) not defined d) 0
2. Degree of the differential equation $(y'')^2 + (y')^3 = x \sin(y')$ is **[BOARD 2024]**
a) 1 b) 2 c) 3 d) not defined
3. The order and degree (if defined) of the differential equation $\left(\frac{d^2y}{dx^2}\right)^2 + \left(\frac{dy}{dx}\right)^3 = x \sin\left(\frac{dy}{dx}\right)$ are **[BOARD 2023]**
a) 2, 2 b) 1, 3 c) 2, 3 d) 2, not defined
4. The order and degree of the differential equation $\left(1 + 3 \frac{dy}{dx}\right)^2 = 4 \frac{d^3y}{dx^3}$ respectively are **[BOARD 2023]**
a) $1, \frac{2}{3}$ b) 3, 1 c) 3, 3 d) 1, 2
5. The order and degree of the differential equation $\left[1 + \left(\frac{dy}{dx}\right)^2\right]^3 = \frac{d^2y}{dx^2}$ respectively are **[BOARD 2024]**
a) 1, 2 b) 2, 3 c) 2, 1 d) 2, 6
6. The degree and order of the differential equation $y''^2 + \log(y') = x^5$ respectively are **[BOARD 2024]**
a) not defined, 5 b) not defined, 2 c) 5, not defined d) 2, 2
7. The difference of the order and degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^2 + \left(\frac{dy}{dx}\right)^3 + x^4 = 0$ is **[BOARD 2023]**
a) 1 b) 2 c) -1 d) 0
8. The sum of the order and degree of the differential equation $\frac{d}{dx}\left(\left(\frac{dy}{dx}\right)^3\right)$ is **[BOARD 2023]**
a) 2 b) 3 c) 5 d) 0

9. The sum of the order and degree of the differential equation $\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^3 = \sin y$ is **[BOARD 2023]**

- a) 5 b) 4 c) 3 d) 2

10. Product of the order and degree of the differential equation

$\frac{d^2y}{dx^2} \sin y + \left(\frac{dy}{dx}\right)^3 \cos y = \sqrt{y}$ is **[BOARD 2023]**

- a) 3 b) 2 c) 6 d) not defined

11. The differential equation $\frac{dy}{dx} = F(x, y)$ will not be a homogeneous differential equation, if $F(x, y)$ is **[BOARD 2024]**

- a) $\cos x - \sin\left(\frac{y}{x}\right)$ b) $\frac{y}{x}$ c) $\frac{x^2+y^2}{xy}$ d) $\cos^2\left(\frac{x}{y}\right)$

12. Which of the following is not a homogeneous function of x and y ?

[BOARD 2025]

- a) $y^2 - xy$ b) $x - 3y$ c) $\sin^2\frac{y}{x} + \frac{y}{x}$ d) $\tan x - \sec y$

13. $x \log x \frac{dy}{dx} + y = 2 \log x$ is an example of a **[BOARD 2024]**

- a) Variable separable differential equation
b) Homogeneous differential equation
c) First order linear differential equation
d) Differential equation whose degree is not defined

14. The integrating factor of the differential equation $x \frac{dy}{dx} - y = 2x^2$ is **[BOARD 2023]**

- a) e^{-y} b) e^{-x} c) x d) $\frac{1}{x}$

15. The integrating factor of the differential equation $\frac{dy}{dx} + \frac{2}{x}y = 0, x \neq 0$ is

[BOARD 2024]

- a) $\frac{2}{x}$ b) x^2 c) $e^{\frac{2}{x}}$ d) $e^{\log 2x}$

16. The integrating factor of the differential equation $(3x^2 + y) \frac{dx}{dy} = x$ is

[BOARD 2023 & 2024]

- a) $\frac{1}{x}$ b) $\frac{1}{x^2}$ c) $\frac{2}{x}$ d) $\frac{-1}{x}$

17. The integrating factor of the differential equation $x \frac{dy}{dx} - 2y = 4x^2$ is

[BOARD 2023]

