At the inlet to a constant diameter section of the Alaskan pipeline, the pressure is 8.5 MPa (gage) and the elevation is 45 m. At the outlet the elevation is 115 m. The head loss in this section of pipeline is 6.9 kJ/kg. Assume the oil has a specific gravity of 0.9. Calculate the outlet gage pressure.

SOLUTION:
Apply the Extended Bernoulli Equation from one end of the tube to the other,

$$\left(\frac{p}{\rho g}+\alpha\frac{\bar{V}^2}{2g}+z\right)_2=\left(\frac{p}{\rho g}+\alpha\frac{\bar{V}^2}{2g}+z\right)_1-H_{L,12}+H_{S,12} \quad (1)$$

where,

$p_1=8.5$ MPa (gage),
$\left(\alpha\frac{\bar{V}^2}{2g}\right)_2=\left(\alpha\frac{\bar{V}^2}{2g}\right)_1$
(the mass flow rate and pipe diameter are constant; assume turbulent flow at both sections since the we're dealing with a large pipe diameter (it's the Alaskan pipeline, after all),
$z_2-z_1=115$ m – 45 m = 70 m,
$h_{L,12}=6.9$ kJ/kg => $H_{L,12}=h_{L,12}/g=703.3$ m,
$H_{S,12}=0$.

Substitute and solve for the outlet pressure,

$$\frac{p_2}{\rho g}=\frac{p_1}{\rho g}+(z_1-z_2)-H_{L,12}. \quad (2)$$

Using the given data,

ρ = 900 kg/m^3 (SG_{oil} = 0.9),
g = 9.81 m/s^2,
p_1 = 8.5 MPa (gage),
$z_1 - z_2$ = -70 m,
$H_{L,12}$ = 703.3 m,
=> $\boxed{p_2 = 1.67 \text{ MPa (gage)}}$