

# Derivative Computation Question Bank

## Topic 1 — power functions and sums

1. Find the derivative of  $ax^p + 2bx^{-q/2} + cx + d$ .  
 $a, p = -3..3 \quad q = 1, 3 \quad b = -2..2 \quad c, d = 1..6 \quad abp(p-1) \neq 0$

## Topic 2 — second derivatives

1. Find the second derivative of  $f(x) = x^{p/2} - ax^q + bx$ .  
 $p = 1, 3, 5, 7 \quad q = -4..1 \quad a = 1..3 \quad b = 1..10$
2. Find the second derivative of  $y = x^p(x^q + a) + b\pi^2$ .  
 $p = 3..5 \quad q = 1..4 \quad a, b = 1..10$

## Topic 3 — product rule

1. Suppose  $f$  and  $g$  are functions of  $x$ , with  $f' = k$  and  $g' = h$ . What is the derivative of  $fg$ ?  
 $f, g, h, k = \text{various}$
2. Find the derivative of  $(ax + b)(cx^2 + dx - e)$ .  
 $a, e = 2, 4, \dots, 18 \quad b = -19, -17, \dots, 19 \quad c = 1, 3, \dots, 9 \quad d = 1..19$
3. Find the derivative of  $(ax^n + bx)(cx^{-j} + d)$ .  
 $a, c, j, n = 2..8 \quad b, d = -9..9 \quad bd \neq 0$
4. Suppose  $f$  is a function of  $x$ , with  $f' = g$ . What is the derivative of  $(ax^n + b)f$ ?  
 $a = 1..9 \quad b = -9..9 \quad b \neq 0 \quad n = 2..5$

## Topic 4 — quotient rule

1. Suppose  $f$  and  $g$  are functions of  $x$ , with  $f' = k$  and  $g' = h$ . What is the derivative of  $\frac{f}{g}$ ?  
 $f, g, h, k = \text{various}$
2. Find the derivative of  $(ax^p + b)/(x^q + cx)$ .  
 $a, p, q = 2..4 \quad b, c = -10..10 \quad d = 1..10 \quad bc < 0$
3. Find the derivative of  $(ax^p + bx)/(x^q + c)$  at  $x = 0$ .  
 $a, p, q = 2..4 \quad b = -10..10 \quad c = 1..10 \quad b \neq 0$

## Topic 5 — products with trig functions

1. Find the derivative of  $(x^p + b)f(x)$ .  
 $p = 2..4 \quad b = -9..9 \quad b \neq 0 \quad f = \cos, \sin$
2. Find the derivative of  $(ax + b)\tan(x)$ .  
 $a = 2..9 \quad b = -9..9 \quad b \neq 0 \quad f = \cos, \sin$
3. Find the derivative of  $(x^n + ax)[b + f(x)]$ .  
 $a, b = -9..9 \quad n = 2..5 \quad ab \neq 0 \quad f = \cos, \sin$

## Topic 6 — quotients with trig functions

1. Find the derivative of  $f(x)/(ax^p + b + cx^q)$ .  
 $a, c = 1..9$   $b = -9..9$   $b \neq 0$   $p = 1..6$   $q = -6..-1$   $f = \sin, \cos, \tan$
2. Find the derivative of  $(x^p + bx)/[f(x) + 2c\sqrt{x}]$ .  
 $p = 2..9$   $b = -9..9$   $c = -4..4$   $bc \neq 0$   $f = \sin, \cos, \tan$
3. Find the derivative of  $[a + bf_1(x)]/[c + df_2(x)]$ .  
 $b, d = 1..9$   $a, c = -9..9$   $ac \neq 0$   $f_1, f_2 = \cos, \sin$   $f_1 \neq f_2$