- a) x^2 b) $\frac{-1}{x^2}$ c) $\frac{1}{x^2}$ d) $-x^2$

18. The integrating factor of the differential equation $x \frac{dy}{dx} - y = x^4 - 3x$ is **[BOARD 2024]**
- a) x b) $-x$ c) x^{-1} d) $\log(x^{-1})$
19. The integrating factor of the differential equation $(x^2 - 1) \frac{dy}{dx} + 2xy = \frac{1}{x^2 - 1}$ is **[BOARD 2024]**
- a) e^{2x} b) $e^{x^2 - 1}$ c) $\log(x^2 - 1)$ d) $x^2 - 1$
20. The integrating factor of the differential equation $(x + 2y^3) \frac{dy}{dx} = 2y$ is **[BOARD 2025]**
- a) $e^{\frac{y^2}{2}}$ b) $\frac{1}{\sqrt{y}}$ c) $\frac{1}{y^2}$ d) $e^{-\frac{1}{y^2}}$
21. The integrating factor of the differential equation $(1 - x^2) \frac{dy}{dx} + yx = ax, (-1 < x < 1)$ is **[BOARD 2024]**
- a) $\frac{1}{x^2 - 1}$ b) $\frac{1}{\sqrt{x^2 - 1}}$ c) $\frac{1}{1 - x^2}$ d) $\frac{1}{\sqrt{1 - x^2}}$
22. The integrating factor of the differential equation $(1 - y^2) \frac{dx}{dy} + yx = ay, (-1 < y < 1)$ is **[BOARD 2023]**
- a) $\frac{1}{y^2 - 1}$ b) $\frac{1}{\sqrt{y^2 - 1}}$ c) $\frac{1}{1 - y^2}$ d) $\frac{1}{\sqrt{1 - y^2}}$
23. The number of arbitrary constants in the particular solution of the differential equation $\log\left(\frac{dy}{dx}\right) = 3x + 4y, y(0) = 0$ is/are **[BOARD 2024]**
- a) 2 b) 1 c) 0 d) 3
24. The number of arbitrary constants in the general solution of the differential equation $\frac{dy}{dx} + y = 0$ is **[BOARD 2024]**
- a) 0 b) 1 c) 2 d) 3
25. The number of solutions of the differential equation $\frac{dy}{dx} = \frac{y+1}{x-1}$ when $y(1) = 2$, is **[BOARD 2023]**
- a) 0 b) 1 c) 2 d) infinite
26. The number of solutions of the differential equation $\frac{dy}{dx} - y = 1$ given that $y(0) = 1$, is **[BOARD 2024]**
- a) 0 b) 1 c) 2 d) infinitely many

27. The solution of the differential equation $\frac{dy}{dx} = -\frac{x}{y}$ represents family of

[BOARD 2025]

- a) Parabolas b) circles c) ellipses d) hyperbolas

28. The general solution of the differential equation $\frac{dy}{dx} = e^{x+y}$ is

[BOARD 2024]

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

29. The general solution of the differential equation $x dy - (1 + x^2)dx = dx$ is

[BOARD 2023]

- a) $y = 2x + \frac{x^3}{3} + C$ c) $y = 2 \log x + \frac{x^3}{3} + C$
b) $y = \frac{x^2}{2} + C$ d) $y = 2 \log x + \frac{x^2}{2} + C$

30. Solution of the differential equation $(1 + y^2)(1 + \log x) dx + x dy = 0$ is

[BOARD 2023]

- a) $\tan^{-1} y + \log |x| + \frac{(\log|x|)^2}{2} = C$ c) $\tan^{-1} y - \log |x| - \frac{(\log|x|)^2}{2} = C$
b) $\tan^{-1} y - \log |x| + \frac{(\log|x|)^2}{2} = C$ d) $\tan^{-1} y + \log |x| - \frac{(\log|x|)^2}{2} = C$

31. Solution of the differential equation $\frac{dx}{x} + \frac{dy}{y} = 0$ is

[BOARD 2023 & 2024]

- a) $\frac{1}{x} + \frac{1}{y} = C$ c) $xy = C$
b) $\log x - \log y = C$ d) $x + y = C$

32. The solution of the differential equation $\frac{dy}{dx} = \frac{1}{\log y}$ is

[BOARD 2024]

- a) $\log y = x + C$ c) $\log y - y = x + C$
b) $y \log y - y = x + C$ d) $y \log y + y = x + C$

33. Solution of the differential equation $\log\left(\frac{dy}{dx}\right) = 3x + 4y$ is

[BOARD 2025]

- a) $3e^{4y} + 4e^{-3x} + C = 0$ c) $e^{3x+4y} + C = 0$
b) $3e^{-3y} + 4e^{4x} + 12C = 0$ d) $3e^{-4y} + 4e^{3x} + 12C = 0$

34. A particular solution of the differential equation $x \frac{dy}{dx} + y = 0$ when $x = 1, y = 1$ is

[BOARD 2024]

