ENCE 3356
EXAM I
FALL '09

91

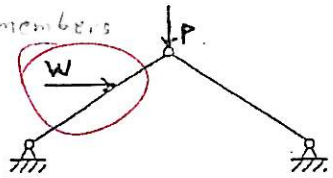
PART 1- *Short answer section.* This section is worth 20 out of 100 points. Maximum suggested time to complete this section is 20-25 minutes. The number of points that a question is worth is given in parenthesis at the beginning of the question. If you get stumped on any question, move on and complete the rest of the test and come back to the tricky one later. Never leave anything blank.

(4) 1. True or False (circle one):

T	(F)	In a simply supported truss spanning a river that is subjected to gravity loads only, the bottom chord members are in compression.
(T)	(F)	You can construct the moment diagram of a beam if given the beam's shear diagram and the beam's dimensions.
T	(F)	A truss that has been found to be statically determinant ($m + r = 2j$) can never also be found to have critical form.
(T)	F	As long as a beam or frame is statically determinate and stable, you can use the equations of equilibrium and the equations of condition (if any) to determine the unknown reactions at the structure's supports.

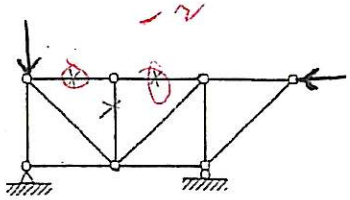
(2) 2. Can the structure shown below qualify to be analyzed as an ideal truss? Why or why not?

No. Because it is an unstable structre when removed from it supports. Ideal truss is at least 3 members

