ANSWERS
September 2014

Answers to selected questions:

Sheet #	(1)	(2)	(3)	(4)
ASCE-355	*D*			
ASCE-86	*A*	*D*		
ASCE-88	*D*	*C*		
MCBM-231	*B*			
MCBM-312	*D*			
BMMC-380	*C*	*B*	*C*	*D*
MCBM-352	*B*	*D*	*B*	*D*
MCBM-331	*C*	*B*	*D*	*D*
MCBM-351	*D*	*A*	*D*	*B*
MCBM-357	*D*	*D*	*B*	*B*
MCBM-360	*A*	*D*	*B*	*B*
BMLS-312	*C*	*B*	*D*	*A*

CASIO / *fx*-115 ES PLUS

MODE	SHIFT SETUP
(1) COMP	(1) Mth-IO
(2) CMPLX	(2) Line-IO
(3) STAT	(3) Deg
(4) BASE-N	(4) Rad
(5) EQN	(5) Gra
(6) MATRIX	(6) Fix
(7) TABLE	(7) Sci
(8) VECTOR	(8) Norm

Frequently asked two Number Systems:

1- Decimal Number System (base 10)
2- Binary Number System (base 2)

In Decimal System 10 different digits are used to create any number, but in Binary System only 0s and 1s are used to create any number

DECIMAL	BINARY
2	10
3	11
5	101
6	110
8	1000
9	1001
10	1010
12	1100
14	1110
15	1111
19	10011
25	11001

NUMBER SYSTEMS
BINARY & DECIMAL
NCEES Reference Handbook, Page: 213

Binary Number System:

In digital computers, binary number system (the base-2) is used. Conversions from BINARY to DECIMAL or from DECIMAL to BINARY can easily be done using the calculator. Binary (base-2), decimal (base-10).

Problem:

Find the binary equivalent of decimal 25? Here, decimal is base-10.
Turn on your calculator

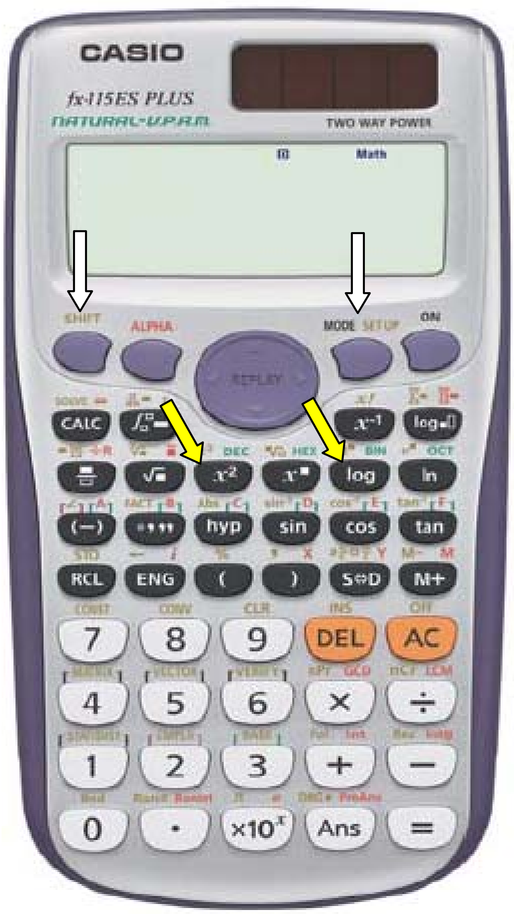
1) Press MODE
2) Press “4”
3) Enter 25 and press “ **=** ”
4) Make sure to see 25 under **Dec** on the screen
5) Press SHIFT then “log”
6) Answer: 11001

Problem:

Find the decimal equivalent of binary 1111?
Turn on your calculator

1) Press MODE
2) Press “4”
3) Press SHIFT then press “log” key
4) Enter 1111 and then press “ **=** ”
5) Make sure to see 1111 under **Bin** on the screen
6) Press SHIFT then hit “ x^2 ” key
7) Answer: 15

