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## Govt. Ghazali Degree College, Jhang

(Important Short Questions)

Course: Calculus and Analytic Geometry

Chapter # 02

Differentiation

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Following short questions are selected from previous 5 years papers of different boards. Solve these at your own to perform well in annual exams.

1. Define derivative of a function.
2. What is the geometrical interpretation of derivative?
3. Prove that derivative of a constant is zero.
4. Find  $\frac{dy}{dx}$  by definition if  $y = \frac{1}{x^2}$ .
5. Find the derivative of  $x^{100}$  by definition.
6. Differentiate  $\cos\sqrt{x} + \sqrt{\sin x}$  w.r.t.  $x$ .
7. Differentiate  $\sinh^{-1}\left(\frac{x}{2}\right)$  w.r.t.  $x$ .
8. Differentiate  $x^{-3} + 2x^{\frac{-3}{2}}$  w.r.t.  $x$ .
9. Differentiate  $y = e^{f(x)}$  w.r.t.  $x$ .
10. Differentiate  $\frac{(1+\sqrt{x})(x-x^{\frac{3}{2}})}{\sqrt{x}}$  w.r.t.  $x$ .
11. Differentiate  $\frac{\sqrt{a-x}}{a+x}$  w.r.t.  $x$ .
12. Differentiate  $\frac{ax+b}{cx+d}$  w.r.t.  $\frac{ax^2+b}{cx^2+d}$ .
13. Differentiate  $(\sqrt{x} - \frac{1}{x})^2$  w.r.t.  $x$ .
14. Differentiate  $(1+x^2)^n$  w.r.t.  $x$ .
15. Differentiate  $\sin^3 x$  w.r.t.  $x$ .
16. Differentiate  $\sin x$  w.r.t.  $\cot x$ .
17. Differentiate  $y = a^x$  w.r.t.  $x$ .
18. Find  $\frac{dy}{dx}$  if  $y = x \cos y$ .
19. Find  $\frac{dy}{dx}$  if  $y = \frac{x}{\ln x}$ .
20. Find  $y_2$  if  $y = xe^{-x}$ .
21. Find  $\frac{dy}{dx}$  if  $y = \frac{a+x}{a-x}$ .
22. Find  $\frac{dy}{dx}$  if  $x = 1 - t^2$ ,  $y = 3t^2 - 2t^3$ .

23. Find  $\frac{dy}{dx}$  if  $y = \ln(\ln x)$ .
24. Find  $y_2$  if  $x = a \cos \theta$ ,  $y = a \sin \theta$ .
25. Find  $\frac{dy}{dx}$  if  $y = x\sqrt{\ln x}$ .
26. Find  $\frac{dy}{dx}$  if  $x^2 + y^2 = a^2$ .
27. Find  $\frac{dy}{dx}$  if  $y = \cos^{-1} x$ .
28. Find  $\frac{dy}{dx}$  if  $x = y \sin y$ .
29. Find  $\frac{dy}{dx}$  if  $y = e^{\sqrt{x}-1}$ .
30. Find  $\frac{dy}{dx}$  if  $y^2 - xy - x^2 + 4 = 0$ .
31. Find  $\frac{dy}{dx}$  if  $y = (\ln x)^{\ln x}$ .
32. Find  $y_4$  if  $y = \cos^3 x$ .
33. Find  $\frac{dy}{dx}$  if  $y = (x - 5)(3 - x)$ .
34. Find  $\frac{dy}{dx}$  if  $y = \tan(\pi \tan^{-1} x)$ .
35. Find  $\frac{dy}{dx}$  if  $y = x^3 e^{\frac{-1}{x}}$ .
36. Find  $y_2$  if  $y = -x^5 + 3x^4 - 4x^3 + x + 2$ .
37. Find  $\frac{dy}{dx}$  if  $y = a \cos(\ln x) + b \sin(\ln x)$ .
38. Find  $\frac{dy}{dx}$  if  $y = (\sqrt{x} - \frac{1}{\sqrt{x}})^2$ .
39. Find  $\frac{dy}{dx}$  if  $y = \ln(e^x + e^{-x})$ .
40. Find  $\frac{dy}{dx}$  if  $y = \sinh^{-1} x$ .
41. Find  $\frac{dy}{dx}$  if  $x = at^2$  and  $y = 2at$ .
42. Find  $\frac{dy}{dx}$  if  $y = \tanh(x^2)$ .
43. Find  $\frac{dy}{dx}$  if  $y = \log_{10}(ax^2 + bx + c)$ .
44. Find  $y_2$  if  $x^2 + y^2 = a^2$ .
45. Find  $\frac{dy}{dx}$  if  $y =$
46. Find  $y_2$  if  $x^3 - y^3 = a^3$ .
47. Find  $\frac{d}{dx}(\cot^{-1} \frac{x}{a})$ .
48. Find  $\frac{dy}{dx}$  if  $y = \tanh(x^2)$ .
49. Find  $\frac{dy}{dx}$  if  $y = \ln(\tanh x)$ .

50. Find  $\frac{dy}{dx}$  if  $y = \ln(x^2 + 2x)$ .
51. Find  $\frac{d^2y}{dx^2}$  if  $x = at^2$ ,  $y = bt^4$ .
52. Find  $\frac{dy}{dx}$  if  $y(x^2 - 1) = x\sqrt{x^2 + 4}$ .
53. Prove that  $\frac{d}{dx}(\cos^{-1}x) = -\frac{1}{\sqrt{1-x^2}}$ .
54. Prove that  $\frac{d}{dx}(\sin^{-1}x) = \frac{1}{\sqrt{1-x^2}}$ .
55. Prove that  $\frac{d}{dx}(\log_a x) = \frac{1}{x \ln a}$ .
56. If  $y = e^{-2x} \sin 2x$ , find  $\frac{d^2y}{dx^2}$ .
57. If  $x = a \cos^3 \theta$ ,  $y = b \sin^3 \theta$ , show that  $\frac{dy}{dx} + b \tan \theta = 0$ .
58. What do you mean by power series?
59. Applying Maclaurin's series, prove that  $\cos x = 1 - \frac{x^2}{2} + \frac{x^4}{4} - \dots$
60. Applying Maclaurin's series, prove that  $e^{2x} = 1 + 2x + \frac{4x^2}{2!} + \dots$
61. Using Maclaurin's series expansion, write first two terms of  $f(x) = \sqrt{1+x}$ .
62. Write Maclaurin's series expansion of  $(1+x)^n$ .
63. Write Maclaurin's series expansion of  $a^x$ .
64. Applying Maclaurin's series, prove that  $e^{x+h} = e^x(1 + h + \frac{h^2}{2!} + \dots)$ .
65. Define stationary point.
66. Define point of inflection.
67. Find critical values of  $f(x) = \sin x + \cos x$ .
68. Find the critical points for  $f(x) = 3x^2 - 4x + 5$ .
69. Define increasing and decreasing function.
70. Determine the intervals in which  $f(x) = 4 - x^2$ ,  $x \in (-2, 2)$  increases or decreases.
71. Determine the interval in which  $f(x) = x^3 - 6x^2 + 9x$  is increasing.
72. Determine the intervals in which  $f(x) = x^2 + 3x + 2$ ,  $x \in (-4, 1)$ .
73. Find the interval in which  $f$  is increasing or decreasing:  $f(x) = \sin x$ ,  $x \in [-\pi, \pi]$ .
74. Find the extreme values of the function  $f(x) = 3x^2$ .

Best of Luck