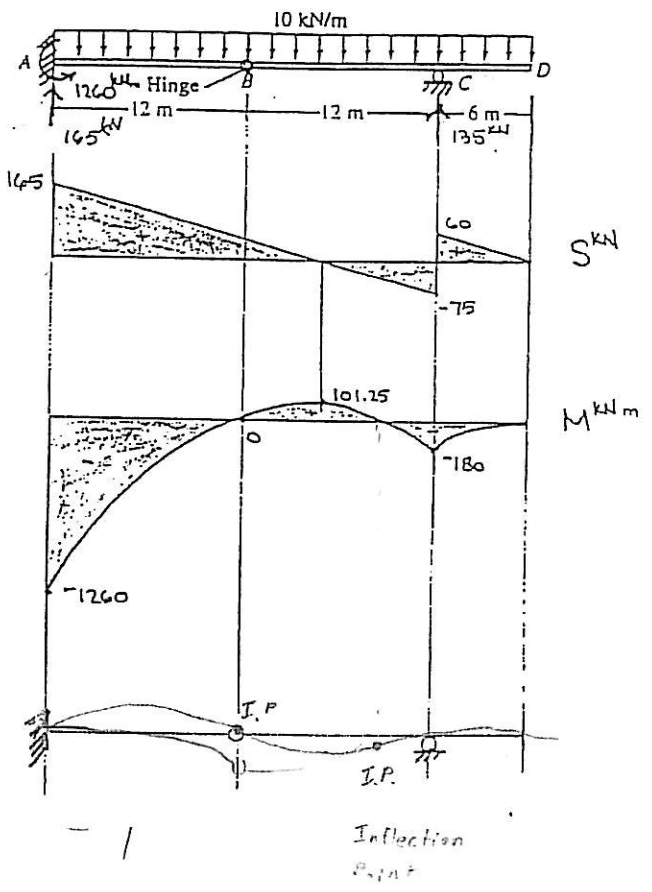


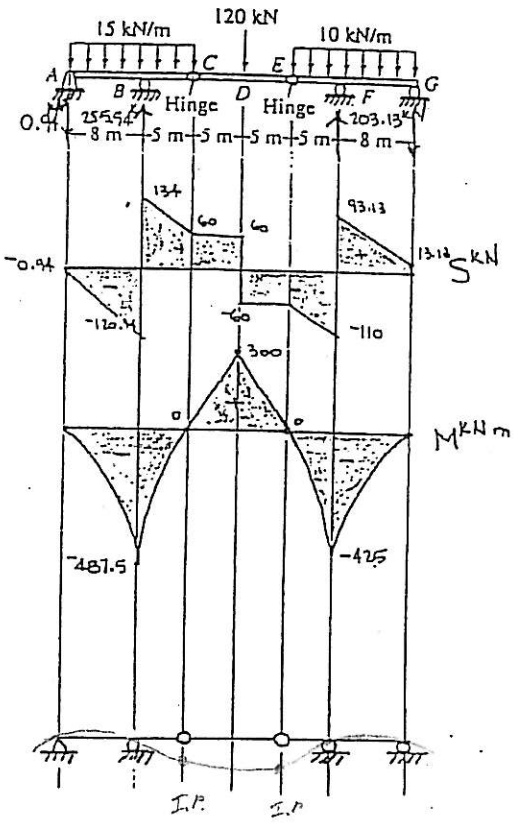
(2) 3. What is the name of the season that is marked by brisk cooler temperatures, the changing colors of leaves and is also the name of this semester? Fall (but where are the cooler temps)

(4) 4. For the truss shown below, identify any and all zero force members by placing a "0" next to or through that member.



(8) 5. Draw the qualitative deflected shape of each beam, given the beam's shear and moment diagram.

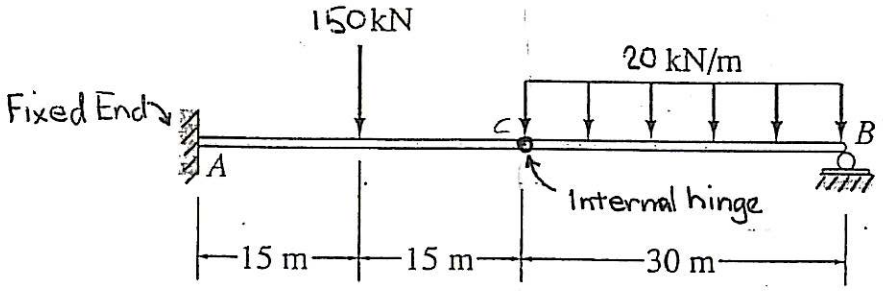


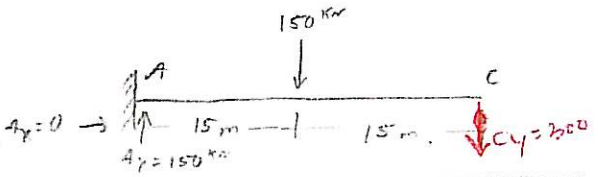


missing C_y shear -4

PART 2- *Problems section.* This portion of the exam is worth 80 out of 100 total points. You should use any extra note sheets that are necessary and turn them in with the exam (stapled at the back). The procedure used to solve each problem is worth a substantial part of the points, so please show all work. Don't turn in a test with just the answers on it. The number of points each problem is worth is given in parenthesis at the beginning of the question. Do not spend too much time on any one problem. Complete the ones that you feel most comfortable with first.

(15) 1. For the given structure, solve for all of the reactions.



