CE WEEKEND RANDOM QUIZ

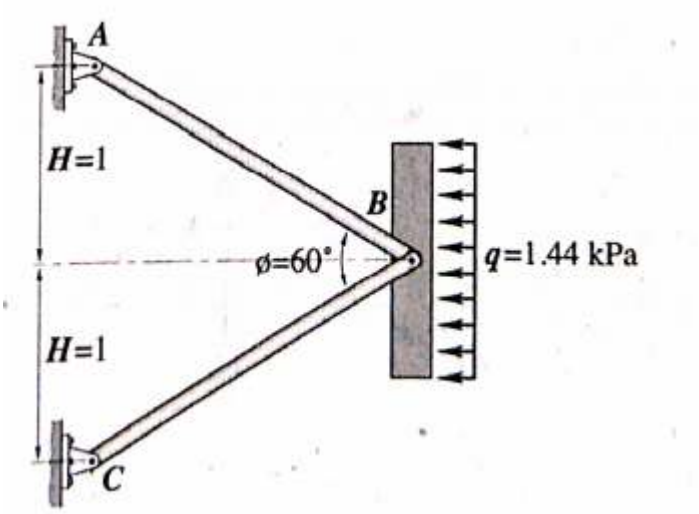
1. (Engineering Mathematics Lv 3) A round underwater transmission cable consists of a core of copper wires surrounded by nonconducting insulation. If x denotes the ratio of the radius of the core to the thickness of the insulation, it is known that the speed of the transmission signal is given by the equation v = x^2 ln(1/x) If the radius of the core is 1 cm, what insulation thickness h will allow the greatest transmission speed?

   a. 2.44 cm b. 1.88 <u>c. 1.65</u> d. 3.61

   SOLUTION:

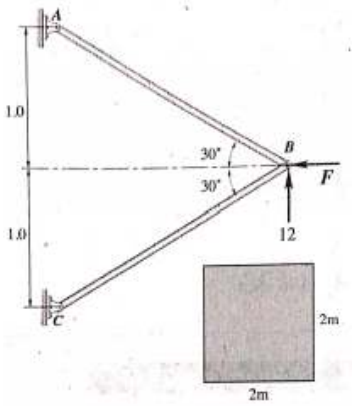
   $v = x^2 \ln\left(\frac{1}{x}\right) = x^2(\ln 1 - \ln x) = -x^2 \ln x \Rightarrow \frac{dv}{dx} = -2x \ln x - x^2\left(\frac{1}{x}\right) = -x(2 \ln x + 1)$; solving $\frac{dv}{dx} = 0$ $\Rightarrow 2 \ln x + 1 = 0 \Rightarrow \ln x = -\frac{1}{2} \Rightarrow x = e^{-1/2}$; $\frac{dv}{dx} < 0$ for $x > e^{-1/2}$ and $\frac{dv}{dx} > 0$ for $x < e^{-1/2} \Rightarrow$ a relative maximum at $x = e^{-1/2}$; $\frac{r}{h} = x$ and $r = 1 \Rightarrow h = e^{1/2} = \sqrt{e} \approx 1.65$ cm

2. (Structural Engineering Lv 2) The pin jointed assembly supports a billboard 2 m high x 4 m wide on each end as shown. The total weight of the billboard is 24 kN. Wind pressure q = 1.44 kPa and C = 1.2. Determine the normal space in strut BC with cross sectional dimensions of 6 mm x 50 mm.

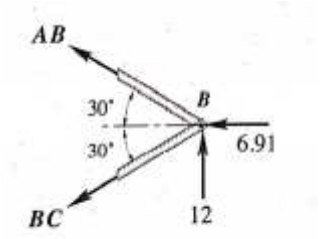


   a. 50.44 MPa <u>b. 53.3 MPa</u> c. 38.72 d. 26.7

   SOLUTION:



F = qAC
F = 1.44(2)(2)(1.2)
F = 6.91 kN

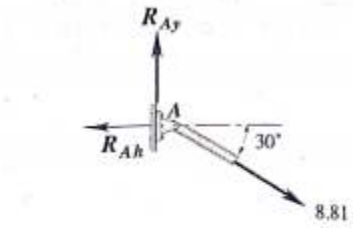


$\sum F_v = 0$

$AB \sin 30^\circ + BC \sin 30^\circ = 12$

$AB + BC = 24$

$BC = 24 - AB$



$\sum F_h = 0$

$AB \cos 30^\circ + 6.91 = BC \cos 30^\circ$

$AB + 7.98 = BC$

$BC = 24 - AB$

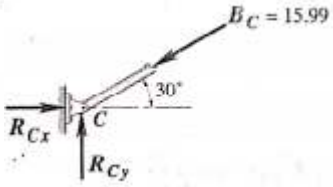
$AB + 7.98 = 24 - AB$

$2AB = 16.02$

$AB = 8.01$

$R_{A_y} = 8.01 \sin 30^\circ$

$R_{A_y} = 4.01\ kN$



$BC = 24 - 8.01$

$BC = 15.99\ kN$

$Rc_y = 15.99 \sin 30^\circ$

$Rc_y = 8\ kN$

$$\sigma_{BC} = \frac{15990}{6(50)}$$

$\sigma_{BC} = 53.3\ MPa$

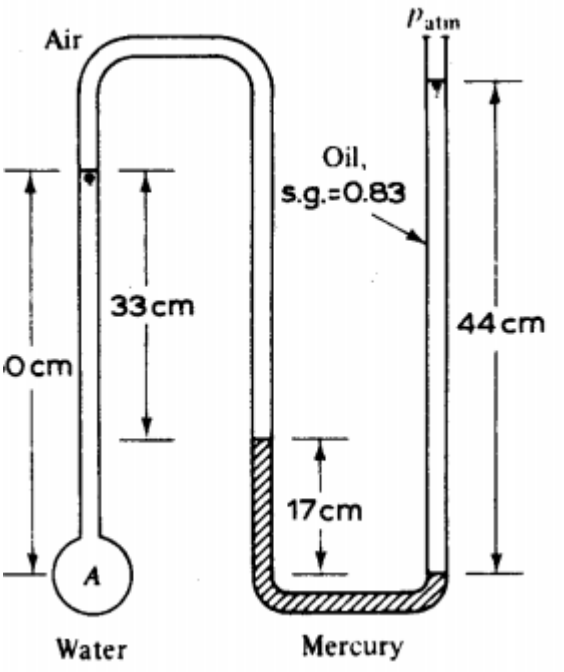
3. (Geotechnical Engineering Lv 1) A cone with an apex angle of 30° and total mass of 80 grams is suspended above, but just in contact with, the soil sample. The cone is permitted to fall freely for a period of 5 seconds. The water content corresponding to a cone penetration of 20 mm defines the liquid limit. What is method is this?

   a. Falling head b. Fall cone c. Rubber Balloon d. Sieve method

4. (CE Laws Lv 2) According to PD 1096, The walkway shall be capable of supporting a uniform live load of _____.

   a. 650 kg/m^2 b. 900 c. 1000 d. 850

5. (Hydraulics Lv 1) Determine the gage pressure at A in the figure shown.



a. -44.62 kPa b. 61.90 c. 13.33 <u>d. -14.17 kPa</u>

SOLUTION:

$$p_A - (9.79)(0.50) + (0.0118)(0.33) + [(13.6)(9.79)](0.17) - [(0.83)(9.79)](0.44) = 0 \qquad p_A = -14.17 \text{ kPa}$$

6. (Surveying Lv 1) It is the angular distance below or above the horizon measured on a vertical circle.
   a. Longitude b. Meridian <u>c. Altitude</u> d. Parallax

7. (Engineering Economics Lv 2) A machine costs P 1.5 M. It has a salvage value of P 600,000 at the end of its economic life. Using the sum of the years digit method, the book value at the end of 2 yrs is estimated to be P 870,000. What is the machines economic life in years?
   <u>a. 4 yrs</u> c. 8 d. 10 d. 12

SOLUTION:

BF = FC - total dep.

870,000 = 1,500,000 - total dep.

Total dep. = 630,000

Sum of years = $\frac{n}{2}(1+n)$

Total dep. after 2 yrs:

Total dep. = $\frac{n+(n-1)}{(n/2)(1+n)}(FC - SV)$

$630000 = \frac{2(2n-1)}{n(1+n)}(1500000-600000)$

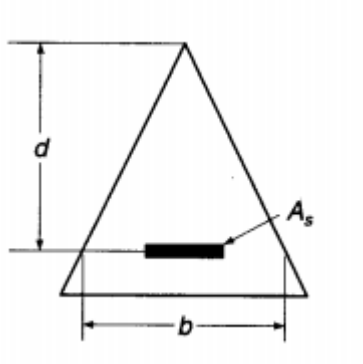
$\frac{2n-1}{n^2+n} = 0.35$

$0.35n^2 + 0.35n = 2n - 1$

$n^2 - 4.71n + 2.857 = 0$

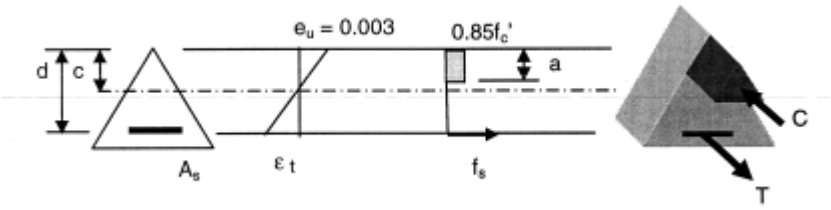
$n = 4$ *yrs.*

8. (Structural Engineering Lv 3) For the beam with a triangular cross section as shown , determine the balanced reinforcement ratio in terms of β^2 (fc/fy). The dimensions of the triangle are such that the width of the triangle equals the distance from the apex. The width at the effective width b equals the effective depth d. Use Grade 60 steel.



a. 0.100 β^2 (fc/fy) b. 0.060 c. 0.153 d. 0.005

SOLUTION:



From Equilibrium

C=T

$0.85f'_c\ (1/2\ a\ b_a) = A_s f_y$

Substitution $A_s = \rho\ b\ d$, where b = d and $b_a = a$ gives

$0.85f_c'\ a^2/2 = \rho\ d^2 f_y$

Solve for ρ

$$\rho = \frac{0.85}{2}\frac{f'_c}{f_y}\left(\frac{a}{d}\right)^2$$

The relationship between a and c is $a = \beta_1 c$. From the relationship of plane sections remain plane, the correlation of c/d is

$$\frac{c}{d} = \frac{\varepsilon_u}{\varepsilon_u + \varepsilon_t}$$

Substitution for a and then c/d gives

$$\rho = \frac{0.85}{2}\frac{f'_c}{f_y}\beta_1^2\left(\frac{\varepsilon_u}{\varepsilon_u + \varepsilon_t}\right)^2$$

