Solutions

2.1

- Gauge pressure from depth: $p = \rho g h = 998 \times 9.81 \times 4.0 = \mathbf{39.2}$ kPa.
- Absolute adds the atmosphere: $p_{abs} = 101.3 + 39.2 = \mathbf{140.5}$ kPa.

2.2

- Centroid depth $h_c = h_{top} + h/2 = 2.0 + 0.75 = 2.75$ m; $A = 1.5$ m^2.
- $F = \rho g h_c A = 998 \times 9.81 \times 2.75 \times 1.5 = \mathbf{40.4}$ kN.
- $I_c = b h^3/12 = 1.0 \times 1.5^3/12 = 0.281$ m^4; $y_{cp} = y_c + I_c/(y_c A) = 2.75 + 0.281/(2.75 \times 1.5) = \mathbf{2.818}$ m.

2.3

- The water columns cancel except over Δh: $\Delta p = (\rho_m - \rho) g \Delta h = (13.6 - 1) \times 998 \times 9.81 \times 0.08 = \mathbf{9.87}$ kPa.

3.1

- (a) Linear profile, so $du/dy = V/h$: $\tau = \mu V/h = 0.29 \times 1.5/0.0008 = \mathbf{544}$ Pa.
- (b) $F = \tau A = 543.75 \times 0.4 = \mathbf{218}$ N.
- (c) $P = FV = 217.5 \times 1.5 = \mathbf{326}$ W, all turned to heat in the oil.

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