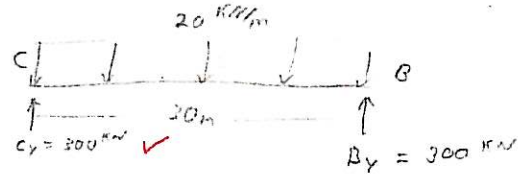


$+\circlearrowleft \Sigma M_A = 150(15) = 2250$ kN-m ↺

$+\uparrow \Sigma F_y = -150 + A_y = 0$

$A_y = 150$ kN

$\Sigma F_x = 0 \quad A_x = 0$ ✓



$+\circlearrowleft \Sigma M_C = 0 \quad 600(15) - B_y(30)$

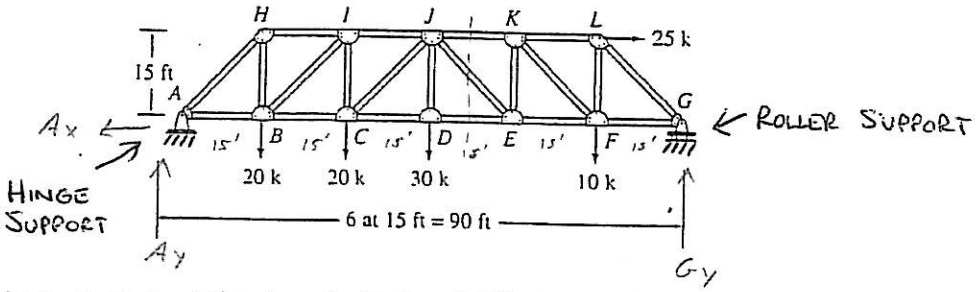
$B_y = 300$ kN ✓

$+\uparrow \Sigma F_y = 0 \quad -600 + C_y + 300 = 0$

$C_y = 300$ kN ✓

$\Sigma F_x = 0 \quad B_x = 0$

(25) 2. Solve for the member forces in members JK, JE, & DE, using either the method of joints or method of sections.



Reactions

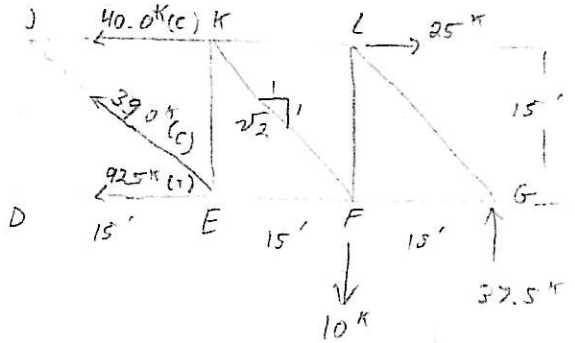
$\circlearrowleft \sum M_A = 0$ $\quad 20(15) + 20(30) + 30(45) + 10(75) - G_y(90) + 25(15) = 0$

$G_y = 37.5^K$

$+\uparrow \sum F_y = 0$ $\quad -20 - 20 - 30 - 10 + A_y + 37.5 = 0$

$A_y = 42.5^K \uparrow$

$\sum F_x = 0$ $\quad A_x = 25^K \leftarrow$



$\circlearrowleft \sum M_E = 0$ $\quad 10(15) - 37.5(30) + 25(15) + F_{JK}(15) = 0$

$F_{JK} = -40$

$F_{JK} = 40.0^K (C)$ ✓

$\circlearrowleft \sum M_J = 0$ $\quad 10(30) - 37.5(45) + F_{DE}(15) = 0$

$F_{DE} = 92.5^K (T)$ ✓

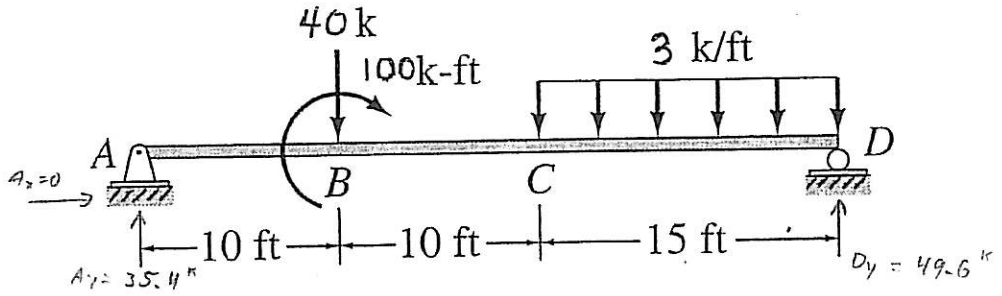
$+\uparrow \sum F_y = 0$ $\quad -10^K + 37.5^K + F_{EJ_y} = 0$

$F_{EJ_y} = -27.5^K$

$F_{EJ} = -38.89^K$

$F_{EJ} = 39.0^K (C)$ ✓

(40) 3. For the beam below, calculate all reactions and draw the shear and bending moment diagrams for beam AD.



