Differential Equations Class 12 Important Questions

10 questions · 27 marks · no calculator · step-marked answers

Name _____ Date _____ Score / 27

- Original questions in the board paper's question types, from 1-mark MCQs to a case study. Try every question before you look at the answers.
- No calculator: as in the CBSE board exam, everything works by hand.
- Worked answers with step marks for 5 questions start after the questions. The other 5 open free on the chapter page with a free account (no card): the link is next to each one.
- Online, with more practice: cbsemathrevision.com/class-12/differential-equations

Section A · Multiple choice and assertion–reason (1 mark each)

1. **1 mark · Order and degree**

What are the order and the degree of $\left(\frac{d^3y}{dx^3}\right)^2 + x\left(\frac{dy}{dx}\right)^5 = 0$?

(a) order 3, degree 2

(b) order 2, degree 3

(c) order 3, degree 5

(d) order 1, degree 5

2. **1 mark · Linear differential equations**

The integrating factor of $\frac{dy}{dx} + \frac{2y}{x} = x^2$ $(x > 0)$ is

(a) $2\log x$

(b) x^2

(c) e^{x^2}

(d) $\frac{1}{x^2}$

3. 1 mark · Variables separable

In the following question, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option.

Assertion (A): $y = Ce^{3x}$ is the general solution of $\frac{dy}{dx} = 3y$.

Reason (R): $\frac{dy}{dx} = 3y$ is a first-order linear differential equation.

(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 · Short answer (2 marks each)

4. 2 marks · Variables separable

Solve the differential equation $y\,\frac{dy}{dx} = x^2$.

5. 2 marks · Variables separable

Find the particular solution of $\frac{dy}{dx} = 2xe^{-y}$ for which $y = 0$ when $x = 0$.

Section C · Short answer (3 marks each)

6. 3 marks · Linear differential equations

Solve $\dfrac{dy}{dx} - y = e^{2x}$.

7. 3 marks · Homogeneous equations

Solve $\dfrac{dy}{dx} = \dfrac{y}{x} + \dfrac{x}{y}$ $(x > 0)$.

Section D · Long answer (5 marks each)

8. 5 marks · Linear differential equations

Find the particular solution of $x\dfrac{dy}{dx} + y = x^3$ given that $y = 1$ when $x = 1$.

9. **5 marks · Homogeneous equations**

Find the particular solution of $xy\dfrac{dy}{dx} = x^2 + 2y^2$ given that $y = 0$ when $x = 1$.

Section E · Case study (4 marks)

10. **4 marks · Variables separable**

Bacteria culture. A bacteria culture grows at a rate proportional to its size: $\dfrac{dP}{dt} = kP$. It starts with 5000 bacteria and doubles in 10 hours.

i. Solve the differential equation, using $P(0) = 5000$. *[1 mark]*

ii. Find k. *[1 mark]*

iii. After how many hours will there be 40000 bacteria? *[2 marks]*

Answers and worked solutions

Question 1 — 1 mark

The highest derivative is $\frac{d^3y}{dx^3}$ (order 3), and it is raised to the power 2 (degree 2) **A1**

Correct option: (a) order 3, degree 2

Question 2 — 1 mark

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/differential-equations#iq-2

Question 3 — 1 mark

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/differential-equations#iq-3

Question 4 — 2 marks

Answer: $3y^2 = 2x^3 + C$

$y\,dy = x^2\,dx \Rightarrow \frac{y^2}{2} = \frac{x^3}{3} + c$ **M1**

$3y^2 = 2x^3 + C$ **A1**

Question 5 — 2 marks

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/differential-equations#iq-5

Question 6 — 3 marks

Answer: $y = e^{2x} + Ce^{x}$

Linear with $P = -1$: $\text{IF} = e^{-x}$ **A1**

$\frac{d}{dx}(ye^{-x}) = e^{2x}e^{-x} = e^{x} \Rightarrow ye^{-x} = e^{x} + C$ **M1**

$y = e^{2x} + Ce^{x}$ **A1**

Question 7 — 3 marks

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/differential-equations#iq-7

Question 8 — 5 marks

Answer: $y = \frac{x^3}{4} + \frac{3}{4x}$

Standard form: $\frac{dy}{dx} + \frac{y}{x} = x^2$ **M1**

$\text{IF} = e^{\int \frac{1}{x}dx} = x$ **A1**

$\frac{d}{dx}(xy) = x^3 \Rightarrow xy = \frac{x^4}{4} + C$ **M1**

$x = 1, y = 1$: $1 = \frac{1}{4} + C \Rightarrow C = \frac{3}{4}$ **A1**

$y = \frac{x^3}{4} + \frac{3}{4x}$ **A1**

Question 9 — 5 marks

Worked answer: free with a free account (no card) on the chapter page: cbsemathrevision.com/class-12/differential-equations#iq-9

Question 10 — 4 marks

i. $\frac{dP}{P} = k\,dt \Rightarrow P = 5000e^{kt}$ **A1**

ii. $10000 = 5000e^{10k} \Rightarrow k = \frac{\log 2}{10}$ per hour **A1**

iii. $5000e^{kt} = 40000 \Rightarrow e^{kt} = 8 \Rightarrow t = \frac{\log 8}{k} = \frac{3\log 2}{(\log 2)/10}$ **M1**

$t = 30$ hours **A1**

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