

CLASS 12

MATHEMATICS

EXTRA QUESTIONS

Class 12 Mathematics Chapter 9 Differential Equations – Extra Questions with Answers

Extra practice questions for Class 12 Maths Chapter 9 (Differential Equations), beyond the textbook. These Class 12 Mathematics Chapter 9 important questions are handy for last-minute exam practice.

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- Very Short Answer Questions (1 mark)
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Extra practice questions for Class 12 Maths Chapter 9 (Differential Equations), beyond the textbook. These Class 12 Mathematics Chapter 9 important questions are handy for last-minute exam practice.

Very Short Answer Questions (1 mark)

Q1. What is the order of $d^2y/dx^2 + 3(dy/dx) = 0$?

Ans: Order 2.

Q2. What is the degree of $(dy/dx)^3 + y = 0$?

Ans: Degree 3.

Q3. Write the general form of a linear differential equation.

Ans: $dy/dx + Py = Q$, where P, Q are functions of x.

Q4. What substitution is used to solve a homogeneous differential equation?

Ans: $y = vx$.

Q5. Write the integrating factor formula for $dy/dx + Py = Q$.

Ans: $IF = e^{\int P dx}$.

Short Answer Questions (2–3 marks)

Q6. Solve the variable separable equation $dy/dx = x/y$.

Ans: $y dy = x dx$. Integrating: $y^2/2 = x^2/2 + C$, i.e., $y^2 - x^2 = 2C$ (a family of hyperbolas).

Q7. Find the order and degree of $[1 + (dy/dx)^2]^{3/2} = d^2y/dx^2$.

Ans: Squaring both sides to remove the fractional power: $[1 + (dy/dx)^2]^3 = (d^2y/dx^2)^2$. Order=2 (highest derivative is d^2y/dx^2), degree=2 (power of the highest-order derivative after removing radicals/fractional powers).

Q8. Form the differential equation representing the family of curves $y = mx$ (m arbitrary constant).

Ans: Differentiate: $dy/dx = m$. Substitute back: $dy/dx = y/x$, i.e., $x(dy/dx) = y$, i.e., $x(dy/dx) - y = 0$.

Higher-Order Thinking / Application Questions

Q9. Solve the linear differential equation $dy/dx + y = e^x$, showing the full method including the integrating factor.

Ans: This is a linear equation of the form $dy/dx + Py = Q$ with $P=1$, $Q=e^x$. The integrating factor is $IF = e^{\int P dx} = e^{\int 1 dx} = e^x$. Multiplying the equation throughout by the integrating factor: $e^x(dy/dx) + e^x y = e^x \cdot e^x = e^{2x}$. The left side is exactly $d/dx(y \cdot e^x)$ by the product rule (this is the whole point of the integrating factor — it makes the left side a perfect derivative). So $d/dx(y \cdot e^x) = e^{2x}$. Integrating both sides with respect to x: $y \cdot e^x = \int e^{2x} dx = e^{2x}/2 + C$. Solving for y: $y = e^{2x}/(2e^x) + Ce^{-x} = e^x/2 + Ce^{-x}$. This is the general solution, containing one arbitrary constant C (consistent with the equation being first order).

Q10. A population grows at a rate proportional to its current size. If the population doubles in 10 years, set up and solve the differential equation to find the population after 20 years in terms of the initial population P_0 .

Ans: Let $P(t)$ be the population at time t. The condition “rate proportional to current size” translates to the differential equation $dP/dt = kP$, where k is the growth constant. This is variable-separable: $dP/P = k dt$. Integrating: $\log P = kt + C$, i.e., $P = Ae^{kt}$ where $A = e^C$. At $t=0$, $P = P_0$, so $A = P_0$, giving $P(t) = P_0 e^{kt}$. Given the population doubles in 10 years: $P(10) = 2P_0$, so $P_0 e^{10k} = 2P_0$, giving $e^{10k} = 2$, i.e., $k = (\ln 2)/10$. Now at $t=20$:

$P(20) = P_0 e^{20k} = P_0 e^{20 \cdot (\ln 2)/10} = P_0 e^{2 \ln 2} = P_0 (e^{\ln 2})^2 = P_0 (2)^2 = 4P_0$. So after 20 years, the population is 4 times the initial population — this makes intuitive sense since exponential growth with a fixed doubling period doubles again over each subsequent equal time period (doubling twice over 20 years gives a 4×

increase), confirming the differential equation model matches the expected exponential growth pattern.

Class 12 Mathematics Chapter 9 – Solutions and Notes

For complete step-by-step answers and a quick summary, check the [Class 12 Mathematics Chapter 9 Solutions](#) and [Class 12 Mathematics Chapter 9 Revision Notes](#).

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