continuum mechanics  $\rightarrow$  surface phenomena

## Membrane Over a Fluid

An infinite membrane of surface mass density  $\sigma$  lies, at rest, in the plane z = 0, surrounded on the top and bottom by a fluid of mass density  $\rho$ . The speed of waves on the membrane (alone) is given by  $c_{\rm m}$ , and the speed of waves in the fluid (alone) is given by  $c_{\rm f}$ .

(a) Show that plane waves propagate on the membrane according to the dispersion relation

$$k^2 = rac{\omega^2}{c_{
m m}^2} \left[ 1 + rac{2
ho}{\sigma\sqrt{k^2 - rac{\omega^2}{c_{
m f}^2}}} 
ight]$$

- (b) Show that there are two modes which can propagate. Sketch the dispersion relations for each of these modes.
- (c) Under what conditions will the waves be damped? What is the physical reason for this?