FER-Fluids.

COMPUTATION SHEET

SUBJECT _____

JOB NO. _____ SHEET NO. ____ OF ____

BY _____ DATE _____

CHKD BY _____ DATE _____

① Viscosity / Density / Pressure

② Submerged forces / bouyancy / pressure prism

③ Conservation of Mass / Momentum / energy

④ Pipe Flow

⑤ Open Flow / sewers

⑥ Pumping   pg 44 — 55

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Fluid Properties   22-5

(4) Kinematic Viscosity Can Be Expressed in which of the Following Units

    (A) m^2/s

    (B) s^2/m

    (C) $kg \cdot s^2/m$

    (D) kg/s

Solution

NCEES pg 44

Defn. Kinematic Viscosity

    L^2/T $(m^2/s) (ft^2/s)$

ANSWER (A)

22-5

(5) Which of the following does <u>not</u> affect the rise or fall of a liquid in a small-diameter capillary tube?

(a) adhesive forces

(b) cohesive forces

(c) surface tension

(d) viscosity of the fluid

<u>Solution</u>

$$h_c = 4\sigma \cos\beta / (\gamma d) \quad Pg \ 44 \ NCEES$$

$\sigma = surf. \ tension$

$\gamma = sp. \ weight$

$d = diameter$

$\beta = wetting \ angle \ (adhesion/cohesion)$

Viscosity <u>not</u> in equation

Answer (d)

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23-5
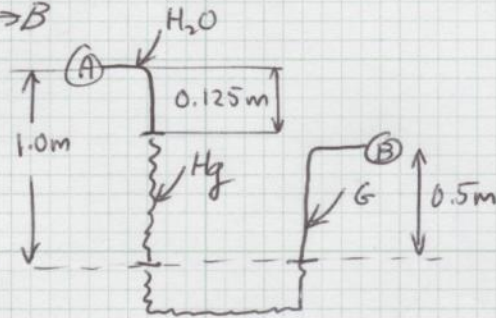
(2) Specify gravity $Hg = 13.6$. SG. glycerine $= 1.26$

For manometer shown find $\Delta p_{A \to B}$

(a) 35 kPa

(b) 42 kPa

(c) 55 kPa

(d) 110 kPa

Diagram: A — H_2O, $0.125m$, $1.0m$, Hg, B, G, $0.5m$

Solution (Rigorous)

$$p_2 = p_B + \gamma_G g h_{12}$$

$$p_2 = p_A + \gamma p g h_{4-3} + \gamma_{Hg} g h_{32}$$

pg 50, NCEES

$$p_B + SG_{gly}(\rho_w g) h_{12} = p_A + \gamma_w g h_{43} + SG_{Hg}(\rho_w g) h_{32}$$

$$p_B - p_A = \gamma_w g (0.125) + 13.6 (\gamma_w g)(0.875) - 1.26 (\gamma_w g)(0.5)$$

$$= \frac{9800 N}{m^3} (0.125 + 13.6(0.875) - 1.26(0.5)) = 111671 \, N/m^2$$

$$= 111 \, kPa$$

Answer (d)

(Solution (quick))

Hg $SG \gg H_2O$, bly

$$\Delta p \approx \gamma_{Hg} g \cdot h_{Hg} = 13.6 (9800 \, N/m^3)(0.875m) = 116,620 \, Pa$$

$$116 \, kPa$$

COMPUTATION SHEET

SUBJECT _____
_____
JOB NO. _____ SHEET NO. _____ OF _____
BY _____ DATE _____
CHKD BY _____ DATE _____

22-6

(7) What is approximate mass of concrete in 1m wide section bounded by F,B,C?

(a) 102 Mg

(b) 195 Mg

(c) 226 Mg

(d) 259 Mg

$y = 0.24x^2$

24 m.

$\rho_{con.} = 2400 \, kg/m^3$

Solution
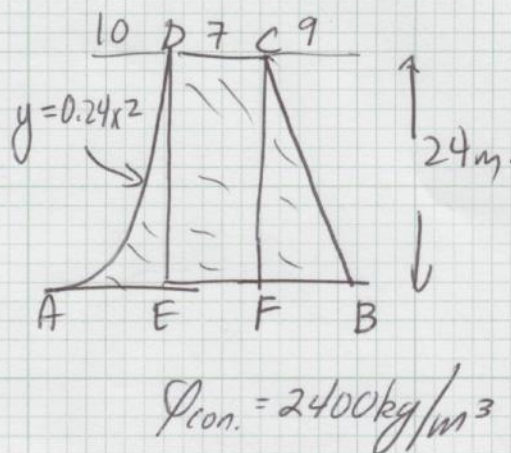
$mass = \rho \forall$

$= 2400(24)(9)(1)(1.5) \quad \sqrt{Triangle}$

$= 259200 \, kg$

$259 \, Mg$

Choose (D)

(8) What is Mass of Concrete in 1m section bounded by ADE?