$+\circlearrowleft \Sigma M_A = 0 \quad -40(10) - 45(27.5) - 100 + D_y(35) = 0$

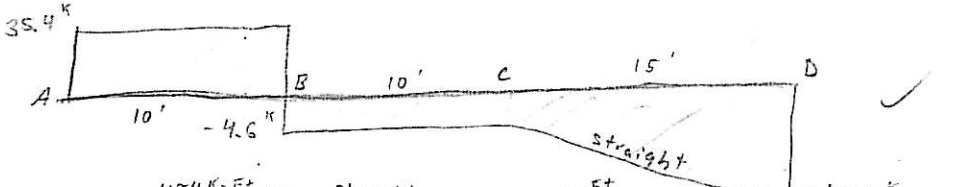
$D_y = 49.6^k$

$+\uparrow \Sigma F_y = 0 \quad -40 - 45 + A_y + 49.6 = 0$

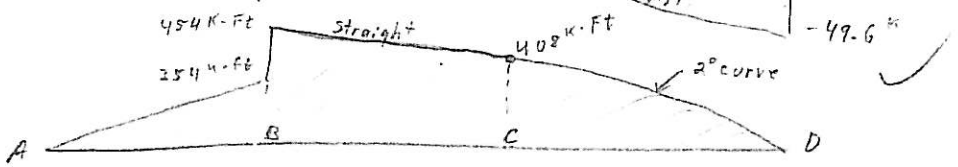
$A_y = 25.4^k$

$+\rightarrow \Sigma F_x = 0 \quad A_x = 0$

Shear



Moment



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100

ENCE 3318
PRINCIPLES OF HYDRAULICS

TEST 1

0.001^m

↑

τ

1. Two large flat plates are separated by a thin fluid layer that is 1 mm thick and at a temperature of 20°C. The dynamic viscosity is 0.06 N-s/m^2. A force is applied to the top plate such that a shear stress $\tau = 30.0$ N/m^2 is generated. How fast will the top plate move (in m/s) relative to the bottom plate after a constant velocity is attained? Assume that the velocity profile between the plates is linear.

25

$\tau = 30.0\ N/m^2$

$\mu = 0.06\ N\text{-}s/m^2$

$\tau = \mu \frac{dV}{dy}$ LINEAR $dV = V$

$30.0\ N/m^2 = 0.06\ N\text{-}s/m^2 \cdot \frac{V}{0.001m}$

$\frac{0.001^m \cdot 30\ N/m^2}{0.06\ N\text{-}s/m^2} = V = 0.5\ m/s$

✓

25

2. What pressure increase must be applied to water at 70 °F to reduce its volume by ½ %? Give your answer in lbf/in^2. What depth (in feet) in sea water (γ=64.2 lbf/ft^3) is this equivalent to?

$E = 3.2 \times 10^5$ psi

$$3.2\times10^5 \text{ psi} = \frac{-\Delta P}{0.005} = \boxed{1600 \text{ psi}}$$ ✓

$P_1 = 0$

$P_2 = P_1 + \gamma d$

$$1600 \frac{\text{lb}}{\text{in}^2} \cdot \frac{144 \text{ in}^2}{\text{ft}^2} = 64.2 \frac{\text{lb}}{\text{ft}^3} \cdot d$$

$$\frac{230400}{64.2} = \frac{64.2\, d}{64.2}$$

$\boxed{d = 3588.79 \text{ ft}}$ ✓

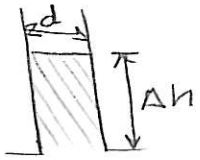
SURFACE TENSION

0.25^m

3. The capillary rise in medium sand is approximately 25 cm. If the medium sand can be modeled by a capillary tube (glass tube), what is its equivalent diameter? Assume that $\theta = 0$ degrees.