## Topic 7 — products with exp and log functions

1. Find the derivative of  $(a\theta^p + b\theta^q)(e^\theta + c\theta^{m/n})$ .  
 $p = 2..6$   $q = -6..-1$   $k = 1..5$   $n = 2..5$   $k \neq n, 2n$   $m = k + n$   $a = 1..9$   $b, c = -9..9$   $bc \neq 0$   $\theta = \text{various}$
2. Find the derivative of  $(ax^p + bx^q)(\ln x + cx^n)$ .  
 $q = 2..4$   $p = q + (1..3)$   $n = 2..5$   $a = 1..9$   $b, c = -9..9$   $bc \neq 0$
3. Find the derivative of  $(ax^p + b)n^x$ .  
 $p = 2..6$   $n = 2..5$   $a = 1..9$   $b = -9..9$   $b \neq 0$

## Topic 8 — quotients with exp and log functions

1. Find the derivative of  $\ln x/(cx^n + de^x)$ .  
 $c, d = 1..9$   $n = 2..5$
2. Find the derivative of  $e^x/(cx^n + d \ln x)$ .  
 $c, d = 1..9$   $n = 2..5$

## Topic 9 — chain rule

1. Find the derivative of  $(ax^n - b)^m$ .  
 $a, b = 2..8$   $n = 2..4$   $m = 4..8$
2. Find the derivative of  $\sqrt{ax^2 + 2bx + c}$ .  
 $a, c = 1..6$   $b = -6..6$   $b \neq 0$

## Topic 10 — chain rule with trig functions

1. Find the derivative of  $f(ax^n + b)$ .  
 $a = 2..9$   $b = -9..9$   $b \neq 0$   $n = 2..5$   $f = \sin, \cos, \tan$
2. Find the derivative of  $af^n(x)$ .  
 $a = 2..6$   $n = 2..5$   $f = \sin, \cos$
3. Find the derivative of  $\sqrt{bx + f(x)}$ .  
 $b = 2..6$   $f = \sin, \cos$

### Topic 11 — chain rule with exp and ln

1. Find the derivative of  $e^{ax}$ .  
 $a = -9..-1$   $x = \text{"x"}, \text{"y"}, \text{"z"}, \text{"t"}, \text{"u"}, \text{"v"}, \text{"w"}$
2. Find the derivative of  $\ln(ax^n + b)$ .  
 $a = 1..9$   $b = -9..9$   $b \neq 0$   $n = 2..5$
3. Find the derivative of  $(bx + e^{-ax})^n$ .  
 $n = 2..15$
4. Find the derivative of  $(\ln x)^n$ .  
 $a, b = 1..9$   $n = 2..5$

### Topic 12 — repeated chain rule

1. Find the derivative of  $f^m(ax^n + b)$ .  
 $a, b = 2..6$   $m, n = 2..5$   $f = \sin, \cos$
2. Find the derivative of  $\ln(f(x^2 + bx + c))$ .  
 $b, c = 1..9$   $f = \sin, \cos$
3. Find the derivative of  $f(e^{ax^n})$ .  
 $a = 2..6$   $n = 2..5$   $f = \sin, \cos$
4. Find the derivative of  $f(\sqrt{2ax^n + b})$ .  
 $a = 1, 2$   $b = -9, -7, \dots, 9$   $n = 2..5$   $f = \sin, \cos$

### Topic 13 — chain rule with product rule

1. Find the derivative of  $x^m e^{ax^n}$ .  
 $a = -6..6$   $a(a-1)(a+1) \neq 0$   $m, n = 2..5$
2. Find the derivative of  $f(x^n e^{ax})$ .  
 $a = -6..6$   $a \neq 0$   $n = 2..6$   $f = \sin, \cos$
3. Find the derivative of  $e^{ax}/(x^m + c)^n$ .  
 $a = 1..6$   $c = -9..9$   $c \neq 0$   $m, n = 2..5$
4. Find the derivative of  $\ln(x^n e^{-ax} + bf(x))$ .  
 $a, b, n = 2..6$   $f = \sin, \cos$

### Topic 14 — implicit differentiation

1. Find  $dy/dx$  if  $bx^m + y^n = a\pi$ .  
 $a = -9..9$   $b, c = 2..9$   $n = 2..5$   $m = -5..5$   $am(m-1) \neq 0$
2. Find  $dy/dx$  if  $x^m y^n + x^p = ay^q$ .  
 $a = 2..9$   $m, n, p, q = 2..6$