NUMBER SYSTEMS
BINARY & DECIMAL
NCEES Reference Handbook, Page: 213



Important Keys

IMAGE-55
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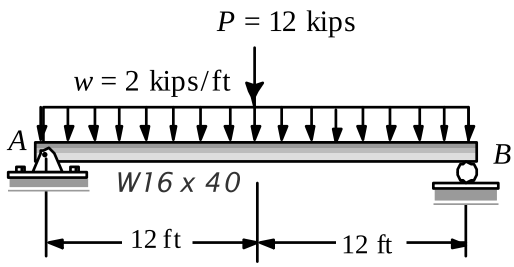
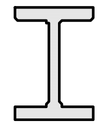
Problem: (Beam Deflections)



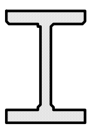


W 16 x 40

E = 29,000 ksi

For the simple beam shown the beam weight is included in the uniform load. Determine the maximum deflection and the slope at A (in radians).

Solution: We will use NCEES-Reference Handbook, page 155 and 81.



W 16 x 40

$I = 518 \text{ in}^4$

FOR DEFLECTIONS : (12^3)

FOR SLOPES : (12^2)

Finding the maximum deflection:

The maximum deflection will be at the midpoint of the span. For quick calculations when using US unit systems, architects and engineers use conversion factors like (12^3) and (12^2). For DEFLECTIONS this conversion factor is (12^3) and for SLOPES the conversion factor will be (12^2).

$$\delta_{max} = \frac{5}{384}\frac{wL^4}{EI} + \frac{1}{48}\frac{PL^3}{EI} = \frac{5}{384}\,\frac{(2.0)\ (24)^4}{(29{,}000)\,(518)}\,(12^3) + \frac{1}{48}\,\frac{(12)\ (24)^3}{(29{,}000)\,(518)}\,(12^3)$$

= 0.994 + 0.397 = 1.391 inches

Finding the slope at support A:

$$\theta_A = \frac{wL^3}{24EI} + \frac{PL^2}{16\,EI} = \frac{1}{24}\,\frac{(2.0)\ (24)^3}{(29{,}000)\,(518)}\,(12^2) + \frac{1}{16}\,\frac{(12)\ (24)^2}{(29{,}000)\,(518)}\,(12^2)$$

= 0.01104 + 0.00414 = 0.01518 Radians

= 0.01518 Radians

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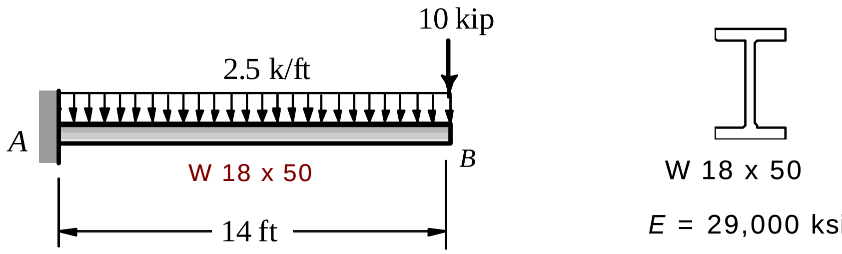
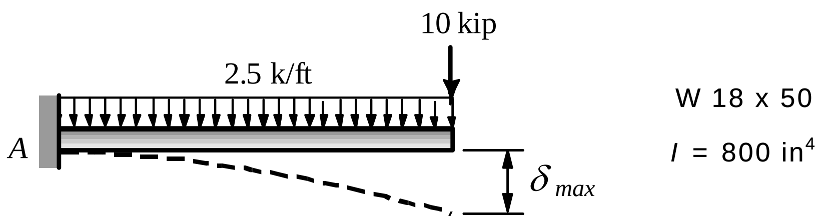
Problem: (Beam Deflection)



A cantilever beam is loaded as shown. Knowing that the beam weight is included in the uniform load, determine the maximum deflection.

Solution: We will use NCEES Ref. Handbook, Page 155 and page 82.



