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Differential Equations — CBSE Class 12 Mathematics Chapter Test

FREE CHAPTER TEST · CLASS XII · MATHEMATICS (041) · PATTERN OF THE CBSE SAMPLE QUESTION PAPER 2026-27

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
1½ hours	40	19 (A 10 · B 3 · C 2 · D 2 · E 2)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 19 questions. All questions are compulsory.
2. This question paper is divided into five sections: A, B, C, D and E.
3. In Section A, Questions 1 to 8 are multiple choice questions (MCQs) and Questions 9 and 10 are assertion-reason based questions of 1 mark each.
4. In Section B, Q11–13 are very short answer (VSA) type questions, carrying 2 marks each.
5. In Section C, Q14–15 are short answer (SA) type questions, carrying 3 marks each.
6. In Section D, Q16–17 are long answer (LA) type questions, carrying 5 marks each.
7. In Section E, Q18–19 are case study based questions, carrying 4 marks each, with sub-parts of the values of 1, 1 and 2 marks.
8. There is no overall choice. However, an internal choice has been provided in 1 question of Section B, 1 question of Section C, 1 question of Section D and in the 2-mark sub-part of each question of Section E.
9. Use of calculators is not allowed. log x denotes the natural logarithm of x.
10. This chapter test follows the section structure, question types and marks per question of the CBSE Class XII Mathematics (041) Sample Question Paper 2026-27, released on 21 September 2026 at cbseacademic.nic.in, at half the length of the 80-mark board paper: 40 marks in 1½ hours.
11. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 1½ hours before you look at them.

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Chapter: Differential Equations · **Topics:** Order and degree · General and particular solutions · Variables separable · Homogeneous equations · Linear equations and integrating factor · Real-life models

SECTION A

This section comprises 10 questions of 1 mark each: 8 multiple choice questions (MCQs) and 2 assertion-reason based questions.

1. The order and degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^4 + y = 0$ are 1

(A) order 2, degree 3 (B) order 3, degree 2

(C) order 2, degree 4 (D) order 4, degree 3

2. The degree of the differential equation $\frac{d^2y}{dx^2} + \sin\left(\frac{dy}{dx}\right) = 0$ is 1

(A) 1 (B) 2

(C) 0 (D) not defined

3. The integrating factor of $\frac{dy}{dx} + \frac{1}{x}y = x^2$, $x > 0$, is 1

(A) $\log x$ (B) $\frac{1}{x}$

(C) x (D) e^x

4. The number of arbitrary constants in the general solution of a differential equation of order 3 is 1

(A) 2 (B) 3

(C) 0 (D) 4

5. The general solution of $\frac{dy}{dx} = e^{x-y}$ is 1

(A) $e^y - e^x = C$ (B) $e^x + e^y = C$

(C) $e^{-x} - e^{-y} = C$ (D) $e^{x-y} = C$

6. The integrating factor of $\frac{dy}{dx} - y\tan x = \cos x$, $0 < x < \frac{\pi}{2}$, is 1

(A) $\sec x$ (B) $\cos x$

(C) $\tan x$ (D) $\sin x$

7. Which of the following is a homogeneous differential equation? 1

(A) $\frac{dy}{dx} = x + y + 1$ (B) $\frac{dy}{dx} = x^2 + y$

(C) $\frac{dy}{dx} = \frac{x+1}{y}$ (D) $(x^2 + y^2)\frac{dy}{dx} = xy$

8. The general solution of $\frac{dy}{dx} = \frac{y}{x}$, $x, y > 0$, is 1

(A) $y = \frac{C}{x}$ (B) $y = x + C$

(C) $y = Cx$ (D) $y = x^2 + C$

9. **Assertion (A):** The differential equation $\frac{dy}{dx} = \frac{x + y}{x}$ is homogeneous. 1

Reason (R): A differential equation $\frac{dy}{dx} = F(x, y)$ is homogeneous if $F(\lambda x, \lambda y) = F(x, y)$ for every non-zero λ.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

10. **Assertion (A):** $y = e^{2x}$ is a solution of the differential equation $\frac{d^2y}{dx^2} - 4y = 0$. 1

Reason (R): The order of the differential equation $\frac{d^2y}{dx^2} - 4y = 0$ is 1.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

SECTION B

This section comprises 3 very short answer (VSA) type questions of 2 marks each.

11. Find the general solution of the differential equation $\frac{dy}{dx} = x(1 + y^2)$. 2

12. (a) Find the general solution of the differential equation $\frac{dy}{dx} = x\, e^{-y}$. 2

OR

(b) Find the general solution of the differential equation $x \frac{dy}{dx} - y = x^3$, $x > 0$.