(a) 192

(b) 240

(c) 288

(d) 384

Solution

Concave parabola ∴ less mass than triangle

Eliminate (c), (d)

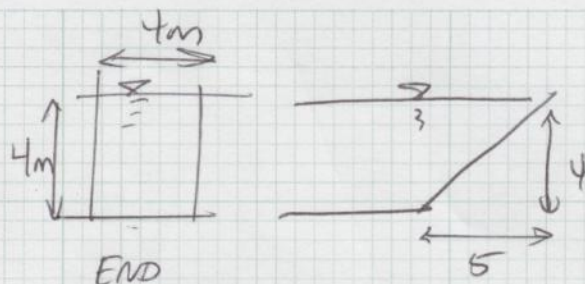NCEES pg 28 $A = \dfrac{bh}{3}$ $\dfrac{1(24)}{3} \cdot 2400 = 192\,000$ 192 Mg

Choose (A)

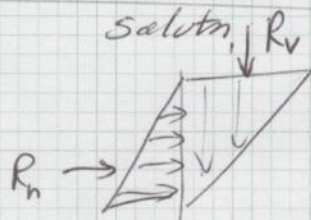T M & Transportation & Mobility Conference
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23-6

(3) What is resultant force on inclined wall?

(a) 222 kN

(b) 395 kN

(c) 503 kN

(d) 526 kN

[diagram: 4m top, 4m side, END; inclined triangle with 3, 4, 5]

(4) What is vertical force on inclined wall?

(a) 197 kN

(b) 392 kN

(c) 486 kN

(d) 544 kN

Done: Choose (B)

(5) What is horizontal force on inclined wall

(a) 197 kN

(b) 314 kN

(c) 421 kN

(d) 540 kN

Done: Choose (B)

solution

[diagram showing R_v downward, R_h horizontal, pressure distribution on inclined wall]

$$R = \sqrt{R_h^2 + R_v^2}$$

$$R_h = \frac{1}{2}\rho g (4) \cdot (4)(4)$$

$$= \frac{1}{2}(9800N)4^3 = 313600N$$

R_v = weight water above plate

$$= \rho g \left(\frac{1}{2}\right)(4)(4)(5)$$

$$= 392000N$$

$$R = \sqrt{313600^2 + 392000^2}$$

$$= 502004N \qquad 502 kN$$
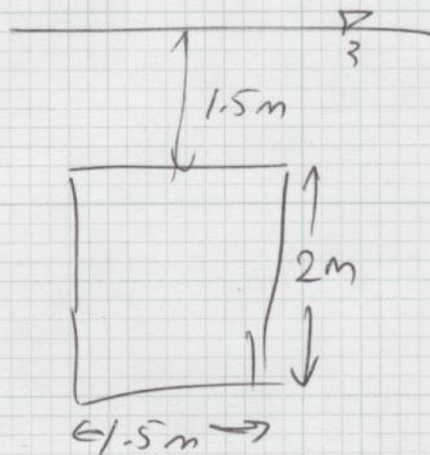
choose C

23-7

(7) What is depth of center of pressure of vertical plate
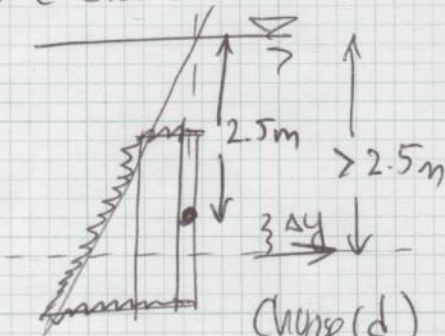if upper edge is 1.5m below water surface?

(a) 2.12 m

(b) 2.32 m

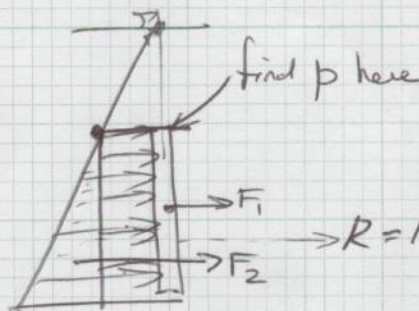(c) 2.50 m

(d) 2.63 m

Solution (Rigorous)

Solution (Simple)

Same sketch

Choose (d)

only answer
> 2.5 m

done!

$P_{1.5} = \rho g (1.5)$

$= \dfrac{9800 N}{m^3} (1.5 m)$

$R = F_1 + F_2 = 14700 \, Pa$

$F_1 = 14700 \, Pa \,(2)(1.5)$

$= 44100$ at $y = 2.5 m$

$F_2 = \frac{1}{2} \rho g (2)(2)(1.5)$

$= 29400$ at $y = 2.8 m$

$R\bar{y} = F_1(2.5) + F_2(2.8)$

$\bar{y} = \dfrac{F_1(2.5) + F_2(2.8)}{F_1 + F_2}$

$= 2.62 \, m$ Choose (d)