

**BASIC CONCEPT**
**VERY SHORT QUESTION (1 MARKS)**

1. Write the sum of the order and degree of the following differential equation  $\frac{d}{dx} \left\{ \left( \frac{dy}{dx} \right)^3 \right\} = 0$  (AI 2015)
2. Write the sum of the order and degree of the following differential equation  $\left( \frac{d^2y}{dx^2} \right)^2 + \left( \frac{dy}{dx} \right)^3 + x^4 = 0$  (Foreign 2015)
3. Write the sum of the order and degree of the following differential equation  $\left( \frac{dy}{dx} \right)^4 + 1 = 7 \left( \frac{d^2y}{dx^2} \right)^3$  (DELHI 2015C)
4. Write the degree of differential equation  $\left( \frac{dy}{dx} \right)^4 + 3x \left( \frac{d^2y}{dx^2} \right) = 0$  (DELHI 2013)
5. Write the degree of differential equation  $x \left( \frac{dy}{dx} \right)^4 + x^3 \left( \frac{d^2y}{dx^2} \right)^2 = 0$  (DELHI 2013)
6. Write the degree of differential equation  $y \left( \frac{dy}{dx} \right)^4 + x^3 + x \left( \frac{d^2y}{dx^2} \right)^3 = 0$  (DELHI 2013)
7. Write the degree of differential equation  $\left( \frac{dy}{dx} \right)^4 + 3y \left( \frac{d^2y}{dx^2} \right) = 0$  (DELHI 2013C)
8. Write the degree of differential equation  $\left( \frac{d^2s}{dt^2} \right)^2 + \left( \frac{ds}{dt} \right)^3 + 4 = 0$  (AI 2013C)
9. Write is the degree of the following differential equation  $5x \left( \frac{dy}{dx} \right)^2 - \left( \frac{d^2y}{dx^2} \right) - 6y = \log x$  (DELHI 2010)

**GENERAL AND PARTICULAR SOLUTIONS OF A DIFFERENTIAL EQUATION**
**LONG QUESTION (4 MARKS)**

10. Verify that  $y = 3\cos(\log x) + 4\sin(\log x)$  is a solution of the differential equation  $x^2 \left( \frac{d^2y}{dx^2} \right) + x \frac{dy}{dx} + y = 0$  (AI 2008C)

**FORMATION OF A DIFFERENTIAL EQUATION WHOSE GENERAL SOLUTION IS GIVEN**
**VERY SHORT QUESTION (1 MARKS)**

11. Find the differential equation representing the family curve  $v = \frac{A}{r} + B$ , where A and B are arbitrary constants. (Delhi 2015)
12. Write the differential equation obtained by eliminating the arbitrary constants C in the equation representing the family curves  $xy = C \cos x$ . (Delhi 2015 C)
13. Write the differential equation representing the family curves  $= mx$ , where m is an arbitrary constant.

(AI 2013)

14. Form the differential equation of the family curves  $y = a \cos(x + b)$ , where a and b are arbitrary constants.  
(Delhi 2007)

**LONG QUESTION (4 MARKS)**

15. Form the differential equation of the family circles in the second quadrant and touching the coordinate axes.  
(AI 2016, 2012)
16. Form the differential equation of the family of parabolas having vertex at origin and axis along positive x-axis.  
(Delhi 2011)
17. Find the differential equation of the family of all circles touching the y-axis at the origin.  
(Delhi 2010 C, AI 2009)
18. Find the differential equation of the family of all circles touching the x-axis at the origin.  
(Delhi 2010 C, AI 2009)
19. Find the differential equation of the family circles in the first quadrant which touch the coordinate axes.  
(AI 2010 C)
20. Form the differential equation representing the family ellipses having foci on x-axis and centre at the origin.  
(AI 2010 C, Delhi 2009 C)
21. Form the differential equation of the family curves  $(x - a)^2 + 2y^2 = a^2$ , where a is an arbitrary constants.  
(AI 2009)
22. Form the differential equation of the family curves  $y = a \cos 2x + b \sin 2x$ , where a and b are arbitrary constants.  
(Delhi 2007)

