

**PROFESSIONAL ENGINEERING I  
SPRING 2022**

**TEST 4: FLUID MECHANICS**

**TOPICS COVERED IN TEST 4:**

**1. FUNDAMENTALS OF FLUID MECHANICS**

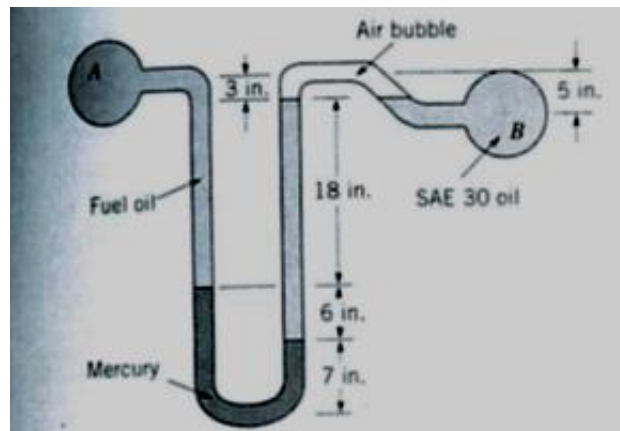
**Department of Civil & Environmental Engineering**  
**CVEG 3102: Professional Engineering I**  
**FLUID MECHANICS TEST**  
**(CLOSED Books/Notes; OPEN NCEES Formula Sheets)**  
**February 15, 2022 (IN-CLASS 2-Hour Test)**  
**Dr. I. Ahmed**

**Name:** \_\_\_\_\_

1. A solid material weighs 10.00 lb in air and 9.15 lb when completely submerged in water. The solid material's shape is irregular. Unit weight of water is 62.4 pcf. The *density* of the material is most nearly:

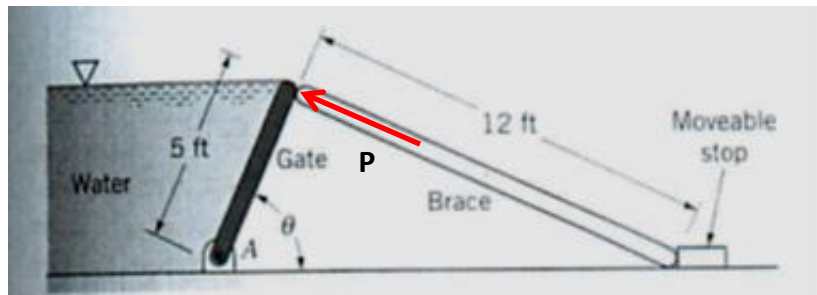
- a. 50 slug/ft<sup>3</sup>
- b. 42 slug/ft<sup>3</sup>
- c. 22 slug/ft<sup>3</sup>
- d. None of the above

2. Determine the pressure in pipe A if the pressure in B is 15.3 psi. An air pocket has got trapped in the SAE 30 oil. Fuel oil specific weight is 53 pcf, and that of SAE 30 lube oil is 57 pcf. The manometer fluid is mercury ( $s = 13.6$ ). Density of water is 1.94 slug/ft<sup>3</sup>.



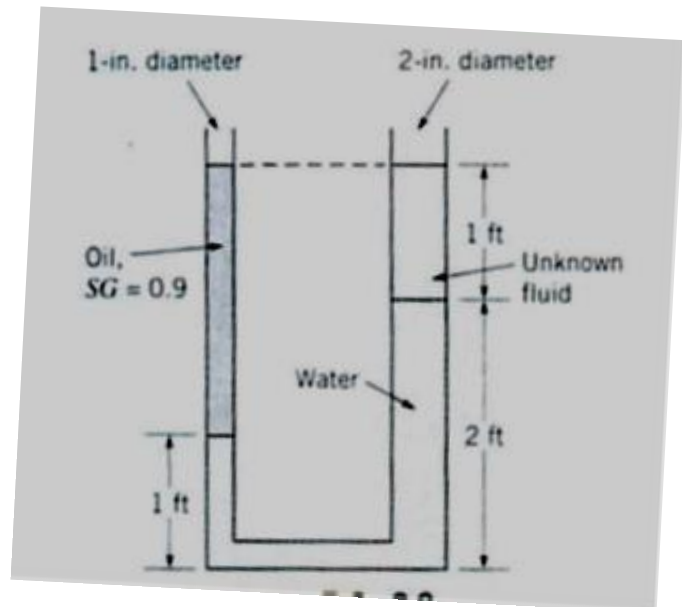
- a. 9.6 psi
- b. 12.5 psi
- c. 17.5 psi
- d. 5.0 psi

3. A rectangular gate of 10-ft width (into the paper) is hinged at A. For the angle  $\theta = 60^\circ$ , find, most nearly, the force, P (shown with an arrow) exerted by the brace on the gate at the point of contact with the free water surface. **The gate weighs 200 lb.** Unit weight of water is 62.4 pcf.



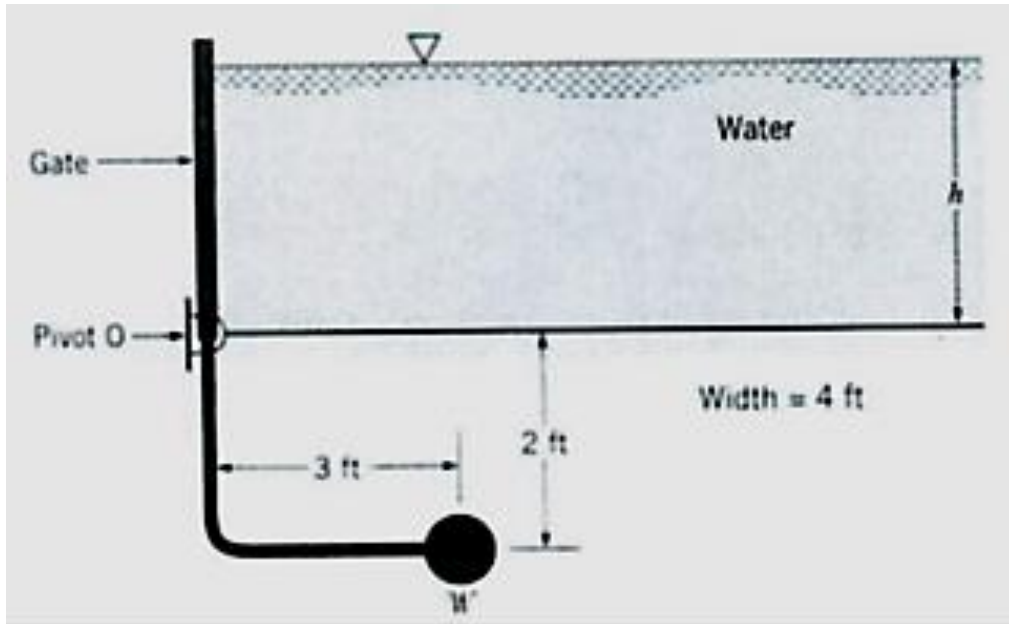
- a. 2290 lb
- b. 4230 lb
- c. 2800 lb
- d. 5035 lb

4. A U-tube with horizontal base is shown. Water, oil and an *unknown* fluid is contained in it. Determine the *density* of the unknown fluid. Atmospheric pressure is 14.7 psi. Specific weight and density of water is 62.4 pcf and 1.94 slug/ft<sup>3</sup>, respectively. **Show all work. (Sorry about the crooked shaded area behind the U-tube drawing, please ignore it.)**



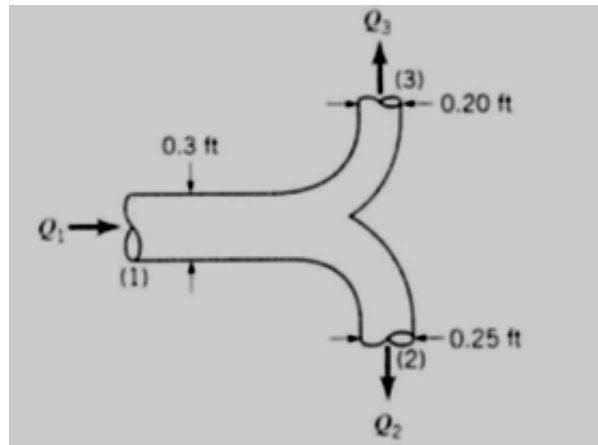
- a. 1.6 pcf
- b. 3.6 pcf
- c. 10.0 pcf
- d. 2.5 pcf

5. The 4-ft wide (into the paper) gate is pivoted (or hinged) at O. The gate is massless. The gate is held in place by the 2000 lb counterweight,  $W$  at the bottom of the figure. Determine the water depth  $h$ . Unit weight of water is 62.4 pcf. (This is not a buoyancy problem).



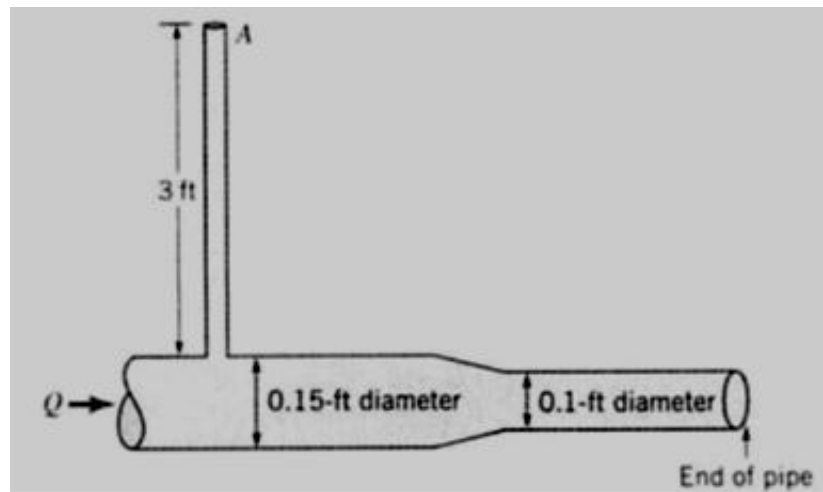
- a. 7 ft
- b. 2.5 ft
- c. 5 ft.
- d. 3.5 ft

6. A *horizontal (Bird's Eye View)* Y-fitting is shown. Flowrate and pressure in section (1) is  $Q_1 = 2.3$  cfs and  $P_1 = 50$  psi. Determine the pressure **at section (2)**, inside the pipe. Assume the flow divides evenly between pipes 2 and 3. Unit weight of water is 62.4 pcf. Flow is steady-state. Losses and viscosity effects may be neglected.



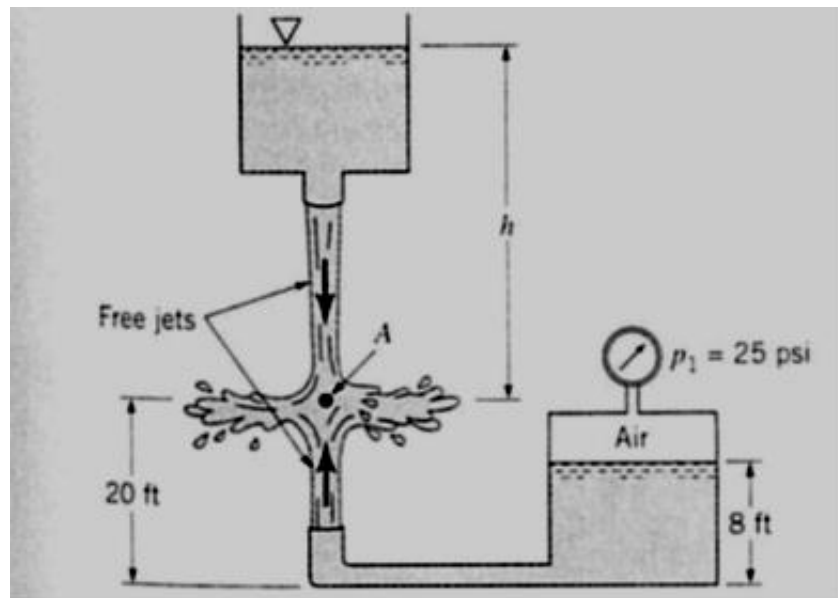
- a. 23.0 psi
- b. 72.0 psi
- c. 53.0 psi
- d. 73.0 psi

7. Determine, most nearly, the maximum flowrate if water is not to flow from the open vertical tube a A. Unit weight of fluid is 62.4 pcf.



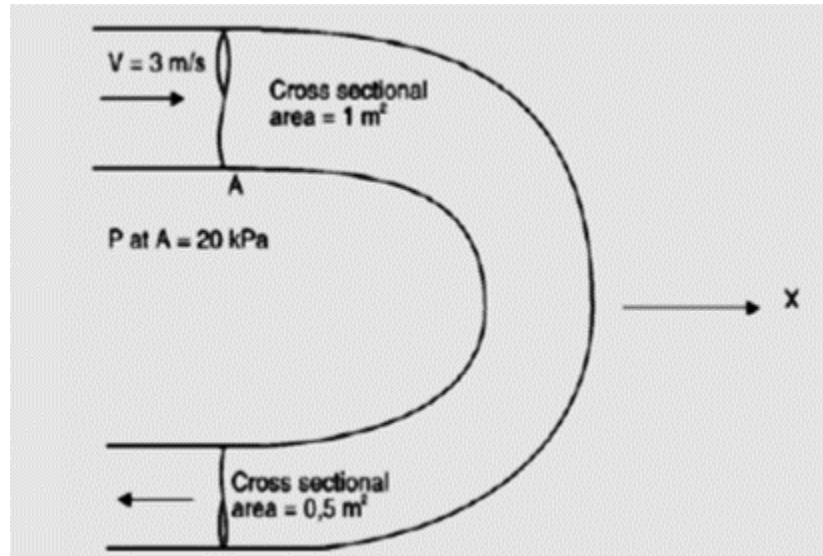
- a. 0.04 cfs
- b. 0.01 cfs
- c. 0.4 cfs
- d. 0.1 cfs

8. Two free jets of water impinge upon each other at A with same velocity  $V_A$ . Unit weight of fluid is 62.4 pcf. **Determine, most nearly, the height  $h$ .** Viscosity effects are negligible.