- a) $y = x$ b) $y = e^x$ c) $y = \frac{1}{x}$ d) $y = \log x$

3 Marks:

1. Find the general solution of the differential equation $(xy - x^2)dy = y^2 dx$.
[BOARD 2023]
2. Find the general solution of the differential equation $y dx = (x + 2y^2)dy$.
[BOARD 2024]
3. Find the general solution of the differential equation $(x^2 + 1)\frac{dy}{dx} + 2xy = \sqrt{x^2 + 4}$.
[BOARD 2023]
4. Find the general solution of the differential equation $\frac{d}{dx}(xy^2) = 2y(1 + x^2)$.
[BOARD 2023]
5. Find the general solution of the differential equation $\frac{dy}{dx} = \frac{x^2 + y^2}{2xy}$. **[BOARD 2024]**
6. Find the general solution of the differential equation $\frac{dy}{dx} = x y \log x \log y$.
[BOARD 2024]
7. Find the general solution of the differential equation $\frac{dx}{dy} = \frac{e^{\frac{x}{y}}(\frac{x}{y} - 1)}{1 + e^{\frac{x}{y}}}$. **[BOARD 2023]**
8. Find the general solution of the differential equation $y dx - x dy + (x \log x)dx = 0$.
[BOARD 2024]
9. Find the general solution of the differential equation
 $e^x \tan y dx + (1 - e^x) \sec^2 y dy = 0$. **[BOARD 2023]**
10. Find the general solution of the differential equation $\frac{dy}{dx} - \frac{2y}{x} = \sin \frac{1}{x}$.
[BOARD 2023]
11. Find the particular solution of the differential equation $\frac{dy}{dx} = \frac{x+y}{xy}$, given that
 $y(1) = 0$. **[BOARD 2023]**
12. Find the particular solution of the differential equation $\frac{dy}{dx} = \frac{xy}{x^2 + y^2}$ given that $y =$
 1 when $x = 0$. **[BOARD 2023]**
13. Find the particular solution of the differential equation $(1 + x^2)\frac{dy}{dx} + 2xy = \frac{1}{x^2 + 1}$
given that $y = 0$ when $x = 1$. **[BOARD 2023]**
14. Find the particular solution of the differential equation $2xy + y^2 - 2x^2 \frac{dy}{dx} = 0$, $y =$
 2 , when $x = 1$. **[BOARD 2024]**
15. Find the particular solution of the differential equation $(x e^{\frac{y}{x}} + y) dx = x dy$, given
that $y = 1$ when $x = 1$. **[BOARD 2024]**

16. Find the particular solution of the differential equation $\frac{dy}{dx} - 2xy = 3x^2 e^{x^2}$, given that $y(0) = 5$. **[BOARD 2024]**
17. Find the particular solution of the differential equation $x \cos y \, dy = (xe^x \log x + e^x)dx$ given that $y = \frac{\pi}{2}$ when $x = 1$. **[BOARD 2024]**
18. Find the particular solution of the differential equation $\frac{dy}{dx} = y \cot 2x$, given that $y\left(\frac{\pi}{4}\right) = 2$. **[BOARD 2024]**
19. Find the particular solution of the differential equation $\frac{dy}{dx} + \sec^2 x \cdot y = \tan x \cdot \sec^2 x$ given that $y(0) = 0$. **[BOARD 2023]**
20. Find the particular solution of the differential equation $\frac{dy}{dx} + \cot x \cdot y = \cos^2 x$ given that when $x = \frac{\pi}{2}$, $y = 0$. **[BOARD 2023]**
21. Find the particular solution of the differential equation $\frac{dy}{dx} = \sin(x + y) + \sin(x - y)$ given that when $x = \frac{\pi}{4}$, $y = 0$. **[BOARD 2023]**
22. Find the particular solution of the differential equation $x^2 \frac{dy}{dx} - xy = x^2 \cos^2\left(\frac{y}{2x}\right)$ given that when $x = 1$, $y = \frac{\pi}{2}$. **[BOARD 2024]**
23. Find the particular solution of the differential equation $\frac{dy}{dx} - \frac{y}{x} + \operatorname{cosec}\left(\frac{y}{x}\right) = 0$ given that $y(0) = 1$. **[BOARD 2025]**
24. Find the particular solution of the differential equation $\left[x \sin^2\left(\frac{y}{x}\right) - y\right] dx + x \, dy = 0$ given that $y = \frac{\pi}{4}$ when $x = 1$. **[BOARD 2025]**
25. Solve: $x^2 dy + y(x + y)dx = 0$. **[BOARD 2024]**
26. Solve: $x \, dy - y \, dx - \sqrt{x^2 + y^2} dx = 0$. **[BOARD 2023]**
27. Solve: $x e^{\frac{y}{x}} - y + x \frac{dy}{dx} = 0$. **[BOARD 2023]**
28. Solve: $(\tan^{-1} y - x)dy = (1 + y^2)dx$. **[BOARD 2024]**
29. Solve: $(1 + x^2) \frac{dy}{dx} + 2xy = 4x^2$. **[BOARD 2025]**
30. Solve: $x \cos\left(\frac{y}{x}\right) \frac{dy}{dx} = y \cos\left(\frac{y}{x}\right) + x$. **[BOARD 2025]**
31. Solve: $2(y + 3) - xy \frac{dy}{dx} = 0$, given that $y(1) = -2$. **[BOARD 2025]**