For the balanced condition, $\varepsilon_t = \varepsilon_y$ and ρ_b is

$$\rho_b = \frac{0.85}{2}\frac{f'_c}{f_y}\beta_1^2\left(\frac{\varepsilon_u}{\varepsilon_u + \varepsilon_y}\right)^2$$

Using grade 60 steel, so ε_y is 0.002 and $\varepsilon_u = 0.003$, the balanced ratio becomes.

$$\rho_b = 0.153\beta_1^2\frac{f'_c}{f_y}$$ **<=Solution for balanced ratio**

9. (Geotechnical Engineering Lv 2) For a normally consolidated clay , the following values are given:

Void ratio, *e*	*k* (cm/sec)
0.95	0.2×10^{-6}
1.6	0.91×10^{-6}

Determine the value of k in cm/sec.

a. 4.66 x 10^-7 <u>b. 3.08 x 10^-7</u> c. 5.19 x 10^-7 d. 1.14 x 10^-7

SOLUTION:

$$\frac{k_1}{k_2} = \left(\frac{e_1^n}{1+e_1}\right)\left(\frac{1+e_2}{e_2^n}\right) = \left(\frac{1+e_2}{1+e_1}\right)\left(\frac{e_1}{e_2}\right)^n$$

$$\frac{0.2\times10^{-6}}{0.91\times10^{-6}} = \left(\frac{2.6}{1.95}\right)\left(\frac{0.95}{1.6}\right)^n ; 0.1648 = 0.593^n$$

$$n = \frac{\log 0.1648}{\log 0.593} = 3.45$$

$$k_1 = C\left(\frac{e_1^n}{1+e_1}\right); \quad C = \frac{(0.2\times10^{-6})(1+0.95)}{0.95^{3.45}} = 4.655\times10^{-7}\ \text{cm/sec}$$

$$k_3 = \left(\frac{1.1^{3.45}}{2.1}\right)(4.655\times10^{-7}) = \mathbf{3.08\times10^{-7}\ cm/sec}$$

10. Structural Engineering (Lv 1) A cast iron column supports an axial compressive load of 250 kN. Determine the inside diameter of the column if its outside diameter is 200 and the limiting compressive stress is 50 MPa.

a. 199.1 b. 94.7 c. 100 <u>d. 183.4</u>

SOLUTION:

$$A = \frac{\pi}{4}(D_2^2 - D_1^2)$$

$$A = \frac{\pi}{4}(40{,}000 - D_1^2)$$

$$[P = AS]$$

$$250(1000) = \frac{\pi}{4}(40{,}000 - D_1^2)(50)$$

$$5000 = \frac{\pi}{4}(40{,}000 - D_1^2)$$

$$40{,}000 - D_1^2 = 6366.2$$

$$D_1 = 183.4 \text{ mm}$$

11. (Engineering Mathematics Lv 2) Coupons in cereal boxes are numbered 1 to 5 , and a set of one each is required for a prize. With one coupon per box , how many boxes on the average are required to make a complete set?

a. 5 b. 10 c. 11.42 d. 20.5

SOLUTION:

We get one of the numbers in the first box. Now the chance of getting a new number from the next box is $\frac{4}{5}$. Using the result of Problem 4, the second new number requires $1/(4/5) = \frac{5}{4}$ boxes. The third new number requires an additional $1/(3/5) = \frac{5}{3}$; the fourth $\frac{5}{2}$, the fifth $\frac{5}{1}$.

Thus the average number of boxes required is

$$5(\tfrac{1}{5} + \tfrac{1}{4} + \tfrac{1}{3} + \tfrac{1}{2} + 1) \approx 11.42.$$

12. (Engineering Mechanics Lv 1) A 5 kg block resting on a smooth surface is pushed horizontally by a force P as shown. The graph of force P vs the time is also shown. Determine the acceleration of the block during the first two seconds in m/s^2.

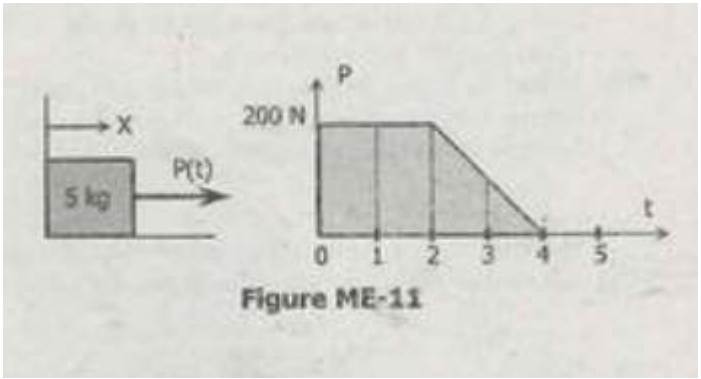
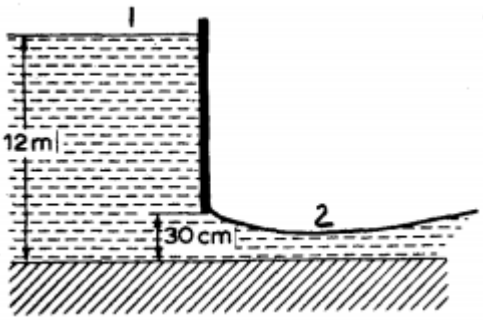