**METHOD OF SOLVING FIRST ORDER, FIRST DEGREE DIFFERENTIAL EQUATIONS**
**VERY SHORT QUESTION (1 MARKS)**

23. Find the integrating factor of the differential equation  $\left(\frac{e^{-2\sqrt{x}}}{\sqrt{x}} - \frac{y}{\sqrt{x}}\right) \frac{dx}{dy} = 1$  (Delhi 2015, AI 2015 C)
24. Write the integrating factor of the following differential equation  $(1 + y^2) + (2xy - \cot y) \frac{dx}{dy} = 0$  (AI 2015)
25. Write the solution of the differential equation  $\frac{dy}{dx} = 2^{-y}$  (Foreign 2015)
26. Find the solution of the differential equation  $\frac{dy}{dx} = x^3 e^{-2y}$  (AI 2015C)
27. Solve the following differential equation  $x \cos y \, dy = (x e^x \log x + e^x) dx$  (Delhi 2007)
28. Solve the following differential equation  $\tan y \, dx + \sec^2 y \tan x \, dy = 0$  (Delhi 2007, AI 2007)
29. Solve the following differential equation  $\sec^2 x \tan y \, dy + \sec^2 y \tan x \, dx = 0$  (AI 2007)
30. Solve the following differential equation  $y(1 - x^2) \frac{dy}{dx} = x(1 + y^2)$  (AI 2007)

**LONG QUESTION 1 (4 MARKS)**

31. Prove that  $x^2 - y^2 = C(x^2 + y^2)^2$  is the general solution of the differential equation  $(x^3 - 3xy^2)dx = (y^3 - 3x^2y)dy$  where C is a parameter. (Delhi 2017)
32. Solve the differential equation  $(\tan^{-1}x - y)dx = (1 + x^2)dy$  (AI 2017)
33. Find the general solution of the following differential equation:  $(1 + y^2) + (x - e^{\tan^{-1}y}) \frac{dy}{dx} = 0$   
(Delhi 2016)
34. Find the particular solution of the following differential equation:  
 $(1 - y^2) + (1 + \log x)dx + 2xy \, dy = 0$ , given that  $y=0$  when  $x=1$  (Delhi 2016)