13. Find the particular solution of $\frac{dy}{dx} = -6xy^2$, given that $y = \frac{1}{2}$ when $x = 0$. 2

SECTION C

This section comprises 2 short answer (SA) type questions of 3 marks each.

14. (a) Solve the differential equation $\frac{dy}{dx} = \frac{x^2 + 3y^2}{2xy}$, $x > 0$. 3

OR

(b) Solve the differential equation $\frac{dy}{dx} + 3y = e^x$.

15. Solve the differential equation $\frac{dy}{dx} + \frac{2y}{x} = x$, $x > 0$. 3

SECTION D

This section comprises 2 long answer (LA) type questions of 5 marks each.

16. (a) Show that the differential equation $\frac{dy}{dx} = \frac{xy + 2y^2}{x^2}$ is homogeneous, and find its particular solution given that $y = 1$ when $x = 1$ (take $x > 0$). 5

OR

(b) Find the particular solution of $\frac{dy}{dx} + y \tan x = 2x + x^2 \tan x$ $(-\frac{\pi}{2} < x < \frac{\pi}{2})$, given that $y = 1$ when $x = 0$.

17. Find the particular solution of $(1 + x^2)\frac{dy}{dx} + 2xy = 3x^2$, given that $y = 0$ when $x = 0$. Hence find the value of y when $x = 1$. 5

SECTION E

This section comprises 2 case study based questions of 4 marks each, with sub-parts of 1, 1 and 2 marks.

18. In a culture, bacteria increase at a rate proportional to the number present: $dN/dt = kN$, where N is the number of bacteria after t hours. Initially there are 1000 bacteria, and the number doubles in 2 hours.

(i) Write the order and degree of this differential equation. [1]

(ii) Write the general solution of the differential equation. [1]

(iii) Find the value of k. [2]

OR

(iii) Find the number of bacteria after 6 hours. [2]

19. A curve passes through the point (1, 2), and the slope of its tangent at any point (x, y) with $x, y > 0$ is $2y/x$.

(i) Write the differential equation of the curve. [1]

(ii) Find its general solution. [1]

(iii) Find the equation of the curve. [2]

OR

(iii) Find instead the curve through (1, 2) whose slope at any point (x, y), $x > 0$, is $x + y/x$. [2]

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
(A)	(D)	(C)	(B)	(A)	(B)	(D)	(C)	(A)	(C)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (A). The highest derivative is d^2y/dx^2 (order 2), and its highest power is 3 (degree 3).

Q2. Answer (D). The equation is not a polynomial in dy/dx (it contains sin(dy/dx)), so its degree is not defined.

Q3. Answer (C). IF = $e^{\int (1/x)\,dx} = e^{\log x} = x$.

Q4. Answer (B). The general solution of an equation of order n contains n arbitrary constants.

Q5. Answer (A). $e^y\,dy = e^x\,dx \Rightarrow e^y = e^x + C \Rightarrow e^y - e^x = C$.

Q6. Answer (B). IF = $e^{-\int \tan x\,dx} = e^{\log \cos x} = \cos x$.

Q7. Answer (D). $dy/dx = xy/(x^2 + y^2) = F(x, y)$ with $F(\lambda x, \lambda y) = F(x, y)$; none of the others has this property.

Q8. Answer (C). $dy/y = dx/x \Rightarrow \log y = \log x + \log C \Rightarrow y = Cx$.

Q9. Answer (A). $F(\lambda x, \lambda y) = (\lambda x + \lambda y)/(\lambda x) = F(x, y)$, so A is true by exactly the test stated in R. Answer (A).

Q10. Answer (C). $y'' = 4e^{2x} = 4y$, so A is true. The highest derivative is the second, so the order is 2 and R is false. Answer (C).

Q11. (2 marks) Answer: $\tan^{-1}y = x^2/2 + C$.
Separating the variables, $dy/(1 + y^2) = x\,dx$. [1]
Integrating, $\tan^{-1}y = x^2/2 + C$. [1]

Q12. (2 marks) Answer: (a) $e^y = x^2/2 + C$; (b) $y = x^3/2 + Cx$.
(a) $e^y\,dy = x\,dx$. [1] Integrating, $e^y = x^2/2 + C$. [1]
OR (b) Dividing by x: $dy/dx - y/x = x^2$, so $P = -1/x$ and IF = $e^{-\log x} = 1/x$. [1] Then $y/x = \int x\,dx = x^2/2 + C$, i.e. $y = x^3/2 + Cx$. [1]

Q13. (2 marks) Answer: $y = 1/(3x^2 + 2)$.
$dy/y^2 = -6x\,dx \Rightarrow -1/y = -3x^2 + C$. [1]
$x = 0$, $y = 1/2$ gives $C = -2$, so $1/y = 3x^2 + 2$, i.e. $y = 1/(3x^2 + 2)$. [1]