Figure ME-11

a. 40 b. 45 c. 28 d. 32

As shown in the diagrams:
Acceleration during the first two seconds = 40 m/s²
Velocity after five seconds = 120 m/s

13. (Hydraulics Lv 3) A wide sluice, made of finished concrete and having slope = 0.0004, is fed from a large reservoir through sharp edged gate as shown in the Figure. The coefficient of contraction Cc = 0.82 and the coefficient of friction Cf = 0.86. How far from the vena contracta does the water increase depth by 30 mm? Make a one stage calculation with linear averages.



a. 14.47 m b. 11.62 c. 13.60 d. 18.56

SOLUTION:

$$v_1^2/2g + y_1 = v_2^2/2g + y_2 \qquad y_2 = (0.30)(0.82) = 0.2460 \text{ m}$$

$$0 + 12 = v_2^2/[(2)(9.807)] + 0.2460 \qquad v_2 = 15.18 \text{ m/s}$$

$$q_{\text{theoretical}} = y_2 v_2 = (0.2460)(15.18) = 3.734 \text{ (m}^3\text{/s)/m} \qquad q_{\text{actual}} = (0.86)(3.734) = 3.21 \text{ (m}^3\text{/s)/m}$$

$$\Delta x = \left([1 - (Q^2 b/gA^3)]/\{s_0 - (n/\kappa)^2[Q^2/(R_h^{4/3}A^2)]\}\right)\Delta y$$

$$\Delta y_{\text{downstream}} = 0.246 + 0.03 = 0.276 \text{ m}$$

$$\Delta x = \left\{\frac{1 - (3.21)^2/(9.807)(0.276)^3}{0.0004 - (0.012/1)^2[3.21^2/(0.276)^{4/3}(0.276)^2]}\right\}(0.030) = 13.60 \text{ m}$$

14. (Transportation Engineering Lv 1) If 2600 vehicles passes a certain lane of road with an average speed of 55 kph, determine the appropriate spacing of the vehicles.

a. 21.15 m/vehicle b. 26.50 c. 28.82 d. 29.12

SOLUTION:

55(1000)/2600 = 21.15

15. (Fluid Mechanics Lv 2) A soap bubble has a radius 5 cm. If the soap solution has a surface tension of T = 30 x 10^-3 N/m, what gage pressure within the bubble?

a. 5 Pa b. 2.4 c. 3.2 d. 6.4

SOLUTION:

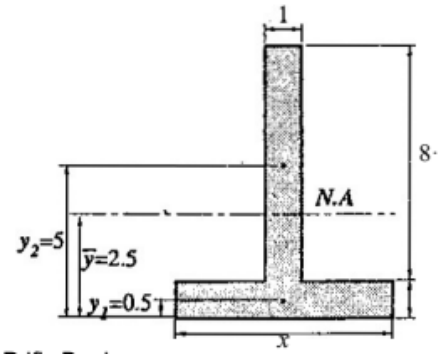
A soap bubble has a radius of 5 cm. If the soap solution has a surface tension $T = 30 \times 10^{-3}$ N/m, what is the gauge pressure within the bubble?

Consider a hemisphere of the bubble (Fig. 15-17). The downward force of surface tension on each of the two bubble surfaces, inside and outside, is $2\pi rT$. For both surfaces the total force F is $F = 2(2\pi rT) = \Delta p\, A$, where A is the area of the flat circular face of the hemisphere. (See, e.g., Prob. 15.36.) Since $A = \pi r^2$,

$$4\pi rT = \Delta p(\pi r^2) \qquad \frac{4T}{r} = \Delta p \qquad \Delta p = \frac{4T}{r} = \frac{4(30 \times 10^{-3})}{0.05} = \underline{2.4 \text{ Pa}}$$

Knockouts (Note: Eight Participants will answer simultaneously, then four , then two and so on.)

1. The T section show has its centroid 2.5 in above the base. What value of 6 in width of the flange be changed?



SOLUTION:

A1=(1)(x)=x
A2=(1)(8)=8
A= 8+x

Y1=05
Y2=5
y=2.5

Ay = A1Y1+ A2Y2
(8+x)(2.5)=x(0.5)+8(5)
20.+2.5x=0.5x+40
2x=20
x=10

2. The sum of two angles is 1600 mils and their difference is 40 grads. Find the value of the bigger angle.

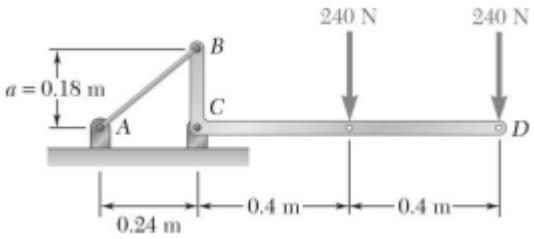
SOLUTION :

6400 mils = 360°
400 grds = 360°
40 grds = 36°
1600 mils = 90°

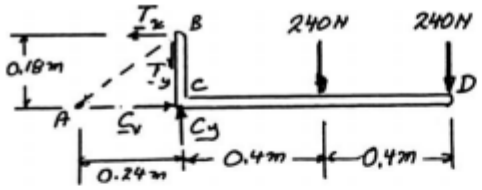
x + y = 90
x - y = 36
2x = 126
x = **63** °

3. Mohr's Circle was named after _____
   Answer: Otto Mohr

4. Bracket BCD is hinged at C and attached to a control cable at B. For the loading shown, determine the reaction at C in Newtons.