35. Solve the differential equation  $y + x \frac{dy}{dx} = x - y \frac{dy}{dx}$  (AI 2016)
36. Solve the differential equation  $(y^2)dx + (x^2 - xy + y^2)dy = 0$  (Foreign 2016)
37. Solve the differential equation  $(\cot^{-1}y + x)dy = (1 + y^2)dx$  (Foreign 2016)
38. Find the particular solution of the following differential equation:  
 $\frac{dy}{dx} = \frac{x(2 \log x + 1)}{\sin y + y \cos y}$  given that  $y = \frac{\pi}{2}$  when  $x=1$  (Delhi 2014)
39. Solve the following differential equation  $(x^2 - 1) \frac{dy}{dx} + 2xy = \frac{2}{x^2 - 1}$   $|x| \neq 1$  (Delhi 2014)
40. Find the particular solution of the following differential equation:  $e^{x\sqrt{1-y^2}} + \frac{y}{x} dy = 0$  given that  $y=0$  when  $x=1$  (Delhi 2014)
41. Solve the following differential equation  $\operatorname{cosec} x \log y \frac{dy}{dx} + x^2 y^2 = 0$  (Delhi 2014)
42. Find the particular solution of the following differential equation:  $\frac{dy}{dx} = 1 + x + y + xy$  given that  $y=0$  when  $x=1$
43. Solve the differential equation  $(1 + x^2) \frac{dy}{dx} + y = (e^{\tan^{-1}x})$  (AI 2014)
44. Find the particular solution of the following differential equation:  $x(1 + y^2)dx - y(1 + x^2)dy = 0$  given that  $y=1$  when  $x=0$  (AI 2014)
45. Find the particular solution of the following differential equation:  $\log \left( \frac{dy}{dx} \right) = 3x + 4y$  Given that  $y=0$  when  $x=0$  (AI 2014)
46. Solve the differential equation  $(x^2 - yx^2)dy + (y^2 + y^2x^2)dx = 0$  Given that  $y=1$  when  $x=1$  (AI 2014)
47. Solve the differential equation  $\frac{dy}{dx} + y \cot x = 2 \cos x$  Given that  $y=1$  when  $x = \frac{\pi}{2}$  (Foreign 2014)
48. Find the particular solution of the following differential equation:  $\frac{dy}{dx} + 2y \tan x = \sin x$  Given that  $y=0$  when  $x = \frac{\pi}{3}$  (AI 2014)
49. Solve the differential equation  $x \log x \frac{dy}{dx} + y = \frac{2}{x} \log x$  (Foreign 2014, Delhi 2010)
50. If  $y(x)$  is a solution of the differential equation  $\left( \frac{2 + \sin x}{1 + y} \right) \frac{dy}{dx} = -\cos x$  and  $y(0) = 1$ , then Find the value of  $y = \frac{\pi}{2}$  (Delhi 2014 C)
51. Find the general solution of the following differential equation:  $(x - y) \frac{dy}{dx} = 2y + x$  (Delhi 2014 C, AI 2010)
52. Find the particular solution of the following differential equation:  $x \frac{dy}{dx} - y + x \operatorname{cosec} \left( \frac{y}{x} \right) = 0$  Given that  $y=0$  when  $x=1$  (AI 2014C, 2010C, Delhi 2009)
53. Solve the differential equation  $x \frac{dy}{dx} + y = x \cos x + \sin x$ , given  $y \left( \frac{\pi}{2} \right) = 1$  (AI 2014 C)
54. Solve the following differential equation  $x \cos \left( \frac{y}{x} \right) \frac{dy}{dx} = y \cos \left( \frac{y}{x} \right) + x$ ;  $x \neq 0$  (AI 2014C, Delhi 2012C)
55. Find the particular solution of the following differential equation:  $xy \frac{dy}{dx} = (y + 2)(x + 2)$  Given that  $y=-1$  when  $x=1$  (Delhi 2012)
56. Solve the following differential equation  $2x^2 \frac{dy}{dx} - 2xy + y^2 = 0$  (Delhi 2012)
57. Find the particular solution of the following differential equation:  $\frac{dy}{dx} = 1 + x^2 + y^2 + x^2 y^2$  Given that  $y=1$  when  $x=0$  (Delhi 2012)
58. Find the particular solution of the following differential equation:  $(x + 1) \frac{dy}{dx} = 2e^{-y} - 1$  When  $y=0$ ,  $x=0$  (Delhi 2012)

