

**Problem 1.** Calculate derivatives / higher-order derivatives.

1.  $\left(\frac{x^2+1}{x^2-1} + \frac{x^2}{x+2}\right)' =$

2.  $\left(\frac{x \tan x}{1+\cos x}\right)' =$

3.  $\frac{d}{dt}\left(\frac{t+\sin t}{t^2 \cos t}\right) =$

4.  $(x^2 \cos x + x^3)'' =$

5.  $(x^5 + \sin x)^{(29)} =$

**Problem 2.** Some values of  $f(x)$  is given as:

$x$	0	1	2	3	4
$f(x)$	-1	2	6	13	23

Approximate  $f'(3)$  in the best possible way.

**Problem 3.** Use the ‘amount of change’ formula to estimate  $\sqrt{3.999}$ . (Hint: write  $\sqrt{3.999}$  as  $f(a + h)$  for properly chosen function  $f(x)$  and numbers  $a, h$ .)

**Problem 4.** A particle at the origin starts to move at  $t = 0$ . Its position at time  $t$  is given by

$$s(t) = \frac{1}{t+1} + \frac{t}{4} + k, \quad t \geq 0$$

where  $k$  is a constant.

- (1) Find  $k$ .
- (2) Find the particle’s velocity and acceleration (as functions of  $t$ ).
- (3) Find the time(s) at which the particle is at rest.
- (4) Find the time interval(s) during which the particle is moving forward.