SOLUTION:



$$\frac{T_y}{T_x} = \frac{0.18\text{ m}}{0.24\text{ m}}$$

$$T_y = \frac{3}{4}T_x \qquad (1)$$

$$+\circlearrowleft \Sigma M_C = 0: \quad T_x(0.18\text{ m}) - (240\text{ N})(0.4\text{ m}) - (240\text{ N})(0.8\text{ m}) = 0$$

$$T_x = +1600\text{ N}$$

$$T_y = \frac{3}{4}(1600\text{ N}) = 1200\text{ N}$$

$$T = \sqrt{T_x^2 + T_y^2} = \sqrt{1600^2 + 1200^2} = 2000\text{ N} \qquad T = 2.00\text{ kN} \blacktriangleleft$$

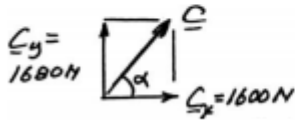
(*b*)

$$\pm \rightarrow \Sigma F_x = 0: \quad C_x - T_x = 0$$

$$C_x - 1600\text{ N} = 0 \quad C_x = +1600\text{ N}$$

$$+\uparrow \Sigma F_y = 0: \quad C_y - T_y - 240\text{ N} - 240\text{ N} = 0$$

$$C_y - 1200\text{ N} - 480\text{ N} = 0$$



$$C_y = +1680\text{ N}$$

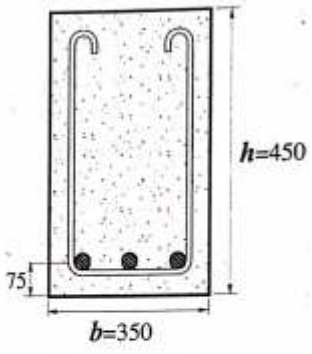
$$\alpha = 46.4°$$

$$C = 2320\text{ N}$$

5. Given:
   Beam dimensions = 350 x 450 mm
   Effective cover to centroid of steel reinforcement = 75 mm
   Main reinforcement steel = 415 MPa , Stirrups = 275 MPa
   Shear strength reduction factor = 0.75
   Beam is subjected to flexure and shear.
   The beam is reinforced with 3 legs of 10 mm diameter stirrups space 90 mm on the center. Find the shear strength of the beam.
   SOLUTION:

Solution:

Shear strength of the beam



$V_c = 0.17\lambda \sqrt{f_c'}\, b_w\, d$

$d = 450 - 75 = 375$

$V_c = 0.17(1)\sqrt{27.5}\,(350)(375)$

$V_c = 117008\ kN$

$V_c = 117\ kN$

$V_s = \dfrac{A_v\, fy_v\, d}{S}$

$A_v = \dfrac{\pi}{4}(10)^2(3)$

$A_v = 235.62\ mm^2$

$V_s = \dfrac{235.62(275)(375)}{90}$

$V_s = 269981\ N$

$V_s = 270\ kN$

$\dfrac{V_u}{\phi} = V_s + V_c$

$V_u = (270 + 117)(0.75)$

$V_u = \mathbf{290.25\ kN}$

6. If y = e^sin x , find the derivative.
   SOLUTION:

$$y = e^{\sin x}$$

$$\frac{dy}{dx} = e^{\sin x}(\cos x)$$

7. A 1 X 1 X 1 m tank is filled 50% with oil (S = 0.82) and the remaining is water. When it is translated vertically upward at 5.10 m/s^2. Determine the velocity at the orifice 50 mm diameter located at the bottom of the tank.

SOLUTION:

Pressure at the bottom.

$P = P_{static}\left(1 + \frac{a}{g}\right)$

$P_{static} = w\,h$

$h = 0.5\,(0.82) + 0.5(1)$

$h = 0.91$ m.

$P = 9.81(0.91)\left(1 + \frac{5.10}{9.81}\right)$

$P = \mathbf{13.57\ kPa}$

$h = 0.91\left(1 + \frac{5.10}{9.81}\right)$

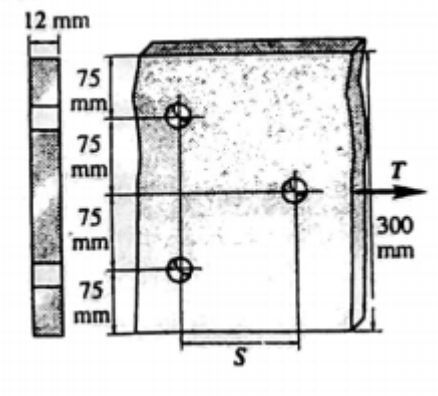
$h = 1.38$ m.

$V = \sqrt{2g\,h}$

$V = \sqrt{2(9.81)(1.38)}$

$V = \mathbf{5.20\ m/s}$

8. The plate shown in the figure has a thickness of 12 mm. Diameter of bolts is 16 mm. A 36 steel is used with Fy = 248 MPa and Fu = 400 MPa. Standard nominal hole diameter of 16 mm bolts = 17 mm. Compute the minimum pitch S for which only two and one half bolts need be subtracted at any one section in calculating the net area.