25

$\Delta h = 0.25^m$



$\sigma = 0.0735\ N/m$

$\gamma_w = 9790\ N/m^3$

$h = \frac{4\sigma}{\gamma d} \rightarrow d = \frac{4\sigma}{\gamma \cdot \Delta h}$ $\quad d = \frac{4 \cdot 0.073\ N/m}{9790\ N/m^3 \cdot 0.25^m} = 1.193 \times 10^{-4}\ m$

✓

25

4. Mercury has a S.G. of 13.57. ~~+33,000 N/m~~ → 132836.73

13.55 IN CHART

■ Problem Statement

What is the absolute and gage pressure in drum *A* in Fig. 2.4 at position *a*?

14.7 lb/in²
101.3 kPa
OR
101.3 kN/m³

ATM PRESSURE
WATER, MERCURY + OIL
101.3 kN/m² → 101300 N/m²

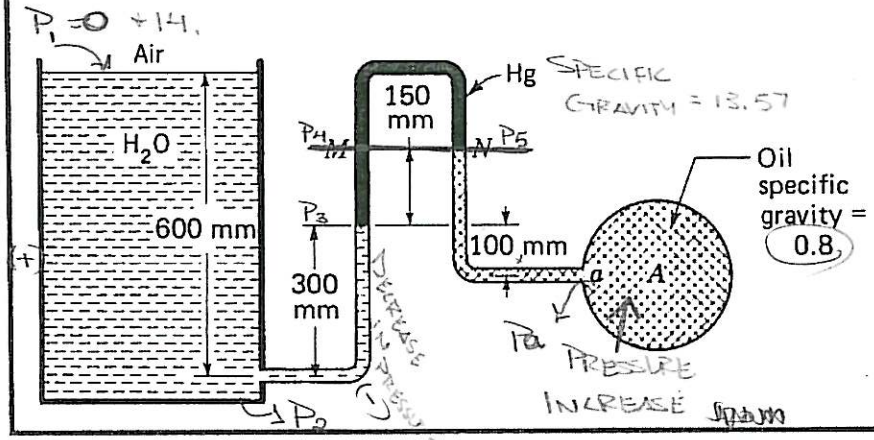


Figure 2.4
Inverted U-tube.

600mm → 0.6m
300mm → 0.3m
150mm → 0.15m
100mm → 0.1m

ABSOLUTE:

$P_1 = 101\,300$

$P_2 = 101300 + (0.60^m \cdot 9789\ N/m^3)$
$= 107173.4\ N/m^2$

$P_3 = 107173.4 - (0.30^m \cdot 9789\ N/m^3)$
$= 104236.7\ N/m^2$

$P_4 = 104236.7 - (0.15^m \cdot 132836.73)$
$= 84311.191$

$P_5 = P_4$ → SAME LEVEL

$P_a = 84311.191 + (0.8 \cdot 0.25^m \cdot 9789\ N/m^3)$
$= 86268.991\ N/m^2$ ✓

GAUGE PRESSURE:

$P_1 = 0$

$P_2 = 0 + (0.60^m \cdot 9789\ N/m^3)$
$= 5873.4\ N/m^2$

$P_3 = 5873.4 - (0.30^m \cdot 9789\ N/m^3)$
$= 2936.7\ N/m^2$

$P_4 = 2936.7 - (0.15^m \cdot 13.57 \cdot 9789 \cdot 132836.73)$
$= -16988.81$

$P_5 = P_4$ → SAME LEVEL

$P_a = -16988.81 + (0.8 \cdot 0.25^m \cdot 9789\ N/m^3)$
$= -15031.010\ N/m^2$ ✓

9/15

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ENCE 3300
COMPUTATIONAL METHODS IN CIVIL ENGINEERING

TEST 1

23

1. The data on fecal coliform concentrations in Lake Pontchartrain are as shown in the table below. The values are in MPN. What are the mean, median, mode, variance and standard deviation of the concentrations? $\bar{x}$ $\tilde{x}$ NONE s^2 s