59. Find the particular solution of the following differential equation:  $(x^2 - 1)x \frac{dy}{dx} = 1$ ;  $y=0$  when  $x=2$  (AI 2012)
60. Solve the following differential equation  $(1 + x^2)dy + 2xy dx = \cot x dx$ ;  $x \neq 0$  (AI 2012, 2012 C, Delhi 2012 C)
61. Find the particular solution of the following differential equation:  $\frac{dy}{dx} + y \cot x = 4x \operatorname{cosec} x$ ;  $(x \neq 0)$   
Given that  $y = 0$  when  $x = \frac{\pi}{2}$  (AI 2012)
62. Find the particular solution of the following differential equation:  $x \frac{dy}{dx} - y + x \sin\left(\frac{y}{x}\right) = 0$  given that when  $x = 0, y = \pi$  (AI 2012)
63. Solve the following differential equation  $\frac{dy}{dx} - y = \cos x$ , given that  $x = 0, y = 1$  (Delhi 2012C)
64. Find the particular solution of the following differential equation, given that  $x = 2, y = 1$   
 $x \frac{dy}{dx} + 2y = x^2, (x \neq 0)$  (Delhi 2012C)
65. Find the particular solution of the following differential equation, given that  $y = 0$ , when  $x = \frac{\pi}{2}$   
 $\frac{dy}{dx} + y \cot x = 2x + x^2, (x \neq 0)$  (Delhi 2012C)
66. Solve the following differential equation  $\frac{dy}{dx} + \sec x \cdot y = \tan x, (0 \leq x \leq \frac{\pi}{2})$  (AI 2012 C, Delhi 2008 C)
67. Solve the following differential equation  $x \frac{dy}{dx} + y - x + xy \cot x = 0, (x \neq 0)$  (AI 2012 C, Delhi 2011 C)
68. Solve the following differential equation  $\cos^2 x \frac{dy}{dx} + y = \tan x$  (Delhi 2011, 2008, 2008 C, AI 2009, 2008)
69. Solve the following differential equation  $(1 + y^2)(1 + \log x)dx + xdy = 0$  (Delhi 2011)
70. Solve the following differential equation  $e^x \tan y dx + (1 - e^x) \sec^2 y dy = 0$  (Delhi 2011)
71. Solve the following differential equation  $xdy + (y - x^3)dx = 0$  (AI 2011)
72. Solve the following differential equation  $xdy - (y - 2x^2)dx = 0$  (AI 2011)
73. Solve the following differential equation  $(y + 3x^2) \frac{dy}{dx} = x$  (AI 2011)
74. Solve the following differential equation  $xdy - ydx = \sqrt{x^2 + y^2} dx$  (AI 2011)
75. Solve the following differential equation  $\left[ x \sin^2\left(\frac{y}{x}\right) - y \right] dx + xdy = 0$  (Delhi 2011C)
76. Find the particular solution of the differential equation satisfying the given Condition  
 $\frac{dy}{dx} y \tan x$ , give that  $y = 1$ , when  $x = 0$ . (Delhi 2010)
77. Solve the following differential equation  $(x^2 + 1) \frac{dy}{dx} + 2xy = \sqrt{x^2 + 4}$  (AI 2010, 2008, Delhi 2008)
78. Solve the following differential equation  $(x^3 + x^2 + x + 1) \frac{dy}{dx} = 2x^2 + x$  (AI 2010)
79. Show that the following differential equation is homogenous and then solve it.  
 $ydx + x \log \frac{y}{x} dy - 2xdy = 0$  (AI 2010)
80. Solve the following differential equation  $(x^2 - 1) \frac{dy}{dx} + 2xy = \frac{1}{x^2 - 1}; |x| \neq 1$  (AI 2010)
81. Solve the following differential equation  $xy \log\left(\frac{y}{x}\right) dx + \left\{ y^2 - x^2 \log\left(\frac{y}{x}\right) \right\} dy = 0$  (Delhi 2010 C)
82. Solve the following differential equation  $x \log x \frac{dy}{dx} + y = 2 \log x$  (Delhi 2009)
83. Solve the following differential equation  $\frac{dy}{dx} + y = \cos x - \sin x$  (Delhi 2009)
84. Solve the following differential equation  $(1 + x^2) \frac{dy}{dx} + y = \tan^{-1} x$  (Delhi 2009)

85. Solve  $x \frac{dy}{dx} = y - x \tan\left(\frac{y}{x}\right)$  (AI 2009)
86. Solve the following differential equation  $(x^2 - y^2)dx + 2xydy = 0$  give that  $y = 1$  when  $x = 1$  (Delhi 2008)
87. Solve the following differential equation  $\frac{dy}{dx} = \frac{x(2y-x)}{x(2y+x)}$  if  $y = 1$  when  $x = 1$  (Delhi 2008)
88. Solve  $\frac{dy}{dx} + 2y \tan x = \sin x$  (AI 2008)
89. Solve the following differential equation  $(x^2) \frac{dy}{dx} = 2xy + y^2 = 0$  Given that  $y = 1$  when  $x = 1$  (AI 2008)
90. Solve the following differential equation  $(1 + e^{2x})dy + (1 + y^2)e^x dx = 0$  (AI 2008 C)
91. Solve the following differential equation  $\frac{dy}{dx} + 2y = 6e^x$  (Delhi 2008)
92. Solve the following differential equation  $x \cos y dy = (xe^x \log x + e^x)dx$  (Delhi 2007)
93. Solve the following differential equation  $4 \frac{dy}{dx} + 8y = 5 e^{-3x}$  (AI 2007)

