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BIRZEIT UNIVERSITY
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Fluid First Exam
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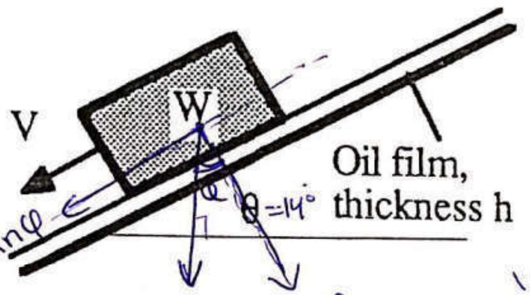
Problem 1(20 Points): ABET SO (a)

16/20

A solid aluminum disk (SG = 2.7) is 2 inches in diameter and 3/16 inch thick. It slides steadily down a 14° incline that is coated with a castor oil (SG = 0.96) film one hundredth of an inch thick. The steady slide velocity is 2 cm/s. Using Figure 1 and a linear oil velocity profile assumption, calculate the viscosity of the oil.

$\tau = \mu \frac{V}{h}$ (shear stress)



1 - 2.54
SG = 13.6

$D = 2\text{ inches} = 5.08\text{ cm}$

$\text{depth} = 0.4762\text{ cm} \approx 0.48$

$W = \rho g V$

$= (2700)(9.8)\frac{\pi}{4}(0.0508)^2(4.8\times10^{-3})$

$W = 0.257\,N$ — 8

thickness of oil film $= 2.45\times10^{-4}$ m

$\frac{2\text{ cm}}{s}\cdot\frac{1\text{ m}}{100\text{ cm}}$ → $V = 0.02$ m/s

$\tau A = W\sin\theta$

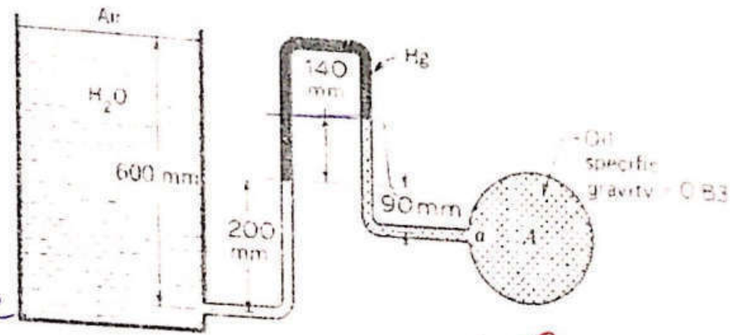
$\tau = \frac{\text{Force}}{\text{Area}} = w\cos\varphi = \frac{0.257(\cos 14)}{\frac{\pi}{4}(0.0508)} = 6.25$ — -4

$6.25 = \frac{\mu(0.02)}{2.45\times10^{-4}}$

$0.076 = \mu$ kg/m.s

...oblem 2(20 Points): ABET SO (a)

...or the setup shown in the figure below, calculate the absolute pressure at a. assume standard atmospheric pressure 101.3 kPa.



Fi...

pressure increase

pressure decrease

18

$P_{att} + \Sigma \rho g h = P_A$

$P_{atm} + (0.6)(1000)(9.8) - (0.2)(1000)(9.8) - (0.14)(13600)(9.8) + (0.23)(830)(9.8) = P_A$

$101300 + 5800 - 1960 - 18659.2 + 1870.82 = P_A$

$P_A = 88351.62$ Pa.

2

Vacume

$P_{absolute} = P_{atm} - P_{vacume}$

$= 101300 - 88351.62$

$= 12948.38$ Pa.

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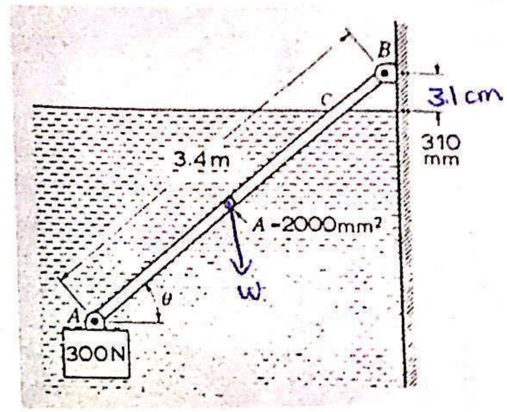
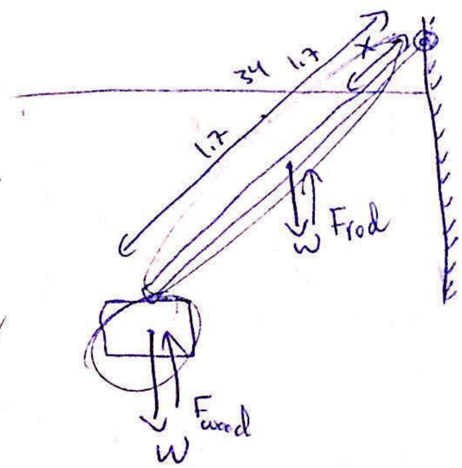
...blem 3 (30 Points): ABET SO(e)

... block of wood having a volume of 0.034 m^3 and weighing 300 N is suspended in water as shown in the figure below. A wood rod of length 3.4 m and cross sectional area of 2000 mm^2 is attached to the weight, and also to the wall. If the rod weighs 16 N what will be the angle θ for the block to be in equilibrium?



~~weigh of the rod = ρ g ∀ = 1000(9.8)(0.034) = 333.2 and it's direction on mid of the rod~~

2000 mm mm × 1m/1000 mm × 1/1000 mm



* weigh of the rod = 16 N
* 300 N = ρ g ∀

$300 = \rho(9.8)(0.034)$

$\rho_{wood} = 900.36$

$F_{wood\ block} = \rho_w g ∀ = 1000(9.8)(0.034)$

$F_{block} = 333.2\ N$

$F_{rod} = \rho_{wood}\, g\, (2000)(3.4 - x) \times 10^{-6}$

$= ~~1764705 8.82(3.4-x)~~ \quad 17.65(3.4 - x)$

$= (59.9 - 17.65x)$

-2

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