- a. 45 ft.
- b. 55 ft.
- c. 35 ft.
- d. None of the above

9. Water flows through a reducing 180° bend. The bend is in a horizontal plane (looking at the top view). Determine the magnitude of the force *exerted by the fluid on the bend in the x-direction*. Neglect energy losses. Density and Unit weight of water are  $1000 \text{ kg/m}^3$  and  $9800 \text{ N/m}^3$ , respectively. Pipe is pressurized.

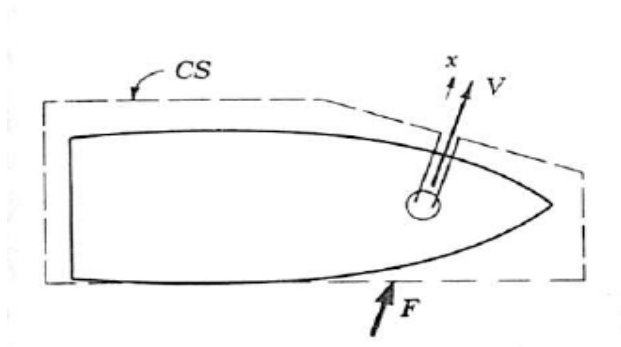


- a. 25 kN
- b. 120 kN
- c. 50 kN
- d. 66 kN

10. Water issues from a *large* tank through a circular 5-in-diameter orifice under a head of 45 ft.  $534 \text{ ft}^3$  of *water volume* is discharged in 2 **minutes**. If the diameter at the *vena contracta* is measured to be 3.93 inches, what is the *coefficient of velocity*. A clean sketch may help.

- a. 0.361
- b. 0.671
- c. 0.521
- d. 0.981

11. A jet of water 80 mm in diameter with a velocity of 40 m/s is discharged in a **horizontal x direction (as shown)** from a nozzle mounted on a boat. What force,  $F$ , is required to hold the boat *stationary*? Density of water is  $1000 \text{ kg/m}^3$ .



- a. 12 kN
- b. 3 kN
- c. 30 kN
- d. 8 kN

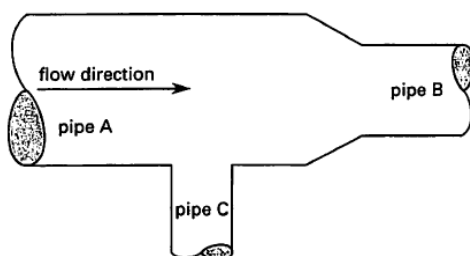
12. Water flowing in pipe divides at a tee as show in the figure. The characteristics of each pipe segment are summarized in the table. The discharge in pipe A is 0.76 cfs. What is the discharge in pipe C? *Flow is in a horizontal plane.*

| Pipe | Diameter (in.) | Pressure (psi) |
|------|----------------|----------------|
| A    | 2.5            | 100            |
| B    | 1.5            | 90             |
| C    | 1.0            | -              |

$\gamma_w = 62.4 \text{ pcf}$

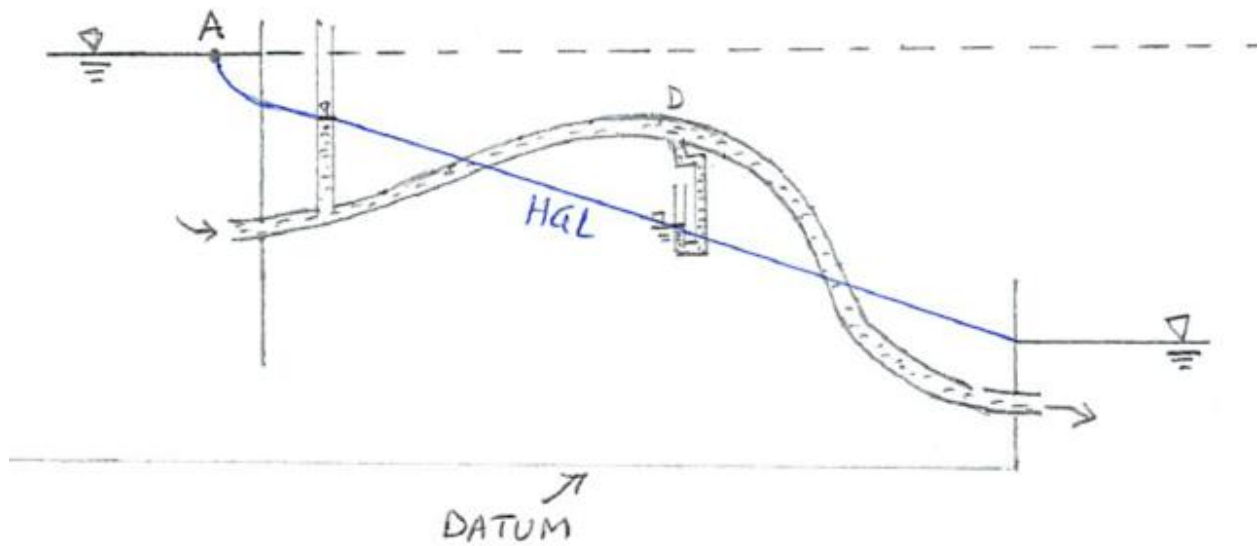
Flow is steady, inviscid and incompressible.

Neglect minor head losses



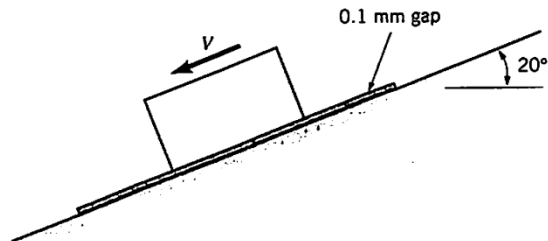
- a. 12 ft/s
- b. 50 ft/s
- c. 40 ft/s
- d. 22 ft/s

13. Is the hydraulic grade line (HGL) shown in the figure correct or incorrect *at the two piezometers?*



- a. Correct
- b. Incorrect

14. A 10-kg block slides down a smooth inclined surface as shown in the figure. Determine the terminal *velocity* of the block if the 0.1-mm gap between the block and the surface contains SAE 30W oil at 60 °F ( $\mu = 0.85 \text{ N}\cdot\text{s}/\text{m}^2$ ). Assume the velocity distribution in the gap is linear (Newtonian fluid), and the bottom area of the block in contact with the oil layer is  $0.2 \text{ m}^2$ .



- a. 0.002 m/s
- b. 0.02 m/s
- c. 0.05 m/s
- d. None of the above

15. Oil, with density  $\rho = 900 \text{ kg}/\text{m}^3$  and  $\nu = 0.00001 \text{ m}^2/\text{s}$ , flows at  $0.2 \text{ m}^3/\text{s}$  through 500m length of a 200-mm diameter cast-iron pipe ( $e = 0.26\text{mm}$ ). The *relative roughness* of the pipe is most nearly:

- a. 0.0064
- b. 0.0045
- c. 0.0013
- d. None of the above

**ABOVE AVERAGE**

06/15

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 CVEG 3102: Professional Engineering I  
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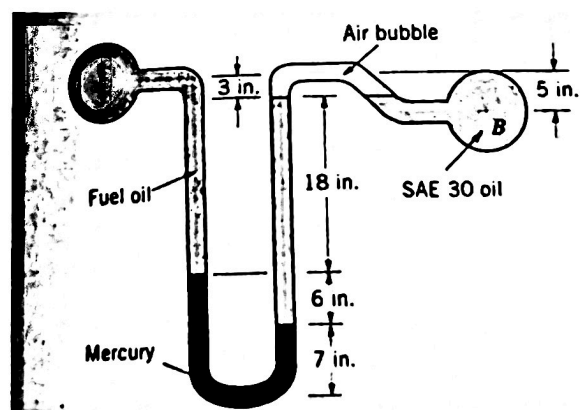
Name: Paige Hines

1. A solid material weighs 10.00 lb in air and 9.15 lb when completely submerged in water. The solid material's shape is irregular. Unit weight of water is 62.4 pcf. The density of the material is most nearly:

weight<sub>a</sub> = 10 lb  
 weight<sub>s</sub> = 9.15 lb  
 unit weight of water 62.4 pcf

- a. 50 slug/ft<sup>3</sup>
- b. 42 slug/ft<sup>3</sup>
- c. 22 slug/ft<sup>3</sup>
- ☒ d. None of the above

2. Determine the pressure in pipe A if the pressure in B is 15.3 psi. An air pocket has got trapped in the SAE 30 oil. Fuel oil specific weight is 53 pcf, and that of SAE 30 lube oil is 57 pcf. The manometer fluid is mercury (s = 13.6). Density of water is 1.94 slug/ft<sup>3</sup>.



$$\gamma_{FO} = 53 \frac{\text{lb}}{\text{ft}^3}$$

$$\gamma_{SAE} = 57 \frac{\text{lb}}{\text{ft}^3}$$

$$SG_{mer} = 13.6$$

$$\rho_w = 1.94 \frac{\text{slug}}{\text{ft}^3}$$

$$P = 15.3 \frac{\text{lb}}{\text{in}^2} \times \frac{144 \text{ in}^2}{\text{ft}^2}$$

$$P = 2203.2 \frac{\text{lb}}{\text{ft}^2}$$

$$P_A = P_B + \gamma_2 h_2 - \gamma_1 h_1$$

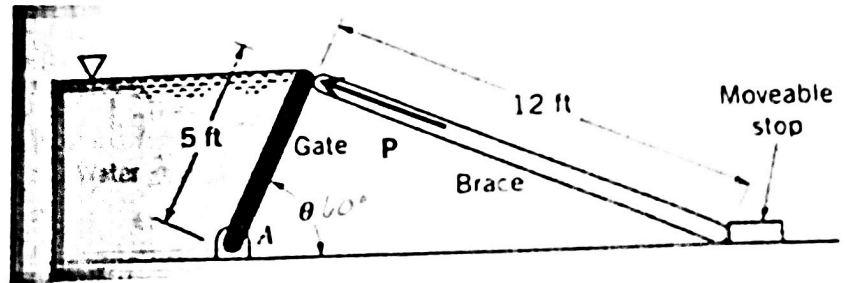
$$= 2203.2 \frac{\text{lb}}{\text{ft}^2} + 57 \frac{\text{lb}}{\text{ft}^3} (24 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}}) - 53 \frac{\text{lb}}{\text{ft}^3} (18 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}})$$

$$P_A = 2203.2 \frac{\text{lb}}{\text{ft}^2} + 114 \frac{\text{lb}}{\text{ft}^2} - 79.5 \frac{\text{lb}}{\text{ft}^2}$$

$$P_A = 2237.7 \frac{\text{lb}}{\text{ft}^2} \times \frac{1 \text{ of } 11}{144 \text{ in}^2} = 15.5 \text{ psi}$$

- a. 9.6 psi
- b. 12.5 psi
- ☒ c. 17.5 psi
- d. 5.0 psi

3. A rectangular gate of 10-ft width (into the paper) is hinged at  $A$ . For the angle  $\theta = 60^\circ$ , find, most nearly, the force,  $P$  (shown with an arrow) exerted by the brace on the gate at the point of contact with the free water surface. The gate weighs 200 lb. Unit weight of water is 62.4 pcf.



a. 2290 lb

b. 4230 lb

c. 2800 lb

d. 5035 lb

4. A U-tube with horizontal base is shown. Water, oil and an *unknown* fluid is contained in it. Determine the *density* of the unknown fluid. Atmospheric pressure is 14.7 psi. Specific weight and density of water is 62.4 pcf and 1.94 slug/ft<sup>3</sup>, respectively. **Show all work.** (Sorry about the crooked shaded area behind the U-tube drawing, please ignore it.)

$$0.9 = \frac{\rho_f}{1.9 \frac{\text{slug}}{\text{ft}^3}} = 1.71 \frac{\text{slug}}{\text{ft}^3}$$

$$P_0 = 2116.8 \frac{\text{lb}}{\text{ft}^2} + 32.4 \frac{\text{ft}}{\text{s}^2} \left( 1.71 \frac{\text{slug}}{\text{ft}^3} (2\text{ft}) - 1.94 \frac{\text{slug}}{\text{ft}^3} (2\text{ft}) \right)$$

$$14.7 \frac{\text{lb}}{\text{in}^2} \times \frac{144 \text{ in}^2}{\text{ft}^2} = 2116.8 \frac{\text{lb}}{\text{ft}^2}$$

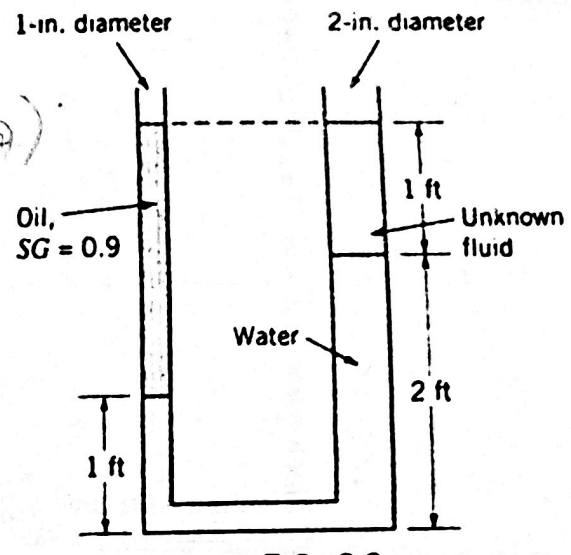
$$P_0 = 2101.9 \frac{\text{lb}}{\text{ft}^2} = 14.596 \text{ psi}$$

$$14.596 \text{ psi} = \gamma (1\text{ft} (12 \frac{\text{in}}{\text{ft}}))$$

$$14.596 \frac{\text{lb}}{\text{in}^2} \times \frac{1}{12 \text{ in}} = 1.216 \frac{\text{lb}}{\text{in}^3} = \gamma$$

