82. (a) We consider a thin slab of water with bottom area A and infinitesimal thickness dh. We apply Newton's second law to the slab:

$$\begin{aligned} dF_{\text{net}} &= (p + dp)A - pA \\ &= dp \cdot A - dm \cdot g \\ &= Adp - \rho g A dh \\ &= dm \cdot a = \rho a A dh \end{aligned}$$

which gives

$$\frac{dp}{dh} = \rho(g + a) \ .$$

Integrating over the range $(0, h)$, we get

$$p = \int_0^h \rho(g + a) dh = \rho h(g + a) \ .$$

(b) We reverse the direction of the acceleration, from that in part (a). This amounts to changing a to $-a$. Thus,

$$p = \rho(g - a) \ .$$

(c) In a free fall, we use the above equation with $a = g$, which gives $p = 0$. The internal pressure p in the water totally disappears, because there is no force of interaction among different portions of the water in the bucket to make their acceleration different from g.