SOLUTION:

SOLUTION:

Min. pitch "S" for which only two and a half bolts need be subtracted at any one section.

Diameter of hole = 17 + 1.6

Diameter of hole = 18.6

Net width = 300 - 2.5(18.6)

Net width = 253.50 mm

For route ABCDE:

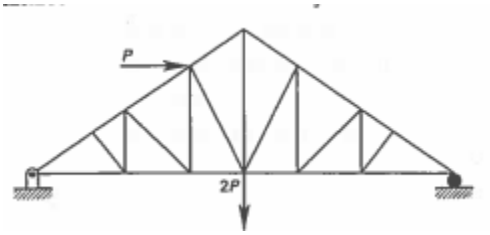
Net width = $300 - 3(18.6) + \frac{S^2}{4(75)} + \frac{S^2}{4(75)}$

$253.50 = 300 - 55.8 + \frac{2S^2}{4(75)}$

$S = \mathbf{37.35\ mm}$

9. It refers to the polygon with x number of sides. Answer: Apeirogon

10. For the loading shown, the number of zero force members in the truss is _____.



Answer: 9

11. The same angle was measures by two different observers using the same instrument, as follows:

Observer A			*Observer B*		
°	′	″	°	′	″
86	34	10	86	34	05
	33	50		34	00
	33	40		33	55
	34	00		33	50
	33	50		34	00
	34	10		33	55
	34	00		34	15
	34	20		33	44

Determine the most probable value of the angle. (In Degrees , minutes and seconds)
SOLUTION:

Observer A			r	r^2
°	′	″	″	″
86	34	10	10	100
	33	50	−10	100
	33	40	−20	400
	34	00	0	0
	33	50	−10	100
	34	10	10	100
	34	00	0	0
	34	20	20	400
Mean = 86	34	00	0	$1200 = \Sigma r^2$

Observer B			r	r^2
°	′	″	″	″
86	34	05	7	49
	34	00	2	4
	33	55	−3	9
	33	50	−8	64
	34	00	2	4
	33	55	−3	9
	34	15	17	289
	33	44	−14	196
86	33	58	0	$624 = \Sigma r^2$

(a) (i) Standard deviation $(\Sigma r^2 = \Sigma(x_i - \bar{x})^2)$

$$S_A = \left(\frac{\sum r^2}{n-1}\right)^{\frac{1}{2}} = \left(\frac{1200}{7}\right)^{\frac{1}{2}} = 13.1''$$

(b) (i) Standard error $S_{\bar{x}_A} = \frac{S_A}{n^{\frac{1}{2}}} = \frac{13.1}{8^{\frac{1}{2}}} = 4.6''$

(a) (ii) Standard deviation $S_B = \left(\frac{624}{7}\right)^{\frac{1}{2}} = 9.4''$

(b) (ii) Standard error $S_{\bar{x}_B} = \frac{9.4}{8^{\frac{1}{2}}} = 3.3''$

(c) As each arithmetic mean has a different precision exhibited by its $S_{\bar{x}}$ value, the arithmetic means must be weighted accordingly before they can be averaged to give the MPV of the angle:

$$\text{Weight of } A \propto \frac{1}{S^2_{\bar{x}_A}} = \frac{1}{21.2} = 0.047$$

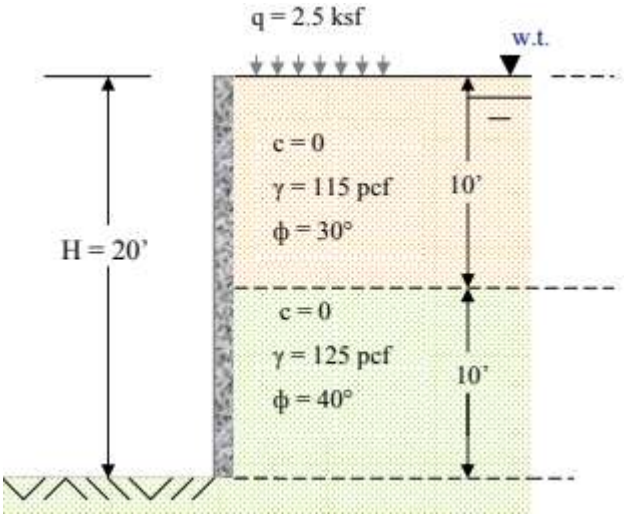
$$\text{Weight of } B \propto \frac{1}{10.9} = 0.092$$

The ratio of the weight of A to the weight of B is 0.047:0.092

$$\therefore \text{MPV of the angle} = \frac{(0.047 \times 86^\circ\,34'\,00'' + 0.092 \times 86^\circ\,33'\,58'')}{(0.047 + 0.092)}$$

$$= 86^\circ\,33'\,59''$$

12. Find the location of the resultant with respect to the top of the wall in an active pressure condition in the figure shown.