- a. 1.6 pcf  
b. 3.6 pcf  
c. 10.0 pcf  
d. 2.5 pcf

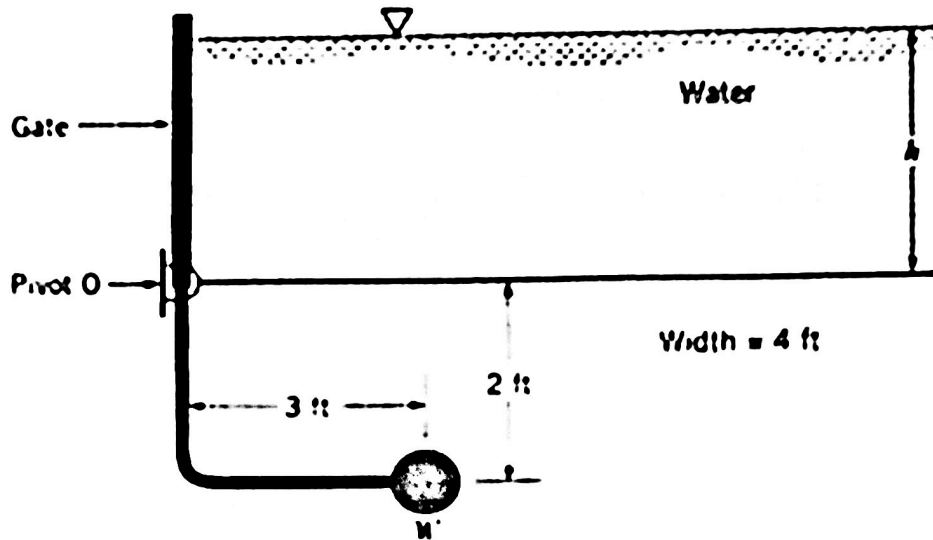
$$1.216 \frac{\text{lb}}{\text{in}^3} \times \frac{(12)^3 \text{ in}^3}{1 \text{ ft}^3}$$



$$\gamma = \rho g = 1.216 \frac{\text{lb}}{\text{in}^3} = \rho \times 32.4 \frac{\text{ft}}{\text{s}^2}$$

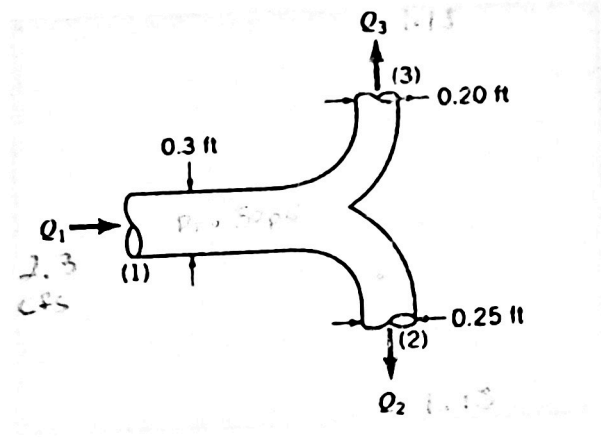
$$\frac{2101.9 \frac{\text{lb}}{\text{ft}^2}}{32.4 \frac{\text{ft}}{\text{s}^2}} = \rho \times \frac{\text{ft}}{\text{s}^2}$$

5. The 4-ft wide (into the paper) gate is pivoted (or hinged) at O. The gate is massless. The gate is held in place by the 2000 lb counterweight,  $W$  at the bottom of the figure. Determine the water depth  $h$ . Unit weight of water is 62.4 pcf. (This is not a buoyancy problem).



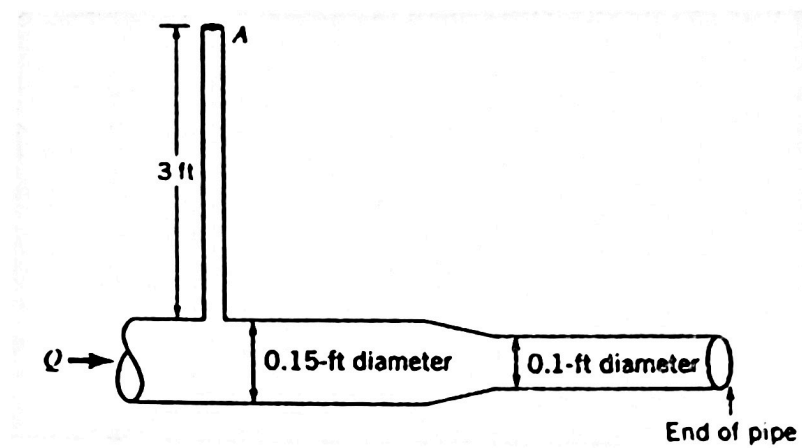
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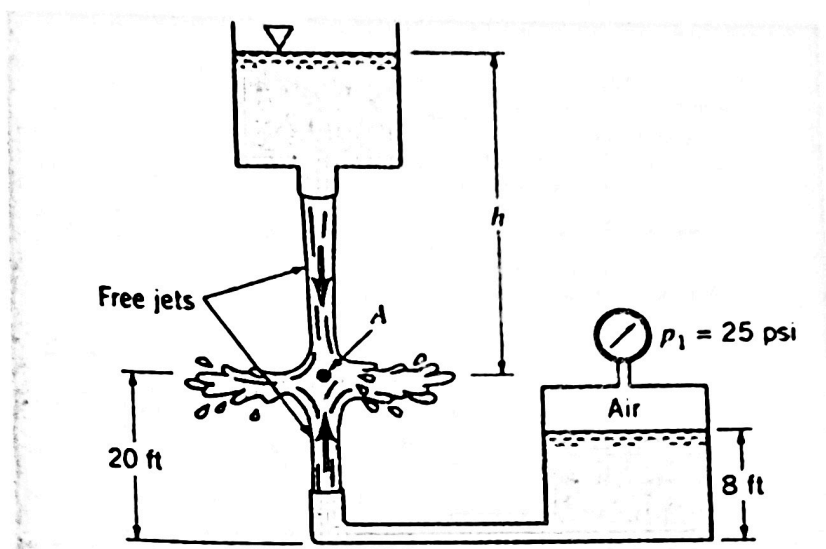
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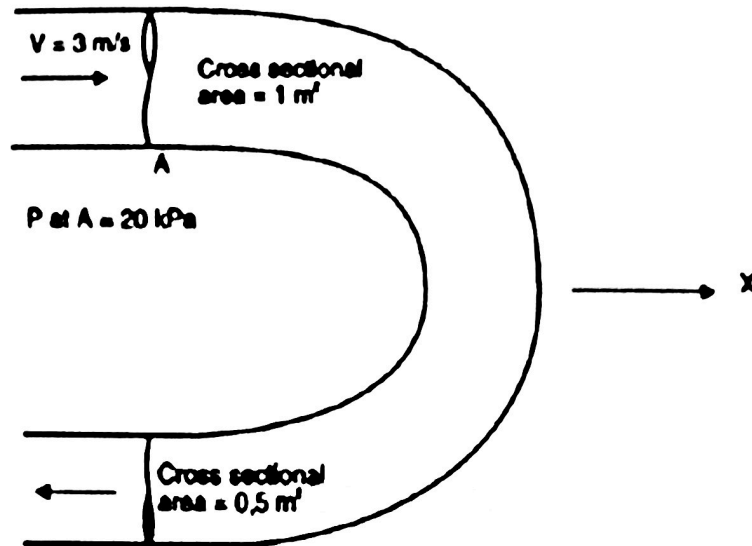
- ☒ a. 0.04 cfs  
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☐ c. 0.4 cfs  
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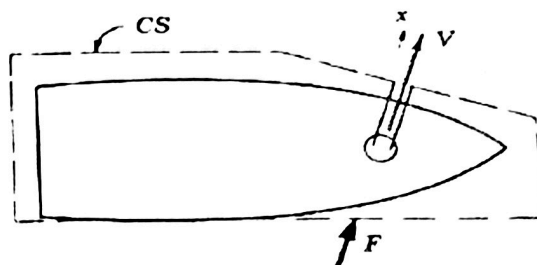


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11. A jet of water 80 mm in diameter with a velocity of 40 m/s is discharged in a **horizontal x direction (as shown)** from a nozzle mounted on a boat. What force,  $F$ , is required to hold the boat *stationary*? Density of water is  $1000 \text{ kg/m}^3$ .



- a. 12 kN
- b. 3 kN
- ~~c. 30 kN~~
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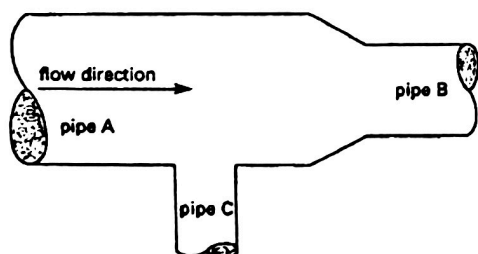
Pipe    Diameter (in.)    Pressure (psi)

|   |     |     |
|---|-----|-----|
| A | 2.5 | 100 |
| B | 1.5 | 90  |
| C | 1.0 | -   |

$\gamma_w = 62.4 \text{ pcf}$

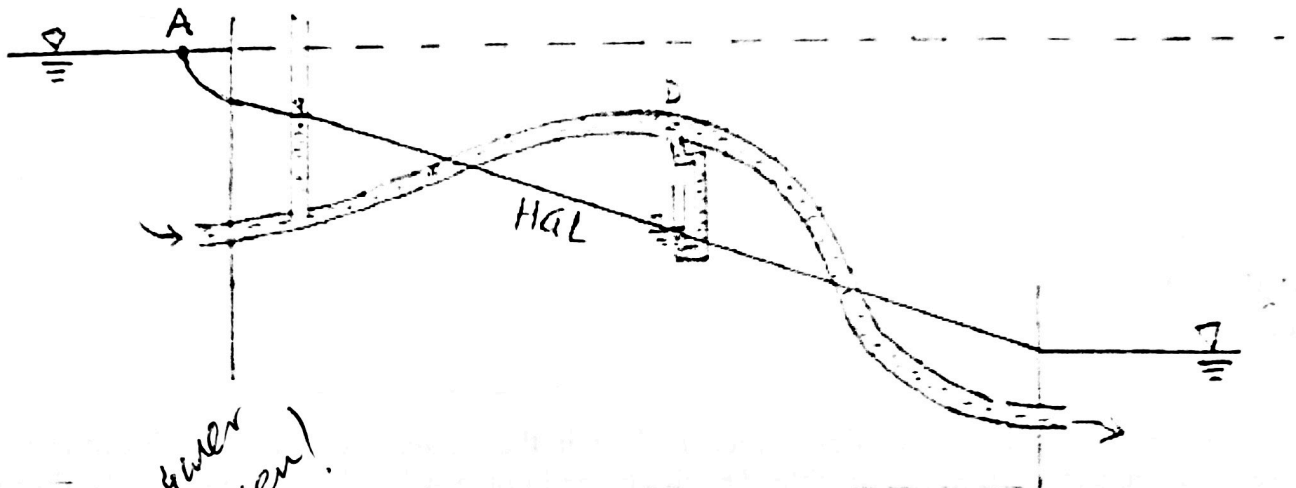
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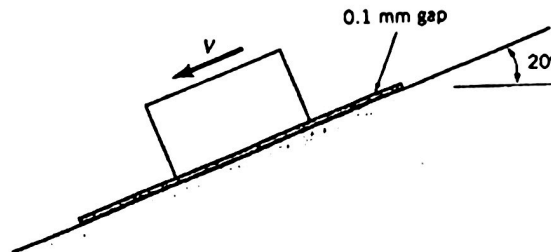
- a. 12 ft/s
- b. 50 ft/s
- c. 40 ft/s
- d. 22 ft/s

13. Is the hydraulic grade line (HGL) shown in the figure correct or incorrect *at the two piezometers?*



- a. Correct
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14. A 10-kg block slides down a smooth inclined surface as shown in the figure. Determine the terminal *velocity* of the block if the 0.1-mm gap between the block and the surface contains SAE 30W oil at 60 °F ( $\mu = 0.85 \text{ N}\cdot\text{s}/\text{m}^2$ ). Assume the velocity distribution in the gap is linear (Newtonian fluid), and the bottom area of the block in contact with the oil layer is  $0.2 \text{ m}^2$ .



- a. 0.002 m/s
- b. 0.02 m/s
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15. Oil, with density  $\rho = 900 \text{ kg}/\text{m}^3$  and  $\nu = 0.00001 \text{ m}^2/\text{s}$ , flows at  $0.2 \text{ m}^3/\text{s}$  through 500m length of a 200-mm diameter cast-iron pipe ( $e = 0.26\text{mm}$ ). The *relative roughness* of the pipe is most nearly:

- a. 0.0064
- b. 0.0045
- c. 0.0013
- d. None of the above

## **AVERAGE**

**Student sample work could  
not be collected on request**

**BELOW AVERAGE**

03/15

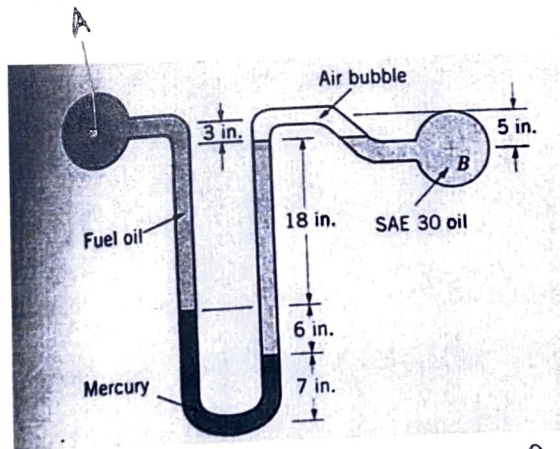
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 CVEG 3102: Professional Engineering I  
**FLUID MECHANICS TEST**  
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 Dr. I. Ahmed

Name: Michael LeBlanc

1. A solid material weighs 10.00 lb in air and 9.15 lb when completely submerged in water. The solid material's shape is irregular. Unit weight of water is 62.4 pcf. The *density* of the material is most nearly:

- a. 50 slug/ft<sup>3</sup>
- ☒ b. 42 slug/ft<sup>3</sup>
- c. 22 slug/ft<sup>3</sup>
- d. None of the above

2. Determine the pressure in pipe A if the pressure in B is 15.3 psi. An air pocket has got trapped in the SAE 30 oil. Fuel oil specific weight is 53 pcf, and that of SAE 30 lube oil is 57 pcf. The manometer fluid is mercury ( $s = 13.6$ ). Density of water is 1.94 slug/ft<sup>3</sup>.

