Question 1:

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

(b)[5 points]   Let $f(x) = \dfrac{\ln\left(1 + x^2\right)}{\cos(\pi x)}$. 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 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 $y = (\sin x)^{\ln x}$.