5 marks:

Prepared by: H.Sabareesh (PGT Mathematics)

1. Solve the differential equation $x^2y dx - (x^3 + y^3)dy = 0$. **[BOARD 2025]**
2. Solve the differential equation $(1 + x^2)\frac{dy}{dx} + 2xy - 4x^2 = 0$ subject to initial condition $y(0) = 0$. **[BOARD 2025]**
3. Solve the differential equation $\frac{dy}{dx} = \cos x - 2y$. **[BOARD 2025]**
4. Solve the differential equation $(x^2 + y^2) dx + xy dy = 0, y(1) = 1$. **[BOARD 2025]**
5. Solve the differential equation $(x - \sin y) dy + (\tan y) dx = 0, y(0) = 0$. **[BOARD 2025]**

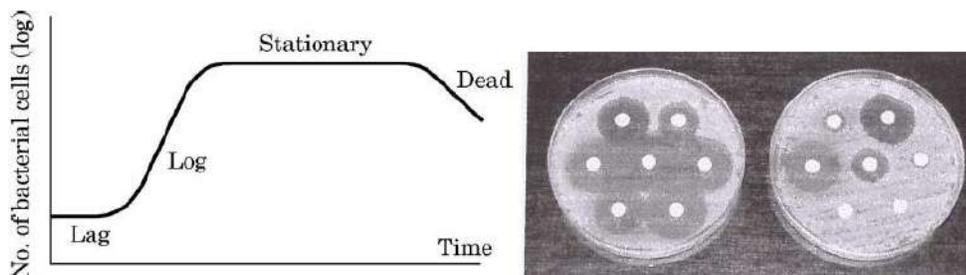
Case Based Questions:

1. An equation involving derivatives of the dependent variable with respect to the independent variables is called a differential equation. A differential equation of the form $\frac{dy}{dx} = F(x, y)$ is said to be homogeneous if $F(x, y)$ is a homogeneous function of degree 0, whereas a function $F(x, y)$ is a homogeneous function of degree n if $F(\lambda x, \lambda y) = \lambda^n F(x, y)$. To solve a homogeneous differential equation of the type $\frac{dy}{dx} = F(x, y) = g\left(\frac{y}{x}\right)$, we make substitution $y = vx$ and then separate the variables. **[BOARD 2023]**

Based on the above information, answer for following questions:

- (i) Show that $(x^2 - y^2)dx + 2xy dy = 0$ is a differential equation of the type $\frac{dy}{dx} = g\left(\frac{y}{x}\right)$. **2**
- (ii) Solve the above equation to find its general solution. **2**

2. A bacteria sample of certain number of bacteria is observed to grow exponentially in a given amount of time. Using exponential growth model, the rate of growth of this sample of bacteria is calculated. **[BOARD 2024]**



The differential equation representing the growth of bacteria is given as

$\frac{dP}{dt} = kP$, where P is the population of bacteria at any time 't'.

Based on the above information, answer for following questions:

- (i) Obtain the general solution of the differential equation and express it as an exponential function of 't'. **2**
- (ii) If population of bacteria is 1000 at $t = 0$ and 2000 at $t = 1$, find the value of k. **2**
3. During a heavy gaming session, the temperature of a student's laptop processor increases significantly. After the session, the processor begins to cool down, and the rate of cooling is proportional to the difference between the processor's temperature and the room temperature (25°C). Initially processor's temperature is 85°C . The rate of cooling is defined by the equation $\frac{d}{dt}(T(t)) = -k(T(t) - 25)$, where $T(t)$ represents the temperature of the processor at time t (in minutes) and k is a constant. **[BOARD 2025]**



Based on the above information, answer for following questions:

- (i) Find the expression for temperature of processor, $T(t)$ given that $T(0) = 85^{\circ}\text{C}$. **2**
- (ii) How long will it take for the processor's temperature to reach 40°C ? Given that $k = 0.03, \log_e 4 = 1.3863$. **2**