1. A liquid, being unable to expand freely, will form an interface with another liquid or gas

(a)For a spherical gas bubble inside a liquid, provide an equation that describes the condition of equilibrium of normal stresses across this static interface, and give physical interpretation of this equation
(This equation is known as Young-Laplace equation, use σ for surface tension, $\triangle P$ for pressure difference and R for radius of the sphere)

(15%)

(b)For a liquid with surface tension σ=0.1 n/m and radius $R=10^{-3}$ m, calculate the pressure difference across the bubble/liquid interface.

(10%)

2. The pressure distribution of a steady incompressible flow is given as $P=6x^2+2y+z^2+8$ Pa

(a)Calculate the pressure gradient of a fluid particle at the position

$$\bar{r}=6\bar{i}+8\bar{j}+5\bar{k}m$$

(10%)

(b)Calculate the acceleration of a fluid particle with a mass density of $1000kg/m^3$ at the same position

(15%)