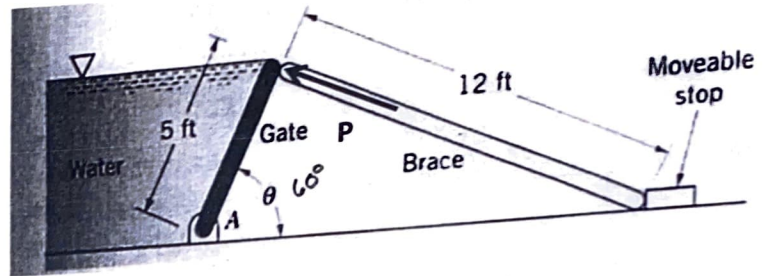


- ☒ a. 9.6 psi
- b. 12.5 psi
- c. 17.5 psi
- d. 5.0 psi

$$\frac{P_A}{\gamma} + \frac{v^2}{2g} + z_2 = \frac{P_1}{\gamma} + \frac{v^2}{2g} + z_1$$

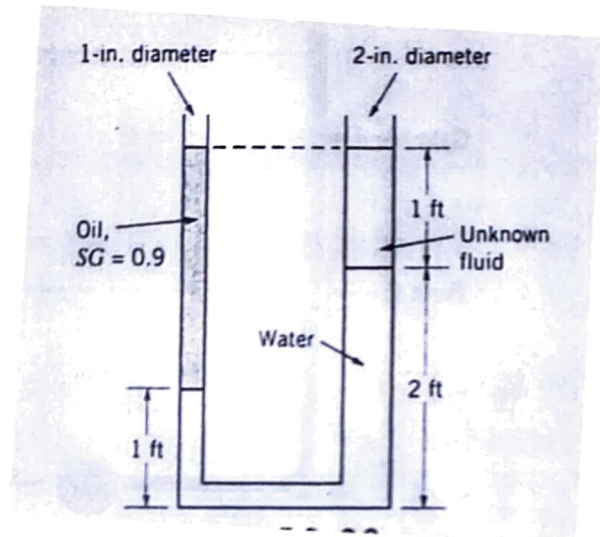
$$\frac{15.3 \text{ psi}}{1.94 \text{ slug/ft}^3} +$$

3. A rectangular gate of 10-ft width (into the paper) is hinged at  $A$ . For the angle  $\theta = 60^\circ$ , find, most nearly, the force,  $P$  (shown with an arrow) exerted by the brace on the gate at the point of contact with the free water surface. The gate weighs 200 lb. Unit weight of water is 62.4 pcf.



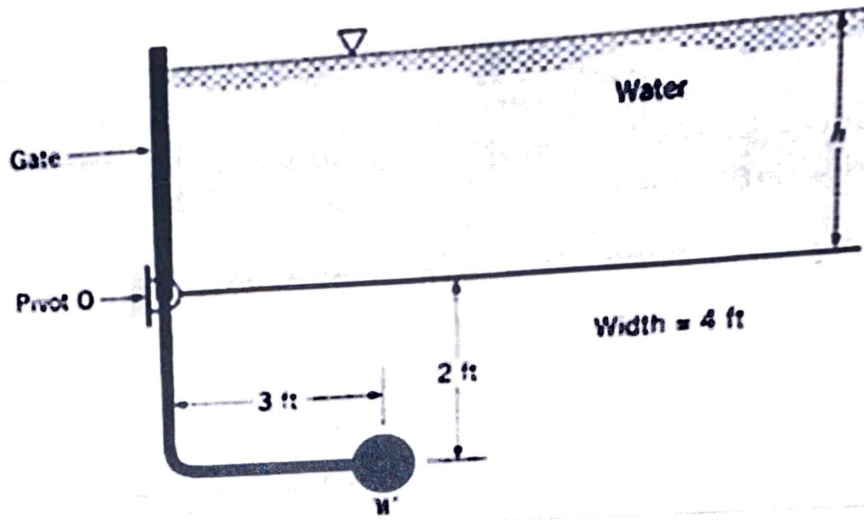
- a. 2290 lb
- b. 4230 lb
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4. A U-tube with horizontal base is shown. Water, oil and an *unknown* fluid is contained in it. Determine the *density* of the unknown fluid. Atmospheric pressure is 14.7 psi. Specific weight and density of water is 62.4 pcf and 1.94 slug/ft<sup>3</sup>, respectively. **Show all work.** (Sorry about the crooked shaded area behind the U-tube drawing, please ignore it.)



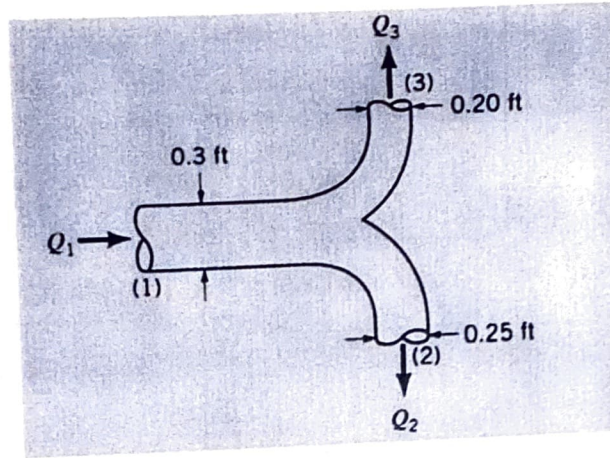
- a. 1.6 pcf
- b. 3.6 pcf
- c. 10.0 pcf
- ☒ d. 2.5 pcf

5. The 4-ft wide (into the paper) gate is pivoted (or hinged) at O. The gate is massless. The gate is held in place by the 2000 lb counterweight,  $W$  at the bottom of the figure. Determine the water depth  $h$ . Unit weight of water is 62.4 pcf. (This is not a buoyancy problem).



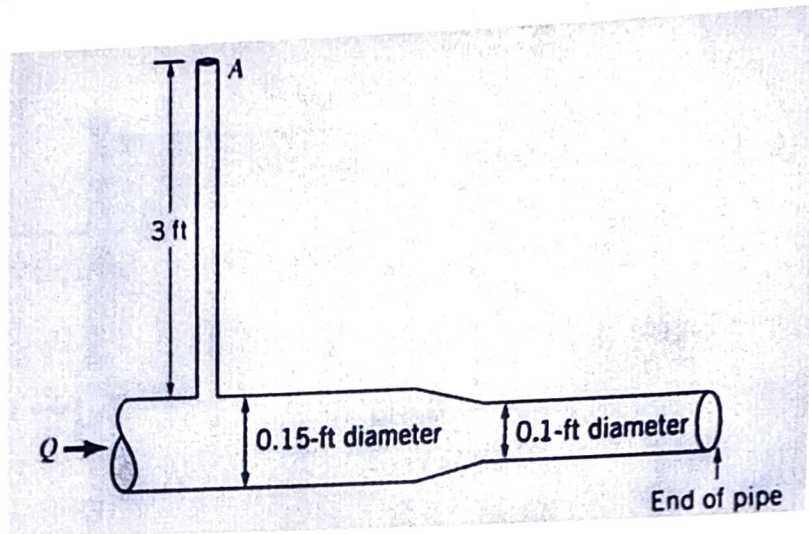
- a. 7 ft
- b. 2.5 ft
- c. 5 ft.
- d. 3.5 ft

6. A *horizontal* (Bird's Eye View) Y-fitting is shown. Flowrate and pressure in section (1) is  $Q_1 = 2.3$  cfs and  $P_1 = 50$  psi. Determine the pressure at section (2), inside the pipe. Assume the flow divides evenly between pipes 2 and 3. Unit weight of water is 62.4 pcf. Flow is steady-state. Losses and viscosity effects may be neglected.



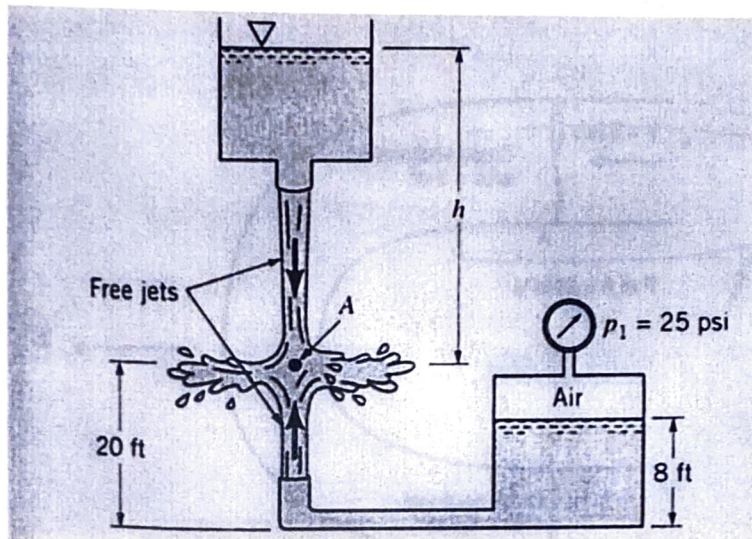
- a. 23.0 psi
- ☒ b. 72.0 psi
- c. 53.0 psi
- d. 73.0 psi

7. Determine, most nearly, the maximum flowrate if water is not to flow from the open vertical tube A. Unit weight of fluid is 62.4 pcf.



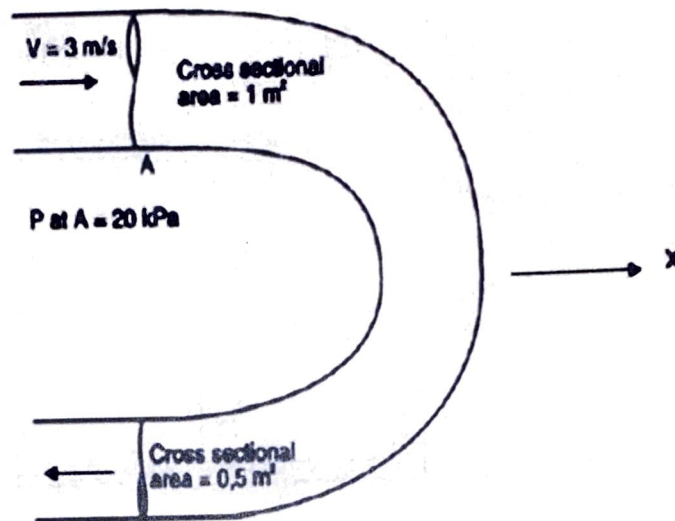
- a. ~~0.04 cfs~~
- b. ~~0.01 cfs~~
- c. 0.4 cfs
- d. 0.1 cfs

8. Two free jets of water impinge upon each other at  $A$  with same velocity  $V_A$ . Unit weight of fluid is 62.4 pcf. **Determine, most nearly, the height  $h$ .** Viscosity effects are negligible.



- a. 45 ft.
- b. 55 ft.
- c. 35 ft.
- d. None of the above

9. Water flows through a reducing 180° bend. The bend is in a horizontal plane (looking at the top view). Determine the magnitude of the force exerted by the fluid on the bend in the x-direction. Neglect energy losses. Density and Unit weight of water are  $1000 \text{ kg/m}^3$  and  $9800 \text{ N/m}^3$ , respectively. Pipe is pressurized.

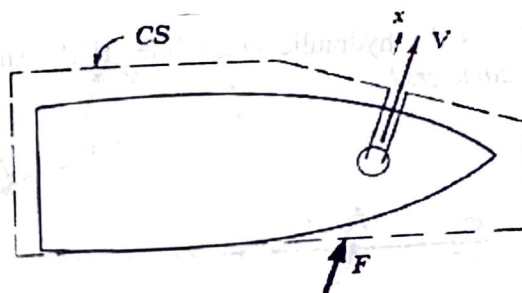


- a. 25 kN
- b. 120 kN
- c. 50 kN
- ☒ d. 66 kN

10. Water issues from a large tank through a circular 5-in-diameter orifice under a head of 45 ft.  $534 \text{ ft}^3$  of water volume is discharged in 2 minutes. If the diameter at the vena contracta is measured to be 3.93 inches, what is the coefficient of velocity. A clean sketch may help.

- a. 0.361
- ☒ b. 0.671
- c. 0.521
- d. 0.981

11. A jet of water 80 mm in diameter with a velocity of 40 m/s is discharged in a **horizontal x direction (as shown)** from a nozzle mounted on a boat. What force,  $F$ , is required to hold the boat *stationary*? Density of water is  $1000 \text{ kg/m}^3$ .