SOLUTION:

Ka1 = tan2 (45°- 30°/2) = 0.333
Ka 2 = tan2 (45°- 40°/2) = 0.217

The stress on the wall at point a is: pa = q Ka 1 = (2.5) (0.333) = 0.83 ksf
The stress at b (within the top stratum) is: pb'+ = (q + γ'h) Ka 1

= [2.5 + (0.115 - 0.0624) (10')] [0.333] = 1.01 ksf

The stress at b (within bottom stratum) is: pb' - = (q + γ'h) Ka 2

= [2.5 + (0.115 – 0.0624) (10')] [0.217] = 0.66 ksf

The stress at point c is: pc' = [q + (γ'h)1 + (γ'h)2] Ka 2

= [2.5 + (0.115 – 0.0624) (10') + (0.125 – 0.0624)(10')] [0.217] = 0.79 ksf

The pressure of the water upon the wall is: pw = γwh = (0.0624) (20') = 1.25 ksf

The forces from each area:

F_1 = (10') (0.83) = 8.30 kips/ft

F_2 = ½ (10')(0.18) = 0.90 kips/ft

F_3 = (10') (0.66) = 6.60 kips/ft

F_4 = ½ (10')(0.13) = 0.65 kips/ft

F_5 = ½ (1.25) (20') = 12.5 kips/ft

F_{total} = 29.0 kips/ft

Step 4

The location of forces ŷ is at:

$$\hat{y} = \frac{5 \cdot 8.3 + {}^{20}/_{3} \cdot 0.9 + 15 \cdot 6.6 + {}^{50}/_{3} \cdot 0.65 + {}^{40}/_{3} \cdot 12.5}{29} = 0.66\ ksf$$

The stress at point *c* is: **ŷ = 11.2 feet from top of wall**

13. What is the difference between the sums of an annuity due and an ordinary annuity for the following data?
    Periodic payment = P 150,000
    Terms = 20 years
    Payment interval = 1 year
    Interest rate = 12% compounded annually
    SOLUTION:
    Difference = $A[(1 + i)^n - 1]$
    Difference = $150{,}000[(1.12)^{20} - 1]$
    Difference = P***1,296,943.96***

14. Timber joists 75 x 300 mm are placed on a spacing 0.40 m on centers. Their end rest upon steel beams of 150 mm flange width and on a 4.25 m on centers. Compute the maximum allowable working load per sq m that the joists could carry including weight of joists and floor so that it will not exceed the allowable bearing stress of 12 MPa.
    SOLUTION :
    Working load due to bending
    Total load $= W(4.25)(0.4)$
    Total load $= 1.7W$
    $W_T = 1.7W$ (kN)
    $f_b = \frac{6M}{bd^2}$
    $12 = \frac{6M}{75(300)^2}$
    $M = 13.5$ kN.m
    $M = \frac{W_T L}{8}$
    $13.5 = \frac{1.7W(4.25)}{8}$
    $W = 14.95$ kN/m²

15. These are the structures in the form of piled projections and they are built out from the shore to deep water and they may be constructed either for a navigable river or in the sea.
    ANSWER: Jetties or Jetty

16. A soil sample has void ratio of 0.72 , moisture content = 12 % and Gs = 2.72. Determine the dry unit weight.
    SOLUTION:
    Givens:
    $e = 0.72$, $\%w = 12\%$, $G_s = 2.72$
    a)
    * $\gamma_{dry} = \frac{G_s \times \gamma_w}{1 + e} = \frac{2.72 \times 9.81}{1 + 0.72} = 15.51$ KN/m³ ✓.

17. If the probability that a player shoots a 3 point range is 2/5 , determine the probability of shooting 5 out of 8 attempts.
SOLUTION:

Use Repeated Trials:

$$P = nC_r p^r q^{n-r} = 8C_5 \left(\frac{2}{5}\right)^5 \left(\frac{3}{5}\right)^{8-5} = 0.124 = 12.4\%$$

18. A pitcher hurls a 0.145-kg baseball past a batter at 40.2 m/s . Find the resistive force acting on the ball at this speed.

$$D = \frac{2mg}{v_T^2 \rho A}$$

$$R = \tfrac{1}{2} D \rho A v^2 = \frac{1}{2}\left(\frac{2mg}{v_\tau^2 \rho A}\right)\rho A v^2 = mg\left(\frac{v}{v_\tau}\right)^2$$

$$R = (0.145\ \text{kg})(9.80\ \text{m/s}^2)\left(\frac{40.2\ \text{m/s}}{43\ \text{m/s}}\right)^2 = 1.2\ \text{N}$$

19. According to PICE Manual, this is frequently used for investigations and studies and for basic services on design type projects where the scope and complexity of the assignment are clearly and fully defined.
ANSWER: Fixed Price

20. A reinforced concrete rectangular beam 300 mm wide has an effective depth of 450 mm and is reinforced for tension only. Assuming f'c = 20.7 MPa and fy = 330 MPa, determine the balanced steel area in sq mm. (Use rho balance = 3/7* f'c/fy)
SOLUTION:

$$\rho_{bal} = \left(\frac{3}{7}\right)\left(\frac{f'c}{fy}\right) = \frac{3}{7}\left(\frac{20.7}{330}\right) = 0.02688311688$$

$$A_{sb} = \rho_{bal}(bd) = 0.02688311688(450)(300) = 3629.221\ mm^2$$

21. Mr J dela Cruz borrowed money from a bank. He received from the bank P 1,340 and promised to pay P 1,500 at the end of 9 months. Determine the corresponding "Banker's discount" rate.

