1. Consider the function $y = f(x) = x^3 - 3x^2 + 4$.

(i) Find the y-intercept.

(ii) Show that $x = 2$ and $x = -1$ are roots.

(iii) Find the first and second derivatives.

(iv) Find the turning points and use the *second derivative test* to classify them as local maxima or minima.

(v) Find the x-values for which y is increasing/decreasing.

(vi) Find the point(s) of inflection.

(vii) Find the x-values for which y is concave up/concave down.

(viii) Sketch the graph of $y = x^3 - 3x^2 + 4$, labeling the various points found above.

2. Differentiate each of the following functions:

(i) $y = x^3 e^x$ (ii) $y = e^x \ln x$ (iii) $P = \ln(Q\sqrt{Q})$

(iv) $y = \dfrac{3x}{4x+1}$ (v) $s = \dfrac{\ln t}{t^2}$ (vi) $y = (3x+1)^{20}$

(vii) $y = \sqrt{x^2+4}$ (viii) $f(x) = \ln(7x-6)$ (ix) $Q = e^{5-3L}$

(x) $P = e^{3Q-Q^2}$ (xi) $y = x^2 e^{-3x}$ (xii) $s = \ln(t^5 + 3t)$.