- a. 12 kN
- ☒ b. 3 kN
- c. 30 kN
- d. 8 kN

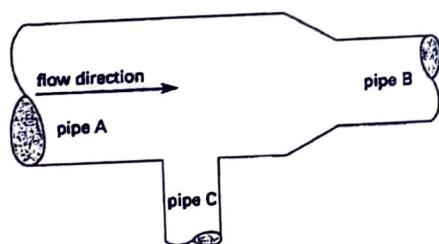
12. Water flowing in pipe divides at a tee as shown in the figure. The characteristics of each pipe segment are summarized in the table. The discharge in pipe A is 0.76 cfs. What is the discharge in pipe C? *Flow is in a horizontal plane.*

| Pipe | Diameter (in.) | Pressure (psi) |
|------|----------------|----------------|
| A    | 2.5            | 100            |
| B    | 1.5            | 90             |
| C    | 1.0            | -              |

$\gamma_w = 62.4 \text{ pcf}$

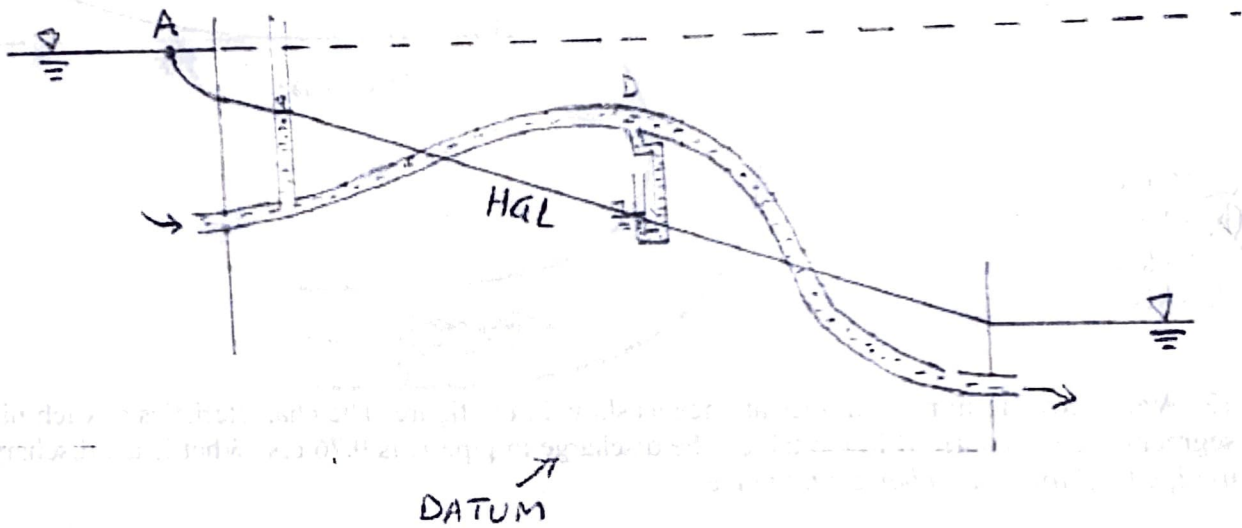
Flow is steady, inviscid and incompressible.

Neglect minor head losses



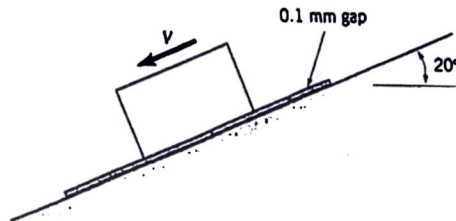
- a. 12 ft/s
- b. 50 ft/s
- c. 40 ft/s
- ☒ d. 22 ft/s

13. Is the hydraulic grade line (HGL) shown in the figure correct or incorrect *at the two piezometers?*



- a. Correct
- ☒ b. Incorrect

14. A 10-kg block slides down a smooth inclined surface as shown in the figure. Determine the terminal *velocity* of the block if the 0.1-mm gap between the block and the surface contains SAE 30W oil at 60 °F ( $\mu = 0.85 \text{ N}\cdot\text{s}/\text{m}^2$ ). Assume the velocity distribution in the gap is linear (Newtonian fluid), and the bottom area of the block in contact with the oil layer is  $0.2 \text{ m}^2$ .



- a. 0.002 m/s
- b. 0.02 m/s
- ☒ c. 0.05 m/s
- d. None of the above

15. Oil, with density  $\rho = 900 \text{ kg}/\text{m}^3$  and  $\nu = 0.00001 \text{ m}^2/\text{s}$ , flows at  $0.2 \text{ m}^3/\text{s}$  through 500m length of a 200-mm diameter cast-iron pipe ( $e = 0.26\text{mm}$ ). The *relative roughness* of the pipe is most nearly:

- a. 0.0064
- ☒ b. 0.0045
- c. 0.0013
- d. None of the above

**PROFESSIONAL ENGINEERING  
SPRING 2022**

**TEST 5: ENGINEERING ECON & COMPUTES**

**TOPICS COVERED IN TEST 5:**

- 1. FUNDAMENTALS OF ENGINEERING ECONOMICS**
- 2. FUNDAMENTALS OF COMPUTER PROGRAMING  
AND COPUTER HARDWARE, SOFTWARE, FILE  
FORMATS**

**Department of Civil & Environmental Engineering**  
**CVEG 3102: Professional Engineering I**  
**ENGINEERING ECONOMICS & COMPUTERS TEST**  
**(CLOSED Books/Notes; OPEN NCEES Formula Sheets)**  
**February 22, 2022 (IN-CLASS Proctored 2-Hour Test)**  
**Dr. I. Ahmed**

**Name:** \_\_\_\_\_

1. If a one-time amount of \$600 is invested at an annual interest rate of 6% (compounded annually), its future worth at the end of 30 years is nearly:
  - a. \$3995
  - b. \$6585
  - c. \$3445
  - d. \$9000
  
2. If you need to have \$800 in savings at the end of 6 years and your savings account yields 3.5% annual interest, the amount you need to deposit today is nearly:
  - a. \$450
  - b. \$550
  - c. \$650
  - d. None of the above
  
3. A company borrows \$100,000 today at 12% nominal annual interest *compounded monthly*. The monthly payment of a 6-year (72 *months*) loan is nearly:
  - a. \$1830
  - b. \$1440
  - c. \$2220
  - d. None of the above
  
4. The annual nominal interest rate on the unpaid portion of a contract is 15%. The effective annual interest rate if the interest is compounded quarterly is *nearly*:
  - a. 16%
  - b. 20%
  - c. 12%
  - d. 3%

5. An asset (could be a machine) is purchased for \$90,000. The estimated life is 7 years and the salvage value is \$12,000. Assuming the item is depreciated via a straight-line method, the Book Value of the asset *at the end of 3 years* is nearly:

- a. \$12,700
- b. \$34,210
- c. \$56,570
- d. \$65,890

6. Two alternative investments have cash flows indicated in the table. At 6% annual interest, which alternative should be selected based on *future* value? (Negative # is a Cost; Positive # is a Benefit)

| Year | Alternate<br>A | Alternate<br>B |
|------|----------------|----------------|
| 0    | -\$1,730       | -\$2,350       |
| 1    | \$1,000        | \$1,200        |
| 2    | \$1,000        | \$1,200        |

- a. Alternative A
- b. Alternative B
- c. Neither
- d. None of the above

7. What is the un-inflated present worth of \$2,000 in 2 years if the average inflation rate is 6% and  $i$  is 10%?

- a. \$1300
- b. \$1471
- c. \$1371
- d. None of the above

8. It costs \$65 per year to maintain a cemetery plot. If the interest rate is 5.0%, how much must be set aside to pay for maintenance on each plot without touching the principal?

- a. \$1200
- b. \$1300
- c. \$1450
- d. None of the above

## COMPUTERS

9. In the structured programming fragment shown, **line 4** can be described as:

```
1      REAL X, Y
2      X = 3
3      Y = COS(X)
4      PRINT Y
```

- a. An assignment
- b. A command
- c. A declaration
- d. A function

10. A structured program contains the following program segment. What is the value of X after the segment is executed?

```
X = 2
T = 3
IF X*2 > T THEN T = X*2
IF T > X THEN X = T*2
IF T < X THEN X = T + 3
```

- a. 8
- b. 6
- c. 7
- d. None of the above

11. A partial spreadsheet is shown below.

|   | A  | B       | C | D  |
|---|----|---------|---|----|
| 1 | 2  | \$A1    |   |    |
| 2 | 4  | B\$1    |   |    |
| 3 | 0  | A2+B2   |   |    |
| 4 | -5 | A\$2*B2 |   | ?? |

The contents of column B are copied and pasted into columns C and D. What number will appear in cell D4?

- a. 4
- b. 16
- c. 0
- d. 10

12. Which of the following terms is best defined as a device that holds data and instructions for further manipulation?

- a. buffer
- b. accumulator
- c. data bus
- d. modem

13. Which of the following is a seven-bit code for representing characters as digital words?

- a. binary
- b. RS-232C
- c. ASCII
- d. DOS

14. Binary number 0101110 is what number in base 10?

- a. 54
- b. 58
- c. 46
- d. 20

15. An HTML document can be viewed on any computer regardless of the Operating System (OS) type (e.g., MS-DOS, Apple OS, Windows, Unix etc.)

- a. False statement
- b. True statement

**ABOVE AVERAGE**

09/15

Department of Civil & Environmental Engineering  
 CVEG 3102: Professional Engineering I  
**ENGINEERING ECONOMICS & COMPUTERS TEST**  
 (CLOSED Books/Notes; OPEN NCEES Formula Sheets)  
 February 22, 2022 (IN-CLASS Proctored 2-Hour Test)  
 Dr. I. Ahmed

Name: Perla Zaldivar

$$P = \$600$$

1. If a one-time amount of \$600 is invested at an annual interest rate of 6% (compounded annually), its future worth at the end of 30 years is nearly:  $i = 0.06$

$$F = ? \quad t = 30$$

- a. \$3995
- b. \$6585
- ☒ c. \$3445
- d. \$9000

$$F = 600(F/P, 6\%, 30)$$

$$F = 600(5.7435) = 3446.1$$

2. If you need to have \$800 in savings at the end of 6 years and your savings account yields 3.5% annual interest, the amount you need to deposit today is nearly:  $2^3 \quad 2^{-4}$

$$t = 6 \text{ yrs} \quad F = 800 \quad (P/F, i, n)$$

- a. \$450
- b. \$550
- ☒ c. \$650
- d. None of the above

$$i = 3.5\% \quad P = ?$$

$$P = 800(P/F, 3.5\%, 6)$$

$$23454 \quad (1 + 0.035)^{-6} = 1.229$$

3. A company borrows \$100,000 today at 12% nominal annual interest compounded monthly. The monthly payment of a 6-year (72 months) loan is nearly:

$$P = \$100,000$$

$$F/P, 1\%, 72$$

$$\frac{1(1+i)^n}{(1+i)^n - 1} = \frac{1.01}{0.973} = 1.0286$$

- a. \$1830
- b. \$1440
- ☒ c. \$2220
- d. None of the above

$$i = 12\%$$

$$(1+i)^n = 2.04$$

$$i = \frac{12\%}{12} = 1\%$$

$$t = 72 \text{ months}$$

4. The annual nominal interest rate on the unpaid portion of a contract is 15%. The effective annual interest rate if the interest is compounded quarterly is nearly:  $r = 15\% = 0.15$

$$0.25$$

- a. 16%
- b. 20%
- ☒ c. 12%
- d. 3%

5. An asset (could be a machine) is purchased for \$90,000. The estimated life is 7 years and the salvage value is \$12,000. Assuming the item is depreciated via a straight-line method, the Book Value of the asset *at the end of 3 years* is nearly:

$$D_3 = \frac{90,000 - 12,000}{7}$$

- a. \$12,700
- b. \$34,210
- c. \$56,570
- d. \$65,890

6. Two alternative investments have cash flows indicated in the table. At 6% annual interest, which alternative should be selected based on *future value*? (Negative # is a Cost; Positive # is a Benefit)  $i = 6\% = 0.06$

| Year | Alternate A | Alternate B |
|------|-------------|-------------|
| 0    | -\$1,730    | -\$2,350    |
| 1    | \$1,000     | \$1,200     |
| 2    | \$1,000     | \$1,200     |

$$A \quad -1,730 + [1,000(1.1236)]^2 = 517.2$$

- a. Alternative A
- b. Alternative B
- c. Neither
- d. None of the above

$$B \quad -2,350 + [1,200(1.1236)]^2 = 346.44$$

7. What is the un-inflated present worth of \$2,000 in 2 years if the average inflation rate is 6% and  $i$  is 10%?

$$d = 0.1 + 0.06 + (0.06 \times 0.1) = 0.166$$

$$F = 2000$$

$$P = ?$$

- a. \$1300
- b. \$1471
- c. \$1371
- d. None of the above

$$2000(P/F, 0.166, 2)$$

$$2000(1 + 0.166)^{-2}$$

8. It costs \$65 per year to maintain a cemetery plot. If the interest rate is 5.0%, how much must be set aside to pay for maintenance on each plot without touching the principal?  $i = 5\% = 0.05$

- a. \$1200
- b. \$1300
- c. \$1450
- d. None of the above

$$\frac{A}{i}$$

## COMPUTERS

9. In the structured programming fragment shown, **line 4** can be described as:

```
1    REAL X, Y
2    X = 3
3    Y = COS(X)
4    PRINT Y
```

- ☐ a. An assignment
- ☒ b. A command
- ☐ c. A declaration
- ☐ d. A function

10. A structured program contains the following program segment. What is the value of X after the segment is executed?

$X = 2$      $T = 3$   
 $X = 2$   
 $T = 3$   
IF  $X*2 > T$  THEN  $T = X*2$      $(2)2 = 4 > 3$  Then  $T = X(2)$   
IF  $T > X$  THEN  $X = T*2$      $3 > 2$      $2 = 3(2) = 6$   
IF  $T < X$  THEN  $X = T + 3$      $3 < 6$      $6 = 3 + 3 = 6$   
 $3 = 2(2)$

- ☐ a. 8
- ☒ b. 6
- ☐ c. 7
- ☐ d. None of the above

11. A partial spreadsheet is shown below.

|   | A  | B                 | C                 | D        |
|---|----|-------------------|-------------------|----------|
| 1 | 2  | \$A1 2            | \$B1 - 2          | \$C1 - 2 |
| 2 | 4  | B\$1 2            | C\$1 - 2          | D\$1 - 2 |
| 3 | 0  | A2+B2 6           | B2+C2=4           | C2+D2=4  |
| 4 | -5 | A\$2*B2<br>4(2)=8 | B\$2*C2<br>2(2)=4 | ?? 2*2=4 |

The contents of column B are copied and pasted into columns C and D. What number will appear in cell D4?