SOLUTION:

Solution :

❶ $F = P + I$

$1500 = 1340 + I$

$I = 160$

$I = P\,r\,t$

$160 = 1340\,r\,\frac{(9)}{12}$

$r = 0.1592$

$r = 15.92\%$ *rate of interest*

❷ *Bankers discount:*

$i = \frac{d}{1 - d}$

$0.1592 = \frac{d}{1 - d}$

$d = 0.1373$

$d = 13.73\%$ *(bankers discount)*

22. For how many different values of k is the 4 digit number 7k52 divisible by 12?

SOLUTION:

Solution

Since $12 = 4 \times 3$ the number $7k52$ must be divisible by both 4 and 3. Since 52 is the number formed by the last two digits divisible by 4 then we need only ask, 'for what values of k is $7k52$ divisible by 3?' If a number is divisible by 3 the sum of its digits must be a multiple of 3. Thus $7 + k + 5 + 2$ or $14 + k$ must be a multiple of 3. The only acceptable values for k are 1, 4 or 7.

Thus, are three values. ANSWER: (D)

23. Speed data collected on an urban highway yielded a standard deviation in speeds of ± 4.8 mi/ hour. If an engineer wishes to estimate the average speed on the roadway at a 95% confidence level so that the estimate is within ±2 mi/h. of the true average, how many spot speeds should be collected?

SOLUTION:

(a)

$N = [(z\,\sigma)/\,d]^2$

$N = [1.96(4.8) / 2]^2$

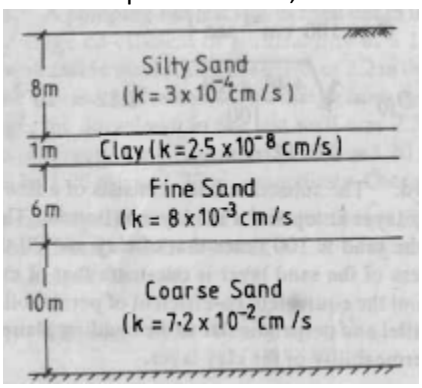
$N = 22.1 \Rightarrow 23$ spot speeds

Note: z=1.96 for 95% confidence interval

24. It denotes all forms of water that reach the earth from the atmosphere. The usual forms are snowfall, hail, frost, and dew.

ANSWER: Precipitation

25. In the soil profile shown, determine the average coefficient of the deposit.



SOLUTION:

Fig. 3.17

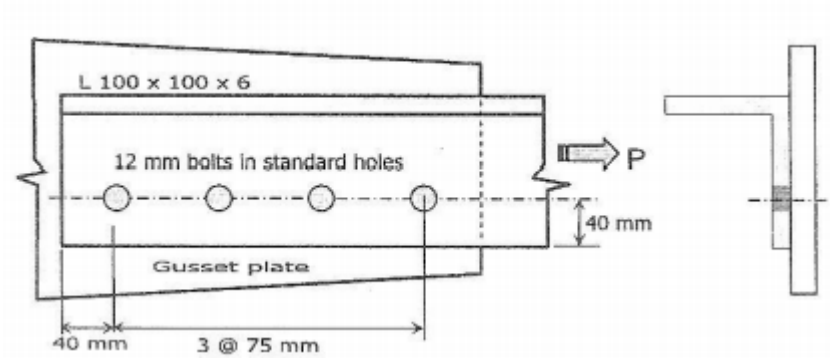
Solution : (i) Average co-efficient of permeability of the deposit,

$$k_{av} = \frac{k_1 + k_2 + k_3 + k_4}{4}$$

$$= \frac{3 \times 10^{-4} + 2.5 \times 10^{-8} + 8 \times 10^{-3} + 7.2 \times 10^{-2}}{4}$$

$$= 2 \times 10^{-2} \text{ cm/sec} = 0.02 \text{ cm/sec.}$$

26. Calculate the shear on bolts for an L 100 x 100 x 6 A 53 steel connected with 12 mm diameter A 490 in standard holes as shown. (Use ASD)



SOLUTION:

Relevant properties of L100 × 100 × 6:

$A = 1{,}179 \text{ mm}^2$

$t = 6$ mm

Bolt diameter = 12 mm

Standard hole = 14 mm

Use hole diameter = 14 + 1.6 = 15.6 mm

For A53 steel:

$F_y = 241$ MPa

$F_u = 414$ MPa

Shear on bolts (4 bolts in single shear):

$F_v = 276$ MPa

$P = F_v A_v = 276[4 \times \frac{\pi}{4}(12)^2]$

$P = 124{,}859$ N

$P = 124.859$ kN

27. Let f(x) = (3+x)/(3-x) , x ≠ 3. Evaluate f'(2).

$$f'(2) = \lim_{h\to 0}\frac{f(2+h)-f(2)}{h} = \lim_{h\to 0}\frac{1}{h}\left(\frac{5+h}{1-h} - 5\right) = \lim_{h\to 0}\frac{1}{h}\cdot\frac{6h}{1-h} = \lim_{h\to 0}\frac{6}{1-h} = 6$$

Note: By using rules of differentiation we find

$$f'(x) = \frac{(3-x)\dfrac{d}{dx}(3+x) - (3+x)\dfrac{d}{dx}(3-x)}{(3-x)^2} = \frac{(3-x)(1) - (3+x)(-1)}{(3-x)^2} = \frac{6}{(3-x)^2}$$

at all points x where the derivative exists. Putting $x = 2$, we find $f'(2) = 6$. Although such rules are often useful, one must be careful not to apply them indiscriminately (see Problem 4.5).

28. According to occupational safety standards, no stairway shall have a height of more than _____

ANSWER: 3.6 Meters

NOTHING FOLLOWS