Q14. (3 marks) Answer: (a) $x^2 + y^2 = Cx^3$; (b) $y = e^x/4 + Ce^{-3x}$.
(a) The equation is homogeneous; put $y = vx$, $dy/dx = v + x\,dv/dx$. [½] Then $v + x\,dv/dx = (1 + 3v^2)/(2v)$, so $x\,dv/dx = (1 + v^2)/(2v)$. [1] Separating, $2v\,dv/(1 + v^2) = dx/x \Rightarrow \log(1 + v^2) = \log x + k$. [1] So $1 + v^2 = Cx$, i.e. $x^2 + y^2 = Cx^3$. [½]
OR (b) $P = 3$, IF = e^{3x}. [1] $y\,e^{3x} = \int e^{3x}\,e^x\,dx = e^{4x}/4 + C$ [1], so $y = e^x/4 + C\,e^{-3x}$. [1]

Q15. (3 marks) Answer: $y = x^2/4 + C/x^2$.
This is linear with $P = 2/x$, $Q = x$; IF = $e^{2\log x} = x^2$. [1]
$x^2y = \int x^2 \cdot x\,dx = x^4/4 + C$. [1]
So $y = x^2/4 + C/x^2$. [1]

Q16. (5 marks) Answer: (a) $y = x/(1 - 2\log x)$; (b) $y = x^2 + \cos x$.

(a) $F(x, y) = y/x + 2(y/x)^2$, so $F(\lambda x, \lambda y) = F(x, y)$: homogeneous. [1] Put $y = vx$: $v + x\,dv/dx = v + 2v^2$, so $dv/v^2 = 2\,dx/x$. [1] Integrating, $-1/v = 2\log x + C$, i.e. $-x/y = 2\log x + C$. [1] $x = 1$, $y = 1$ gives $C = -1$. [1] So $x/y = 1 - 2\log x$, i.e. $y = x/(1 - 2\log x)$. [1]

OR (b) $P = \tan x$, $IF = e^{\log \sec x} = \sec x$. [1] $y \sec x = \int (2x \sec x + x^2 \sec x \tan x)\,dx = x^2 \sec x + C$ (as $d(x^2 \sec x)/dx = 2x \sec x + x^2 \sec x \tan x$). [2] $x = 0$, $y = 1$ gives $C = 1$. [1] So $y \sec x = x^2 \sec x + 1$, i.e. $y = x^2 + \cos x$. [1]

Q17. (5 marks) Answer: $y = x^3/(1 + x^2)$; $y(1) = 1/2$.

Dividing by $1 + x^2$: $dy/dx + (2x/(1 + x^2))\,y = 3x^2/(1 + x^2)$. [1]

$IF = e^{\log (1 + x^2)} = 1 + x^2$. [1]

$y(1 + x^2) = \int 3x^2\,dx = x^3 + C$. [1]

$x = 0$, $y = 0$ gives $C = 0$, so $y = x^3/(1 + x^2)$. [1]

At $x = 1$, $y = 1/2$. [1]

Q18. (4 marks) Answer: (i) order 1, degree 1; (ii) $N = Ae^{kt}$; (iii) $k = (1/2)\log 2$, or 8000.

(i) Order 1, degree 1. [1]

(ii) $dN/N = k\,dt \Rightarrow \log N = kt + c \Rightarrow N = A\,e^{kt}$. [1]

(iii)(a) $N(0) = 1000$ gives $A = 1000$. [1] $2000 = 1000\,e^{2k} \Rightarrow k = (1/2)\log 2$ per hour. [1]

OR (iii)(b) $N = 1000\,e^{kt}$ with $e^{2k} = 2$. [1] $N(6) = 1000\,(e^{2k})^3 = 1000 \times 8 = 8000$. [1]

Q19. (4 marks) Answer: (i) $dy/dx = 2y/x$; (ii) $y = Cx^2$; (iii) $y = 2x^2$, or $y = x^2 + x$.

(i) $\frac{dy}{dx} = 2y/x$. [1]

(ii) $dy/y = 2\,dx/x \Rightarrow \log y = 2\log x + \log C \Rightarrow y = Cx^2$. [1]

(iii)(a) (1, 2) gives $C = 2$ [1], so the curve is $y = 2x^2$. [1]

OR (iii)(b) $dy/dx - y/x = x$, $IF = 1/x$, so $y/x = x + C$. [1] (1, 2) gives $C = 1$, so $y = x^2 + x$. [1]

All questions are original and © Master Testing Agency. Free to download and use for personal practice; not for resale. Every solution in this paper was checked independently by computer: it was substituted back into the differential equation at many points, every initial condition was tested, and in each MCQ every option was tested.