MPN
MOST PROBABLE NUMBER

Value of FC concentration	Number of values	
130	20 times	2600
140	21 times	2940
150	23	3450
170	20	3400
230	10	2300
300	10	3000
500	5	2500
800	5	4000
1300	4	5200
1700	3	5100
2800	2	5600
8000	2	16000
13000	1	13000
	126 TOTAL	69090

69090 ÷ 126 = 548.3

$$\bar{x} = (130\cdot 20) + (140\cdot 21) + (150\cdot 23) + (170\cdot 20) + (230\cdot 10) + (300\cdot 10) + (500\cdot 5) + (800\cdot 5) + (1300\cdot 4) + (1700\cdot 3) + (2800\cdot 2) + (8000\cdot 2) + (13000\cdot 1)$$

$$\therefore 126 = \frac{69090}{126} = 548.3 \quad \checkmark$$

$$\tilde{x} = \frac{126}{2} = 63 \quad 7-2 \rightarrow 63^{RD} \text{ VALUE} = \boxed{150}$$

VALUE WHERE ½ ARE ABOVE, ½ BELOW

MODE = 150 ✓

$$s^2 = 20(130-548.3)^2 + 21(140-548.3)^2 + 23(150-548.3)^2 + 20(170-548.3)^2 + 10(230-548.3)^2 + 10(300-548.3)^2 + 5(500-548.3)^2 + 5(800-548.3)^2 + 4(1300-548.3)^2 + 3(1700-548.3)^2 + 2(2800-548.3)^2 + 2(8000-548.3)^2 + 1(13000-548.3)^2 \cdot \frac{1}{(126-1)}$$

$$= 2363598.001 \rightarrow 2.38\times 10^6 \quad \checkmark$$

$s = 1543.9$ ✓

25

2. A temporary drainage structure is to be built to drain a construction equipment storage area. If the contractor wants a 95% probability that the area will not flood during the four years of the construction project, what recurrence interval should be used to design the drainage structure.

n=4

95% Not Flood 5% Flood

Risk $P(\text{flood}) = 1 - (1-p)^n$

$0.05 = 1 - (1-p)^4$

$-0.95 = (1-p)^4$

$\sqrt[4]{0.95} = 1-p$

$0.9873 = 1 = p$

-1

$0.01274 = p$

Return Period $= \frac{1}{p} = \frac{1}{0.01274} = 78.48$ yrs

25

3. Four cards are drawn from a standard deck of cards. Find the probability that they are all different suits. (No more than one card of each suit.)

$\binom{52}{4}$ $\frac{52!}{4!(52-4)!} = \frac{52!}{4!48!} = 270725$

hearts spades clubs diamonds

$\frac{13 \cdot 13 \cdot 13 \cdot 13}{\binom{52}{4} \rightarrow 270725} = \frac{28561}{270725} = 0.1055$ OR 10.5%

✓

25

4. From a class that contains 15 men and 5 women, how many different student committees consisting of 3 men and 2 women can be formed?

15 m
5 w

# of COMMITTEES W { 3 DIFF MEN + 2 DIFF WOMEN }

15 MEN
3 CHOSEN

$$\frac{15!}{3!\,(15-3)!} = 455$$

(12!)

5 WOMEN
2 CHOSEN

$$\frac{5!}{2!\,(5-2)!} = 10$$

(3!)

$455 \cdot 10 = \boxed{4550}$ COMMITTEES

✓