

**Question 1:**

(a)[5 points] Use a linear approximation to estimate  $\sqrt{102}$ .

(b)[5 points] Let  $f(x) = \frac{\ln(1+x^2)}{\cos(\pi x)}$ . Compute  $f'(0)$ .

**Question 2 [10 points]:**

The top of a 5 m long ladder leans against a vertical wall. The top of the ladder slides down the wall as the bottom is pulled horizontally away from the wall at  $\frac{1}{3}$  m/s. At what rate is the top of the ladder sliding down the wall when the top of the ladder is 3 m above the ground?

**Question 3 [10 points]:**

Determine the absolute maximum and absolute minimum values of  $f(x) = e^{x^2-4x+4}$  on  $[1, 4]$ .

**Question 4:**

(a)[8 points] Determine the intervals of increase and decrease of  $f(x) = (x^2 - 1)^3$ .

(b)[2 points] Use your results in part (a) to find all local extreme values of  $f(x) = (x^2 - 1)^3$ .

**Question 5:**

(a)[5 points] The function  $f(x) = x^4 e^x$  has second derivative  $f''(x) = e^x x^2 (x + 6)(x + 2)$ . Determine the intervals of concavity of  $f(x)$ . It is not necessary to determine the inflection points.

(b)[5 points] Use logarithmic differentiation to determine  $y'$  if  $y = (\sin x)^{\ln x}$ .