- ☒ a. 4
- ☐ b. 16
- ☐ c. 0
- ☐ d. 10

12. Which of the following terms is best defined as a device that holds data and instructions for further manipulation?

- a. buffer
- ☒ b. accumulator
- c. data bus
- d. modem

13. Which of the following is a seven-bit code for representing characters as digital words?

- ~~a. binary~~
- ☒ b. RS-232C
- ~~c. ASCII~~
- d. DOS

14. Binary number 0101110 is what number in base 10?

- a. 54
- b. 58
- ☒ c. 46
- d. 20

15. An HTML document can be viewed on any computer regardless of the Operating System (OS) type (e.g., MS-DOS, Apple OS, Windows, Unix etc.)

- ~~a. False statement~~
- ☒ b. True statement

## **AVERAGE**

**Student sample work could not  
be collected on request**

**BELOW AVERAGE**

05/15!

Department of Civil & Environmental Engineering  
CVEG 3102: Professional Engineering I  
**ENGINEERING ECONOMICS & COMPUTERS TEST**  
(CLOSED Books/Notes; OPEN NCEES Formula Sheets)  
February 22, 2022 (IN-CLASS Proctored 2-Hour Test)  
Dr. I. Ahmed

Name: Jerral T. Walker

1. If a one-time amount of \$600 is invested at an annual interest rate of 6% (compounded annually), its future worth at the end of 30 years is nearly:

- a. \$3995
- b. \$6585
- ☒ c. \$3445
- d. \$9000

$$P \left(1 + \frac{r}{100}\right)^n$$
$$600 \left(1 + \frac{6}{100}\right)^{30}$$

2. If you need to have \$800 in savings at the end of 6 years and your savings account yields 3.5% annual interest, the amount you need to deposit today is nearly:

- a. \$450
- b. \$550
- ☒ c. \$650
- d. None of the above

$$800 (1 + 0.035)^{-6}$$

3. A company borrows \$100,000 today at 12% nominal annual interest compounded monthly. The monthly payment of a 6-year (72 months) loan is nearly:

- a. \$1830
- ☒ b. \$1440
- c. \$2220
- d. None of the above

$$100000 \left( \frac{(1 + 0.12)^6 - 1}{0.12} \right)$$

4. The annual nominal interest rate on the unpaid portion of a contract is 15%. The effective annual interest rate if the interest is compounded quarterly is nearly:

- ☒ a. 16%
- b. 20%
- c. 12%
- d. 3%

$$\left(1 + \frac{0.15}{4}\right)^4 - 1$$

5. An asset (could be a machine) is purchased for \$90,000. The estimated life is 7 years and the salvage value is \$12,000. Assuming the item is depreciated via a straight-line method, the Book Value of the asset *at the end of 3 years* is nearly:

- ☒ a. \$12,700
- ☐ b. \$34,210
- ☐ c. \$56,570
- ☐ d. \$65,890

6. Two alternative investments have cash flows indicated in the table. At 6% annual interest, which alternative should be selected based on *future value*? (Negative # is a Cost; Positive # is a Benefit)

| Year | Alternate<br>A | Alternate<br>B |
|------|----------------|----------------|
| 0    | -\$1,730       | -\$2,350       |
| 1    | \$1,000        | \$1,200        |
| 2    | \$1,000        | \$1,200        |

- ☐ a. Alternative A
- ☒ b. Alternative B
- ☐ c. Neither
- ☐ d. None of the above

7. What is the un-inflated present worth of \$2,000 in 2 years if the average inflation rate is 6% and  $i$  is 10%?

- ☐ a. \$1300
- ☒ b. \$1471
- ☐ c. \$1371
- ☐ d. None of the above

8. It costs \$65 per year to maintain a cemetery plot. If the interest rate is 5.0%, how much must be set aside to pay for maintenance on each plot without touching the principal?

- ☐ a. \$1200
- ☐ b. \$1300
- ☒ c. \$1450
- ☐ d. None of the above

## COMPUTERS

9. In the structured programming fragment shown, **line 4** can be described as:

```
1  REAL X, Y
2  X = 3
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4  PRINT Y
```

- a. An assignment
- ☒ b. A command
- c. A declaration
- d. A function

10. A structured program contains the following program segment. What is the value of X after the segment is executed?

```
X = 2
T = 3
IF X*2 > T THEN T = X*2
IF T > X THEN X = T*2
IF T < X THEN X = T + 3
```

- ☒ a. 8
- ☒ b. 6
- c. 7
- d. None of the above

11. A partial spreadsheet is shown below.

|   | A  | B       | C  | D |
|---|----|---------|----|---|
| 1 | 2  | \$A1    |    |   |
| 2 | 4  | B\$1    |    |   |
| 3 | 0  | A2+B2   |    |   |
| 4 | -5 | A\$2*B2 | ?? |   |

The contents of column B are copied and pasted into columns C and D. What number will appear in cell D4?

- ☒ a. 4
- ☒ b. 16
- c. 0
- d. 10

12. Which of the following terms is best defined as a device that holds data and instructions for further manipulation?

- ☒ a. buffer
- b. accumulator
- c. data bus
- d. modem

13. Which of the following is a seven-bit code for representing characters as digital words?

- a. binary
- b. RS-232C
- ☒ c. ASCII
- d. DOS

14. Binary number 0101110 is what number in base 10?

- ☒ a. 54
- ☒ b. 58
- c. 46
- d. 20

15. An HTML document can be viewed on any computer regardless of the Operating System (OS) type (e.g., MS-DOS, Apple OS, Windows, Unix etc.)

- ☒ a. False statement
- b. True statement

**PROFESSIONAL ENGINEERING LAB  
SPRING 2022**

**TEST 6: GEOTECHNICAL ENGINEERING**

**TOPICS COVERED IN TEST 6:**

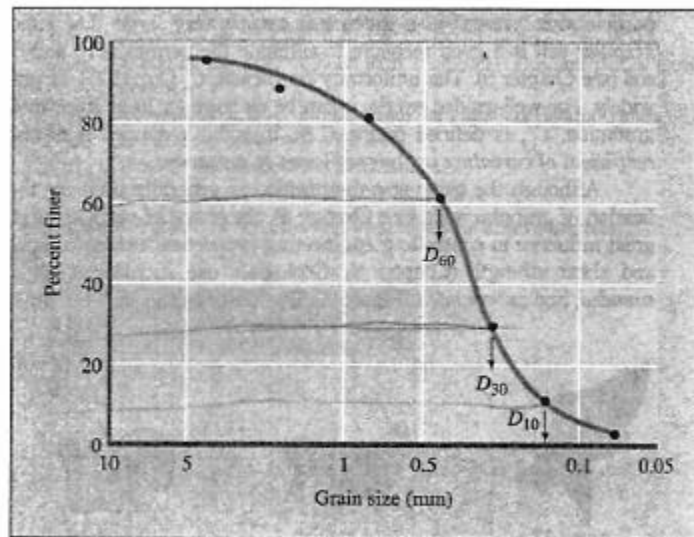
**1. FUNDAMENTALS OF GEOTECHNICAL ENGINEERING**

**Department of Civil & Environmental Engineering**  
**CVEG 3102: Professional Engineering I**  
**GEOTECHNICAL ENGINEERING TEST**  
**(CLOSED Books/Notes; OPEN NCEES Formula Sheets)**  
**March 1, 2022 (IN-CLASS 2-Hour Test)**  
**Dr. I. Ahmed**

1. An undisturbed sample of clay has a wet mass of 100 kg, a dry mass of 93 kg, and a total volume of  $0.0491 \text{ m}^3$ . The solids have a specific gravity of 2.65. The void ratio is most nearly:

- a. 0.31
- b. 0.61
- c. 0.40
- d. 1.0

2. A soil's grain-size distribution curve is shown. The *coefficient of gradation* is most nearly:



- a. 6.00
- b. 2.23
- c. 5.25
- d. 1.24

3. The lines in a graphical flow net intersect to form a pattern of:

- a. Triangles
- b. Trapezoids
- c. Squares
- d. Rectangles

4. A flow net is constructed of:

- a. Isobars and aquicludes
- b. Streamlines and equipotential lines
- c. Isogons and isopleths
- d. None of the above

5. A soil has a void ratio of 0.41. The unit weight of the solids is  $33 \text{ kN/m}^3$ . The *saturated unit weight* of the soil is most nearly

- a.  $33 \text{ kN/m}^3$
- b.  $29 \text{ kN/m}^3$
- c.  $26 \text{ kN/m}^3$
- d.  $37 \text{ kN/m}^3$

6. The soil directly below a footing experiences a total compressive stress of 52 kPa. The surface of the water (water table) is 2 m higher than the bottom of the footing. The *effective stress* under the footing is most nearly

- a. 19 kPa
- b. 38 kPa
- c. 13 kPa
- d. 32 kPa

7. A sand has a minimum void ratio of 0.41 and a maximum void ratio of 0.78. The actual void ratio of the sand is 0.576. The *relative density* of the sand is most nearly

- a. 40%
- b. 45%
- c. 55%
- d. 80%

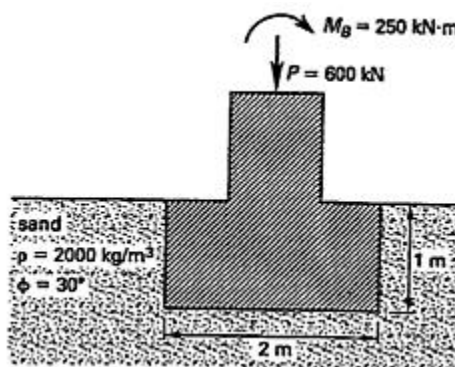
8. A moist soil has these values:  $V = 0.25 \text{ ft}^3$ ,  $W = 30.75 \text{ lb}$ ,  $w = 9.8\%$ , and  $G_s = 2.66$ . The porosity,  $n$ , is most nearly:

- a. 0.554
- b. 0.465
- c. 0.324
- d. 0.658

9. A concentrated vertical point load of 6000 lbs is applied at the ground surface. Most nearly, the increase in vertical pressure 3.5 ft below the surface and 4 ft away from a point directly below the concentrated load is

- a. 29 psf
- b. 36 psf
- c. 41 psf
- d. 58 psf

10. A 2 m wide continuous wall footing is designed to support an axial column load of 600 kN (per meter wall length) and a moment of 250 kN.m (per meter of wall length), as shown. The footing is placed 1 m into a sandy soil with a density of  $2000 \text{ kg/m}^3$ , a cohesion of 0.5 Pa, and an angle of internal friction of  $30^\circ$ . Most nearly, the ultimate bearing capacity per meter of footing length is:



- a. 870 kPa
- b. 210 kPa
- c. 830 kPa
- d. 430 kPa

11. A soil has an angle of internal friction of  $25^\circ$ . The Rankine *active* earth pressure coefficient is nearly

- a. 0.34
- b. 0.41
- c. 0.52
- d. 0.58

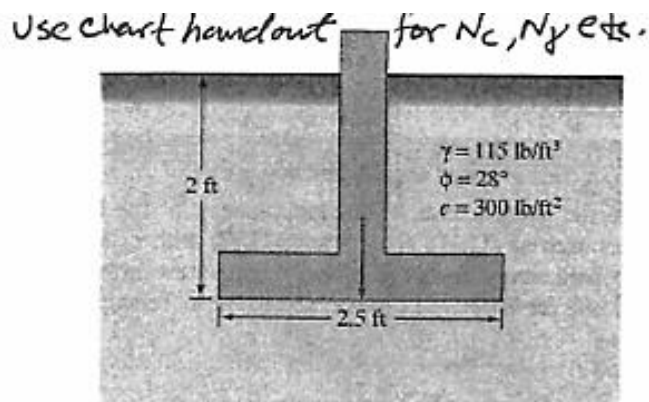
12. A retaining wall supports soil with a vertical height of 2 m. The soil has an angle of internal friction of  $32^\circ$  and a specific (unit) weight of  $25 \text{ kN/m}^3$ . The *active* lateral soil resultant *force* is most nearly:

- a. 5 kN/m
- b. 15 kN/m
- c. 46 kN/m
- d. 92 kN/m

13. A uniform soil slope has a planar slip surface length of 100 m. The soil's cohesion is 5 kPa, and the angle of internal friction is  $40^\circ$ . The angle that the assumed failure plane makes with respect to the horizontal is  $25^\circ$ . The weight of the soil mound above the assumed failure plane is 2000 kN/m. The *mobilized shear force* along the assumed failure plane is most nearly

- a. 500 kN/m
- b. 850 kN/m
- c. 1500 kN/m
- d. 2000 kN/m

14. A continuous footing is shown. Using Terzaghi's bearing capacity factors, determine the gross allowable load per unit area ( $q_{all}$ ) that the footing can carry. Assume General Shear Failure. **(Use the Chart for  $N_c$ ,  $N_\gamma$  etc., e-mailed to you on 03/29/2021)**



$$D_f = 2 \text{ ft}$$

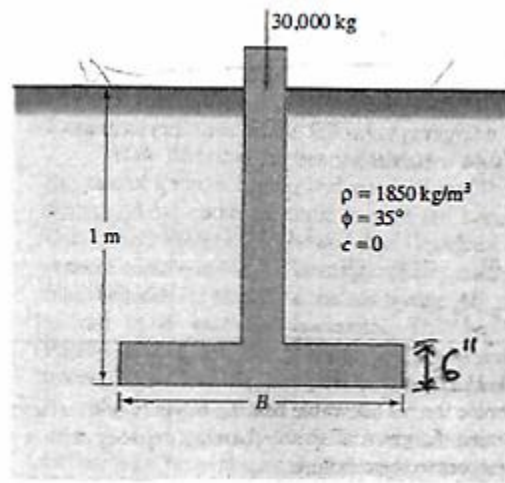
$$B = 2.5 \text{ ft}$$

$$FS = 4$$

$$q = \gamma D_f$$

- a. 5010 psf
- b. 6010 psf
- c. 4010 psf
- d. 7010 psf

15. A square footing is shown. The footing will carry a gross mass of 30,000 kg. Using  $FS = 3$ , determine the size ( $B$ ) of the footing.