**LONG QUESTION 2(4 MARKS)**

94. Solve the following differential equation  $x \frac{dy}{dx} + y = x \cos x + \sin x$  Given that  $y = 1$  when  $x = \frac{\pi}{2}$  (Delhi 2007)
95. Find the particular solution of the differential equation  $(x - y) \frac{dy}{dx} = (x + 2y)$  Given that  $y = 0$  when  $x = 1$  (AI 2017)
96. Solve the differential equation:  $(\tan^{-1}y - x)dy = (1 + y^2)dx$  (Delhi 2015)
97. Find the particular solution of the differential equation Given that  $y = 0$  when  $x = 1$   $\frac{dy}{dx} = \frac{xy}{x^2 + y^2}$  (Delhi 2015)
98. Show that the differential equation  $\frac{dy}{dx} = \frac{y^2}{xy - x^2}$  is a homogenous and also solve it. (AI 2015)
99. Find the particular solution of the differential equation  $(\tan^{-1}y - x)dy = (1 + y^2)dx$  Given that  $x = 1$  when  $y = 0$  (AI 2015)
100. Solve the following differential equation:  $\left[y - x \cos\left(\frac{y}{x}\right)\right] dy + \left[y \cos\left(\frac{y}{x}\right) - 2x \sin\left(\frac{y}{x}\right)\right] dx = 0$  (Foreign 2015)
101. Solve the following differential equation:  $(\sqrt{1 + x^2 + x^2 y^2 + y^2})dx + xy dy = 0$  (Foreign 2015, AI 2010)
102. Find the particular solution of the differential equation  $x \frac{dy}{dx} + y - x + xy \cot x = 0$ ;  $x \neq 0$  Given that  $y = 0$  when  $x = \frac{\pi}{2}$  (Delhi 2015C)
103. Solve the following differential equation:  $(xy + y^2)dx + x^2 dy = 0$  Given that  $y = 1$  when  $x = 1$  (Delhi 2015C, 2013C, 2010)
104. Solve the following differential equation:  $(x \sin^2\left(\frac{y}{x}\right) - y) dx + x dy = 0$  Given that  $y = \frac{\pi}{4}$  when  $x = 1$  (AI 2015C, 2014C, 2013C, 2013)
105. Solve the following differential equation:  $\frac{dy}{dx} - 3y \cot x = \sin 2x$  Given that  $y = 2$  when  $x = \frac{\pi}{2}$  (AI 2015C)
106. Solve the following differential equation:  $x \frac{dy}{dx} \sin\left(\frac{y}{x}\right) + x - y \sin\left(\frac{y}{x}\right) = 0$  Is a homogenous. Find the particular solution of the differential equation. Given that  $x = 1$  when  $y = \frac{\pi}{2}$  (Delhi 2013)
107. Solve the following differential equation:  $(2ye^{x/y})dx + (y - 2xe^{x/y})dy = 0$  Is a homogenous. Find the particular solution of the differential equation. Given that  $x = 0$  when  $y = 1$

(AI 2012C, Delhi 2013)

108. Solve that differential equation:  $(xe^{x/y} + y)dx = xdy$  is a homogenous. Find the particular solution of the differential equation. Given that  $x = 1$  when  $y = 1$  (Delhi 2013)
109. Find the particular solution of the differential equation  $(\tan^{-1} - x)dy = (1 + y^2)dx$  Given that  $x = 0$  when  $y = 0$  (AI 2013)
110. Find the particular solution of the differential equation  $\frac{dy}{dx} + x \cot y = 2y + y^2 \cot y$  ;  $y \neq 0$  Given that  $x = 0$  when  $y = \frac{\pi}{2}$  (AI 2013)
111. Find the particular solution of the differential equation  $(3xy + y^2)dx + (x^2 + xy)dy = 0$  Given that  $x = 1, y = 1$  (Delhi 2013C)
112. Find the particular solution of the differential equation Given that  $y = 0$  when  $x = 1$   
 $(xy + x^2)dy = (x^2 + y^2)dx$  (Delhi 2013C)
113. Find the particular solution of the differential equation  $(x - y)\frac{dy}{dx} = x + 2y$  Given that when  $x = 1, y = 0$  (AI 2013C)
114. Find the particular solution of the differential equation  $x \cos\left(\frac{y}{x}\right) = y \cos\left(\frac{y}{x}\right) + x$  Given that  $x = 1$  when  $y = \frac{\pi}{4}$  (AI 2013C)
115. Solve the following differential equation  $x \cos\left(\frac{y}{x}\right) (y dx + x dy) = y \sin\left(\frac{y}{x}\right) (xdy - ydx)$  (AI 2013C, 2010C)



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