(a) $B = W$

H93 $\quad \frac{17W(1)}{20\,s} = W$

no. 9 $\quad s = \frac{17}{20}$

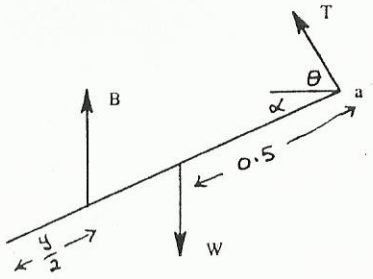
Let x = depth of layer of oil; A = cross-sectional area

$B_{WATER} + B_{OIL} = W$

$1000A(20-x)g + 800Axg = 850A(20)g$ or $\frac{\frac{(20-x)W(1)}{20}}{17/20} + \frac{\frac{xW(0.8)}{20}}{17/20} = W$

$x = 15$ cm.

(b) (i)



horiz: $T\cos\theta = 0 \Rightarrow \cos\theta = 0$

$\Rightarrow \theta = 90°$

(ii) $B = \frac{y\,W\,(1)}{0.64}$

moments about a:

$W(0.5)\cos\alpha = B(1 - 0.5y)\cos\alpha$

$0.32 = y - 0.5y^2$

$y^2 - 2y + 0.64 = 0$

$(y - 0.4)(y - 1.6) = 0$

$y = 0.4$ m.

10 (a) $(x^2 + 2)\frac{dy}{dx} = x(y + 1)$

H93 1993

$\int \frac{dy}{y+1} = \int \frac{x.dx}{x^2+2}$

$\ln(y + 1) = 0.5\ln(x^2 + 2) + C$

$y = 2, x = 1 \Rightarrow \ln 3 = 0.5\ln 3 + C$

$C = 0.5\ln 3$

$\ln(y + 1) = 0.5\ln(x^2 + 2) + 0.5\ln 3$

$y + 1 = \sqrt{3x^2 + 6}$

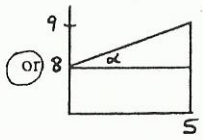
$x = 2 \Rightarrow y + 1 = \sqrt{18}$

$y = 3\sqrt{2} - 1$ or 3.24

(b) (i) retardation $= 8 + kx$

$9 = 8 + k(5)$

$k = 0.2$



$\tan\alpha = 0.2$

$y = 0.2x + 8$

$v\frac{dv}{dx} = -\left(8 + \frac{x}{5}\right)$

(ii) $\int_{20}^{0} v\,dv = -\int_{0}^{x_1}\left(8 + \frac{x}{5}\right)dx$

$\left[0.5v^2\right]_{20}^{0} = -\left[8x + \frac{x^2}{10}\right]_{0}^{x_1}$

$-200 = -8x_1 - 0.1x_1^2$

$x_1^2 + 80x_1 - 2000 = 0$

$(x_1 - 20)(x_1 + 100) = 0$

$x_1 = 20$ metres