- a. 2 m
- b. 3 m
- c. 1 m
- d. 4m

**ABOVE AVERAGE**

Department of Civil & Environmental Engineering  
 CVEG 3102: Professional Engineering I  
**GEOTECHNICAL ENGINEERING TEST**  
 (CLOSED Books/Notes; OPEN NCEES Formula Sheets)  
 March 1, 2022 (IN-CLASS 2-Hour Test)  
 Dr. I. Ahmed

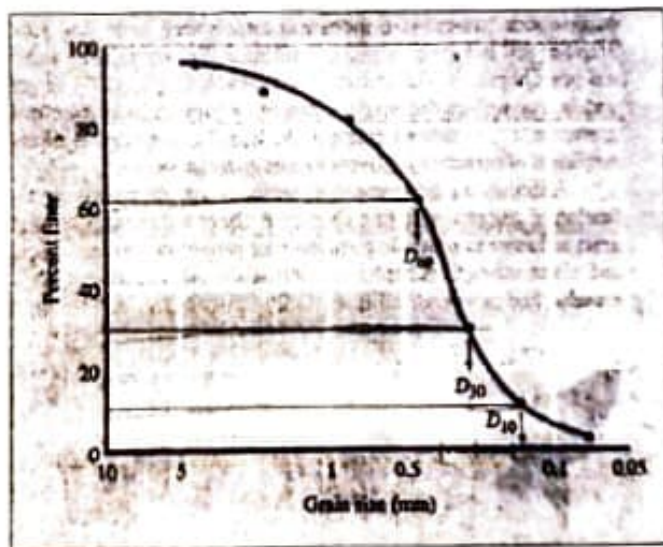
09  
15

Name: Sydney Jones

1. An undisturbed sample of clay has a wet mass of 100 kg, a dry mass of 93 kg, and a total volume of  $0.0491 \text{ m}^3$ . The solids have a specific gravity of 2.65. The void ratio is most nearly:

- a. 0.31
- b. 0.61
- c. 0.40
- d. 1.0

2. A soil's grain-size distribution curve is shown. The *coefficient of gradation* is most nearly:



$$\begin{aligned} D_{90} &= 0.3 \text{ mm} \\ D_{60} &= 0.45 \text{ mm} \\ D_{10} &= 0.18 \text{ mm} \end{aligned}$$

- ~~a. 6.00~~
- ~~b. 2.23~~
- ~~c. 5.25~~
- d. 1.24

3. The lines in a graphical flow net intersect to form a pattern of;

- a. Triangles
- b. Trapezoids
- ☒ c. Squares
- d. Rectangles

4. A flow net is constructed of;

- a. Isobars and aquicludes
- ☒ b. Streamlines and equipotential lines
- c. Isogons and isopleths
- d. None of the above

5. A soil has a void ratio of 0.41. The unit weight of the solids is  $33 \text{ kN/m}^3$ . The *saturated unit weight* of the soil is most nearly

- a.  $33 \text{ kN/m}^3$
- b.  $29 \text{ kN/m}^3$
- ☒ c.  $26 \text{ kN/m}^3$
- d.  $37 \text{ kN/m}^3$

6. The soil directly below a footing experiences a total compressive stress of  $52 \text{ kPa}$ . The surface of the water (water table) is  $2 \text{ m}$  higher than the bottom of the footing. The *effective stress* under the footing is most nearly

- a.  $19 \text{ kPa}$
- b.  $38 \text{ kPa}$
- c.  $13 \text{ kPa}$
- ☒ d.  $32 \text{ kPa}$

7. A sand has a minimum void ratio of 0.41 and a maximum void ratio of 0.78. The actual void ratio of the sand is 0.576. The *relative density* of the sand is most nearly

- a. 40%
- b. 45%
- ☒ c. 55%
- d. 80%

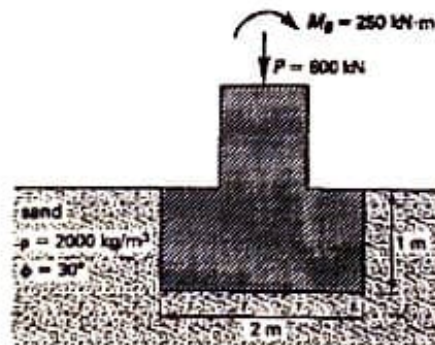
8. A moist soil has these values:  $V = 0.25 \text{ ft}^3$ ,  $W = 30.75 \text{ lb}$ ,  $w = 9.8\%$ , and  $G_s = 2.66$ . The porosity,  $n$ , is most nearly:

- a. 0.554
- b. 0.465
- ☒ c. 0.324
- d. 0.658

9. A concentrated vertical point load of 6000 lbs is applied at the ground surface. Most nearly, the increase in vertical pressure 3.5 ft below the surface and 4 ft away from a point directly below the concentrated load is

- a. 29 psf
- ☒ b. 36 psf
- c. 41 psf
- d. 58 psf

10. A 2 m wide continuous wall footing is designed to support an axial column load of 600 kN (per meter wall length) and a moment of 250 kN.m (per meter of wall length), as shown. The footing is placed 1 m into a sandy soil with a density of 2000 kg/m<sup>3</sup>, a cohesion of 0.5 Pa, and an angle of internal friction of 30°. Most nearly, the ultimate bearing capacity per meter of footing length is:



- a. 870 kPa
- b. 210 kPa
- c. 830 kPa
- ☒ d. 430 kPa

11. A soil has an angle of internal friction of 25°. The Rankine *active* earth pressure coefficient is nearly

- a. 0.34
- ☒ b. 0.41
- c. 0.52
- d. 0.58

12. A retaining wall supports soil with a vertical height of 2 m. The soil has an angle of internal friction of  $32^\circ$  and a specific (unit) weight of  $25 \text{ kN/m}^3$ . The *active* lateral soil resultant *force* is most nearly:

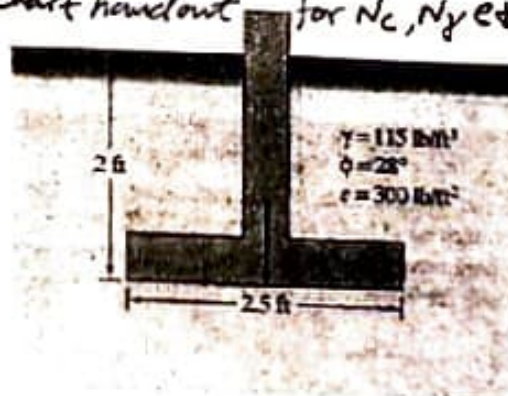
- a.  $5 \text{ kN/m}$
- ☒ b.  $15 \text{ kN/m}$
- c.  $46 \text{ kN/m}$
- d.  $92 \text{ kN/m}$

13. A uniform soil slope has a planar slip surface length of 100 m. The soil's cohesion is 5 kPa, and the angle of internal friction is  $40^\circ$ . The angle that the assumed failure plane makes with respect to the horizontal is  $25^\circ$ . The weight of the soil mound above the assumed failure plane is 2000 kN/m. The *mobilized shear force* along the assumed failure plane is most nearly

- a.  $500 \text{ kN/m}$
- b.  $850 \text{ kN/m}$
- ☒ c.  $500 \text{ kN/m}$
- d.  $2000 \text{ kN/m}$

14. A continuous footing is shown. Using Terzaghi's bearing capacity factors, determine the gross allowable load per unit area ( $q_{all}$ ) that the footing can carry. Assume General Shear Failure. (Use the Chart for  $N_c$ ,  $N_\gamma$  etc., e-mailed to you on 03/29/2021)

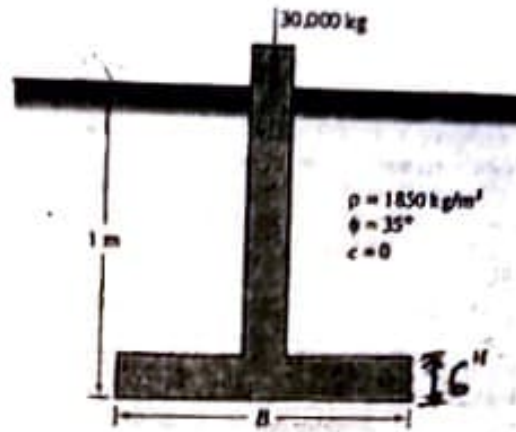
Use Chart handout for  $N_c, N_\gamma$  etc.



$D_f = 2 \text{ ft}$   
 $B = 2.5 \text{ ft}$   
 $FS = 4$   
 $q = \gamma D_f$

- a.  $5010 \text{ psf}$
- ☒ b.  $6010 \text{ psf}$
- c.  $4010 \text{ psf}$
- d.  $7010 \text{ psf}$

15. A square footing is shown. The footing will carry a gross mass of 30,000 kg. Using  $FS = 3$ , determine the size ( $B$ ) of the footing.



- a. 2 m
- b. ~~3 m~~
- c. 1 m
- d. 4 m

**AVERAGE**

Autumn 2022

08/15

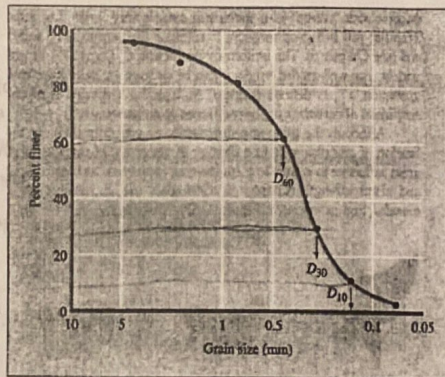
Department of Civil & Environmental Engineering  
CVEG 3102: Professional Engineering I  
GEOTECHNICAL ENGINEERING TEST  
(CLOSED Books/Notes; OPEN NCEES Formula Sheets)  
March 1, 2022 (IN-CLASS 2-Hour Test)  
Dr. I. Ahmed

1. An undisturbed sample of clay has a wet mass of 100 kg, a dry mass of 93 kg, and a total volume of  $0.0491 \text{ m}^3$ . The solids have a specific gravity of 2.65. The void ratio is most nearly:

- a. 0.31
- b. 0.61
- c. 0.40
- d. 1.0

Void ratio  $e = \frac{V_v}{V_s}$   $V_v = V_A + V_w$  Wet mass + dry mass =  $100 \text{ kg} + 93 \text{ kg} = 193 \text{ kg}$   
 $\frac{93 \text{ kg}}{193 \text{ kg}} = 0.002$   $e = \frac{0.002}{0.0491} = 0.40$   
 $V_w$  unit weight of water =  $9.81$

2. A soil's grain-size distribution curve is shown. The coefficient of gradation is most nearly:



- a. 6.00
- b. 2.23
- c. 5.25
- d. 1.24

Coefficient of Uniformity

$$\frac{D_{60}}{D_{10}} = \frac{0.425}{0.075} = 5.67$$

$\gamma_{10} = 10\%$   
 $\gamma_{30} = 25\%$   
 $\gamma_{60} = 60\%$

3. The lines in a graphical flow net intersect to form a pattern of:

- a. Triangles
- ☒ b. Trapezoids
- c. Squares
- d. Rectangles

4. A flow net is constructed of:

- a. Isobars and aquicludes
- ☒ b. Streamlines and equipotential lines
- c. Isogons and isopleths
- d. None of the above

5. A soil has a void ratio of 0.41. The unit weight of the solids is  $33 \text{ kN/m}^3$ . The saturated unit weight of the soil is most nearly

- a.  $33 \text{ kN/m}^3$
- ☒ b.  $29 \text{ kN/m}^3$
- c.  $26 \text{ kN/m}^3$
- d.  $37 \text{ kN/m}^3$

$$e = 0.41$$

$$\gamma_{\text{sat}} = \frac{(G_s + e) \gamma_w}{1 + e}$$

6. The soil directly below a footing experiences a total compressive stress of  $52 \text{ kPa}$ . The surface of the water (water table) is  $2 \text{ m}$  higher than the bottom of the footing. The effective stress under the footing is most nearly

- a.  $19 \text{ kPa}$
- b.  $38 \text{ kPa}$
- c.  $13 \text{ kPa}$
- ☒ d.  $32 \text{ kPa}$

$$\sigma = \sigma' - u$$

$$\text{Unit weight of water} = 9.81 \text{ kN/m}^3$$

$$(9.81 \text{ kN/m}^3)(2 \text{ m}) = 19.62 \text{ kPa}$$

$$52 \text{ kPa} - 19.62 \text{ kPa} = 32.38 \text{ kPa}$$

7. A sand has a minimum void ratio of  $0.41$  and a maximum void ratio of  $0.78$ . The actual void ratio of the sand is  $0.576$ . The relative density of the sand is most nearly

- a.  $40\%$
- b.  $45\%$
- ☒ c.  $55\%$
- d.  $80\%$

$$\begin{aligned} \min e &= 0.41 \\ \max e &= 0.78 \\ e &= 0.576 \end{aligned}$$

$$\left[ \frac{(0.78 - 0.576)}{(0.78 - 0.41)} \right] \times 100 = 55.13\%$$

8. A moist soil has these values:  $V = 0.25 \text{ ft}^3$ ,  $W = 30.75 \text{ lb}$ ,  $w = 9.8\%$ , and  $G_s = 2.66$ . The porosity,  $n$ , is most nearly:

- a.  $0.554$
- ☒ b.  $0.465$
- c.  $0.324$
- d.  $0.658$

$$\begin{aligned} V &= 0.25 \text{ ft}^3 \\ W &= 30.75 \text{ lb} \\ w &= 9.8\% \\ G_s &= 2.66 \\ \text{Find } n &= ? \end{aligned}$$

$$n = \frac{V_v}{V} = \frac{e}{1+e}$$

9. A concentrated vertical point load of 6000 lbs is applied at the ground surface. Most nearly, the increase in vertical pressure 3.5 ft below the surface and 4 ft away from a point directly below the concentrated load is

- a. 29 psf
- b. 36 psf
- c. 41 psf
- d. 58 psf

$$\downarrow P = 6000 \text{ lbs}$$

$$\rightarrow 3.5 \text{ ft}$$

4 ft away from  
a point  
below  
the load

$$\sigma_z = \frac{3Pz^3}{2\pi(r^2 + z^2)^{5/2}}$$

$$= \frac{3(6000 \text{ lbs})(3.5 \text{ ft})^3}{(2)(\pi)(4^2 + 3.5^2)^{5/2}} =$$

10. A 2 m wide continuous wall footing is designed to support an axial column load of 600 kN (per meter wall length) and a moment of 250 kN.m (per meter of wall length), as shown. The footing is placed 1 m into a sandy soil with a density of 2000 kg/m<sup>3</sup>, a cohesion of 0.5 Pa, and an angle of internal friction of 30°. Most nearly, the ultimate bearing capacity per meter of footing length is:

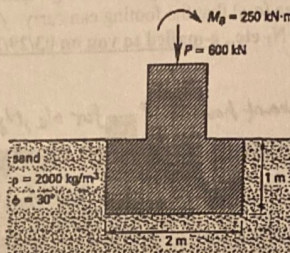
ultimate bearing capacity

$$B = 2 \text{ m}$$

$$D_f = 1 \text{ m}$$

$$c = 0.5$$

$$30^\circ$$



- a. 870 kPa
- b. 210 kPa
- c. 830 kPa
- d. 430 kPa

11. A soil has an angle of internal friction of 25°. The Rankine active earth pressure coefficient is nearly

internal friction = 25°

- a. 0.34
- b. 0.41
- c. 0.52
- d. 0.58

$$\tan^2(45 - \frac{\phi}{2}) = .405$$

12. A retaining wall supports soil with a vertical height of 2 m. The soil has an angle of internal friction of  $32^\circ$  and a specific (unit) weight of  $25 \text{ kN/m}^3$ . The active lateral soil resultant force is most nearly:

- a. 5 kN/m
- ☒ b. 15 kN/m
- c. 46 kN/m
- d. 92 kN/m

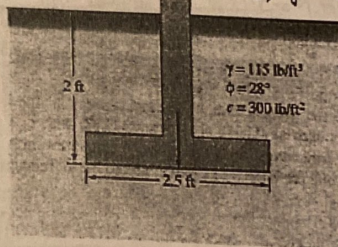
Unit weight =  $25 \text{ kN/m}^3$   
 $\uparrow 2 \text{ m}$   
 internal friction =  $32^\circ$

13. A uniform soil slope has a planar slip surface length of 100 m. The soil's cohesion is 5 kPa, and the angle of internal friction is  $40^\circ$ . The angle that the assumed failure plane makes with respect to the horizontal is  $25^\circ$ . The weight of the soil mound above the assumed failure plane is 2000 kN/m. The mobilized shear force along the assumed failure plane is most nearly

- a. 500 kN/m
- b. 850 kN/m
- ☒ c. 1500 kN/m
- d. 2000 kN/m

14. A continuous footing is shown. Using Terzaghi's bearing capacity factors, determine the gross allowable load per unit area ( $q_{all}$ ) that the footing can carry. Assume General Shear Failure. (Use the Chart for  $N_c$ ,  $N_\gamma$  etc., e-mailed to you on 03/29/2021)

Use chart handout for  $N_c, N_\gamma$  etc.



- $D_f = 2 \text{ ft}$
- $B = 2.5 \text{ ft}$
- $FS = 4$
- $q = \gamma D_f$

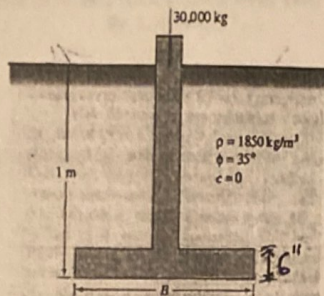
Find  $q_{all}$

$$q_{all} = \frac{1}{FS} \left[ c N_c + \gamma D_f N_q + \frac{1}{2} \gamma B N_\gamma \right]$$

$$= \frac{1}{4} \left[ (300)(11.5) + (115)(2)(1) + \frac{1}{2}(115)(2.5)(1) \right] (2.5)$$

- a. 5010 psf
- b. 6010 psf
- c. 4010 psf
- ☒ d. 7010 psf

15. A square footing is shown. The footing will carry a gross mass of 30,000 kg. Using  $FS = 3$ , determine the size ( $B$ ) of the footing.



$q_u =$

- ☒ a. 2 m
- ☐ b. 3 m
- ☐ c. 1 m
- ☐ d. 4 m

**BELOW AVERAGE**

M. Leblanc ??

NAME ??

Department of Civil & Environmental Engineering  
CVEG 3102: Professional Engineering I  
**GEOTECHNICAL ENGINEERING TEST**  
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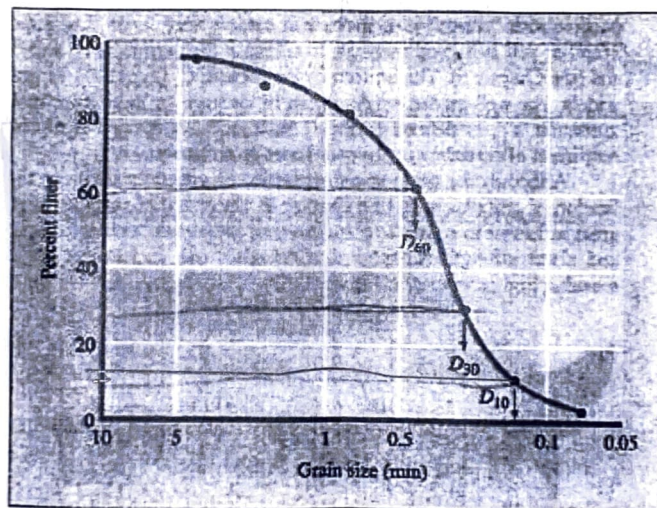
04/15

Michael LeBlanc

1. An undisturbed sample of clay has a wet mass of 100 kg, a dry mass of 93 kg, and a total volume of  $0.0491 \text{ m}^3$ . The solids have a specific gravity of 2.65. The void ratio is most nearly:

- ~~a. 0.31~~  
~~b. 0.61~~  
c. 0.40  
d. 1.0

2. A soil's grain-size distribution curve is shown. The *coefficient of gradation* is most nearly:



- ~~a. 6.00~~  
b. 2.23  
c. 5.25  
d. 1.24

$$C_u = \frac{60}{7}$$

$$D_{60} = 10$$

My interpretation

3. The lines in a graphical flow net intersect to form a pattern of:

- ☒ a. Triangles
- ☐ b. Trapezoids
- ☐ c. Squares
- ☐ d. Rectangles

4. A flow net is constructed of:

- ☐ a. Isobars and aquicludes
- ☒ b. Streamlines and equipotential lines
- ☐ c. Isogons and isopleths
- ☐ d. None of the above

5. A soil has a void ratio of 0.41. The unit weight of the solids is  $33 \text{ kN/m}^3$ . The *saturated unit weight* of the soil is most nearly

$$\gamma = 33 \text{ kN/m}^3$$

- ☒ a.  $33 \text{ kN/m}^3$
- ☐ b.  $29 \text{ kN/m}^3$
- ☐ c.  $26 \text{ kN/m}^3$
- ☐ d.  $37 \text{ kN/m}^3$

$$\gamma_{sat} = \text{C}$$

6. The soil directly below a footing experiences a total compressive stress of  $52 \text{ kPa}$ . The surface of the water (water table) is  $2 \text{ m}$  higher than the bottom of the footing. The *effective stress* under the footing is most nearly

- ☐ a.  $19 \text{ kPa}$
- ☐ b.  $38 \text{ kPa}$
- ☐ c.  $13 \text{ kPa}$
- ☒ d.  $32 \text{ kPa}$

$$\sigma' =$$

7. A sand has a minimum void ratio of  $0.41$  and a maximum void ratio of  $0.78$ . The actual void ratio of the sand is  $0.576$ . The *relative density* of the sand is most nearly

- ☐ a.  $40\%$
- ☐ b.  $45\%$
- ☒ c.  $55\%$
- ☐ d.  $80\%$

$$e = 0.41$$

$$e_{max} = 0.7$$

$$e_{sand} = 0.576$$

8. A moist soil has these values:  $V = 0.25 \text{ ft}^3$ ,  $W = 30.75 \text{ lb}$ ,  $w = 9.8\%$ , and  $G_s = 2.66$ . The porosity,  $n$ , is most nearly:

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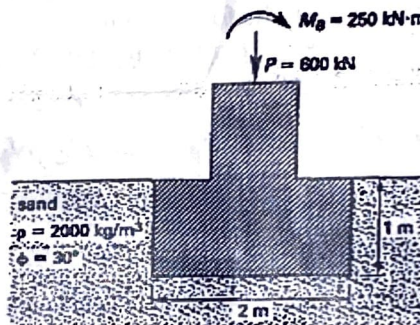
$$n =$$

600?  
9. A concentrated vertical point load of 6000 lbs is applied at the ground surface. Most nearly, the increase in vertical pressure 3.5 ft below the surface and 4 ft away from a point directly below the concentrated load is

- a. 29 psf
- b. 36 psf
- ☒ c. 41 psf
- d. 58 psf

$$E_v = \frac{\Delta \sigma_{TOT}}{(1 + e_0)} =$$

10. A 2 m wide continuous wall footing is designed to support an axial column load of 600 kN (per meter wall length) and a moment of 250 kN.m (per meter of wall length), as shown. The footing is placed 1 m into a sandy soil with a density of 2000 kg/m<sup>3</sup>, a cohesion of 0.5 Pa, and an angle of internal friction of 30°. Most nearly, the ultimate bearing capacity per meter of footing length is:



- ☒ a. 870 kPa
- b. 210 kPa
- c. 830 kPa
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11. A soil has an angle of internal friction of 25°. The Rankine *active* earth pressure coefficient is nearly

- a. 0.34
- ☒ b. 0.41
- c. 0.52
- d. 0.58

Chart?

12. A retaining wall supports soil with a vertical height of 2 m. The soil has an angle of internal friction of  $32^\circ$  and a specific (unit) weight of  $25 \text{ kN/m}^3$ . The active lateral soil resultant force is most nearly:

- ☒ a. 5 kN/m
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13. A uniform soil slope has a planar slip surface length of 100 m. The soil's cohesion is 5 kPa, and the angle of internal friction is  $40^\circ$ . The angle that the assumed failure plane makes with respect to the horizontal is  $25^\circ$ . The weight of the soil mound above the assumed failure plane is 2000 kN/m. The mobilized shear force along the assumed failure plane is most nearly

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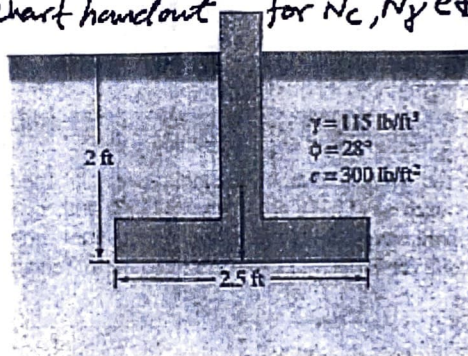
$$c = 5 \text{ kPa}$$

$$\phi = 40^\circ$$

$$T = 5 + 2000 \tan(40) =$$

14. A continuous footing is shown. Using Terzaghi's bearing capacity factors, determine the gross allowable load per unit area ( $q_{all}$ ) that the footing can carry. Assume General Shear Failure. (Use the Chart for  $N_c$ ,  $N_q$  etc., e-mailed to you on 03/29/2021)

Use chart handout for  $N_c, N_q$  etc.



$$D_f = 2 \text{ ft}$$

$$B = 2.5 \text{ ft}$$

$$FS = 4$$

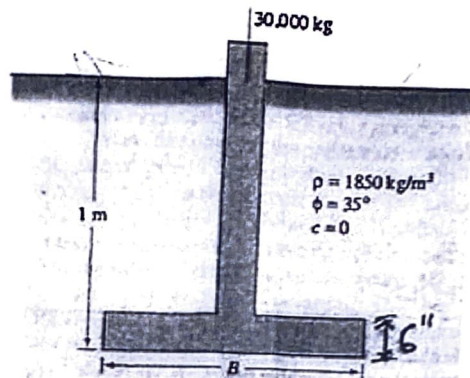
$$q = \gamma D_f$$

$$N_c = 30 \quad N_q = 17 \quad N_\gamma = 12$$

$$q_{ult} = 300 \text{ lb/ft}^2 (30) + 115 \text{ lb/ft}^3 (2 \text{ ft}) (17) + \frac{1}{2} (115) (2.5)$$

- ☐ a. 5010 psf
- ☐ b. 6010 psf
- ☐ c. 4010 psf
- ☒ d. 7010 psf

15. A square footing is shown. The footing will carry a gross mass of 30,000 kg. Using  $FS = 3$ , determine the size ( $B$ ) of the footing.



- ☒ a. 2 m
- ☐ b. 3 m
- ☐ c. 1 m
- ☐ d. 4 m