Maximum deflection:

This is a cantilever beam with a fixed support at A. The maximum deflection will be at the free end as shown. Using the formulas from NCEES Reference Handbook, page 82 and the **unit conversion factor** of (12^3).

$$\delta_{\max} = \frac{1}{8}\frac{wL^4}{EI} + \frac{1}{3}\frac{PL^3}{EI}$$

$$= \frac{1}{8}\frac{(2.5)\,(14)^4}{(29{,}000)\,(800)}\,(12^3) + \frac{1}{3}\frac{(10)\,(14)^3}{(29{,}000)\,(800)}\,(12^3)$$

$$= 0.8942 + 0.6813$$

$$= \underline{1.575 \text{ inches}}$$

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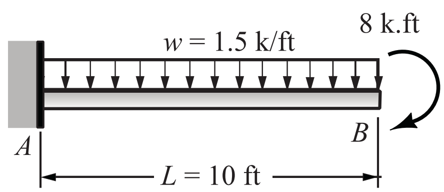
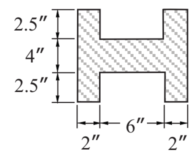
Problem: (Deflections)

FE/PE
EXAM





section

$E = 29 \times 10^6$ psi

A cantilever beam is loaded as shown. The beam weight is included in the uniform load. Using the given cross-section and the modulus of elasticity answer the following questions:

(1) the max. deflection (in.) of the beam is most nearly (δ_B)

(A) 0.0367
(B) 0.4929
(C) 0.6525
(D) 1.4456

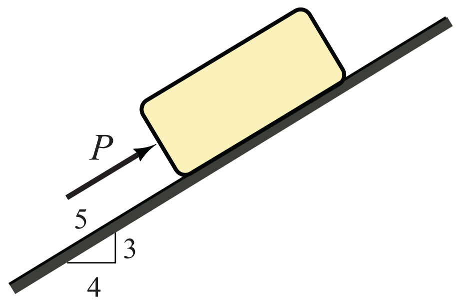
(2) the slope (rad.) at the free end of the beam is most nearly (θ_B)

(A) 0.06458
(B) 0.03782
(C) 0.00415
(D) 0.00596

(3) the moment at the support is most nearly (M_A)

(A) 75
(B) 83
(C) 90
(D) 105

Problem: (Friction)



FE EXAM

$W = 200$ lb
$P = 60$ lb
$\mu_s = 0.25$
$\mu_k = 0.20$

μ_s : coefficient of static friction
μ_k : coefficient of kinetic friction

A 60-lb force acts on a 200-lb crate on an inclined plane as shown in the figure. Using the listed data, answer the following questions:

(1) the magnitude of the friction force (lb) acting on the crate: (F)

(A) 45.5
(B) 50.0
(C) 55.5
(D) 60.0

(2) the magnitude of the normal force (lb) acting on the crate: (N)

(A) 140
(B) 150
(C) 160
(D) 180

(3) the maximum friction force (lb) acting on the crate: (F_m)

(A) 32.9
(B) 40.0
(C) 53.5
(D) 62.0

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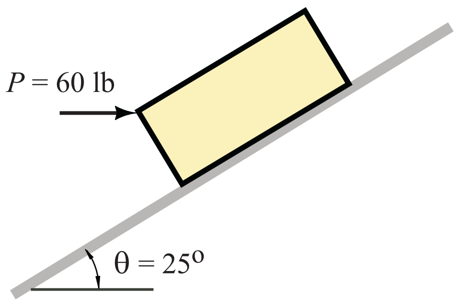
Problem: (Friction)

FE EXAM



$W = 220$ lb
$P = 60$ lb
$\theta = 25^o$
$\mu_s = 0.28$

μ_s : coefficient of static friction

A 60-lb force acts on a 220-lb crate on an inclined plane as shown in the figure. Using the listed data answer the following questions:

(1) the magnitude of the friction force (lb) acting on the crate F

(A) 26.8
(B) 30.5
(C) 38.6
(D) 45.4

(2) the magnitude of the normal force (lb) acting on the crate N

(A) 350
(B) 310
(C) 280
(D) 225

(3) the maximum friction force (lb) acting on the crate (F_m)

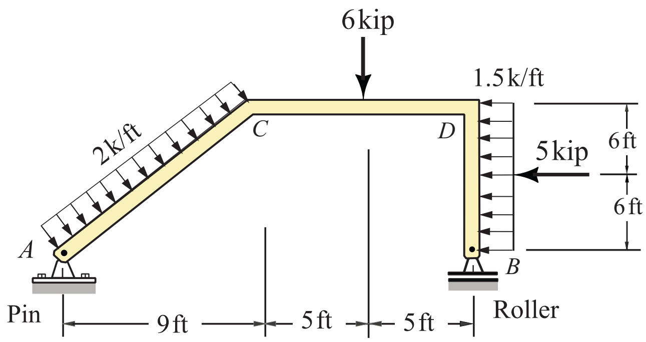
(A) 62.9
(B) 78.4
(C) 83.5
(D) 92.8

DETERMINATE FRAMES

Support Reactions

(4)

FR-410

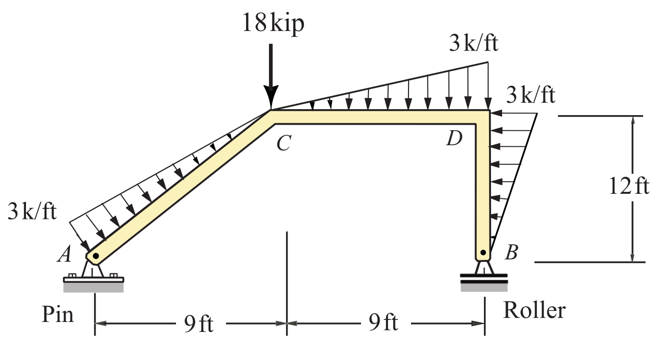


Answers

$A_x = 1.0\text{ k}$ ←
$A_y = 15\text{ k}$ ↑
$B_y = 9\text{ k}$ ↑

(5)

FR-A74



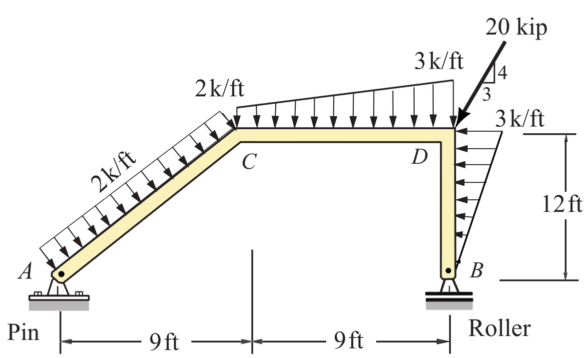
Answers

$A_x = 0$
$A_y = 26.5\text{ k}$ ↑
$B_y = 18.5\text{ k}$ ↑

FR-63

(6)

FR-A73



Answers

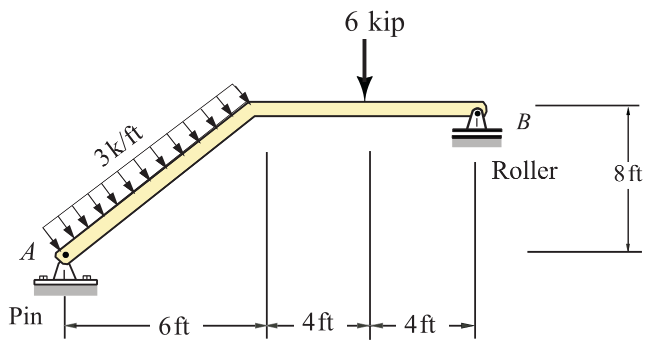
$A_x = 6.0\text{ k}$ →
$A_y = 26.75\text{ k}$ ↑
$B_y = 29.75\text{ k}$ ↑

DETERMINATE FRAMES

Support Reactions

(1)

FR-232-C

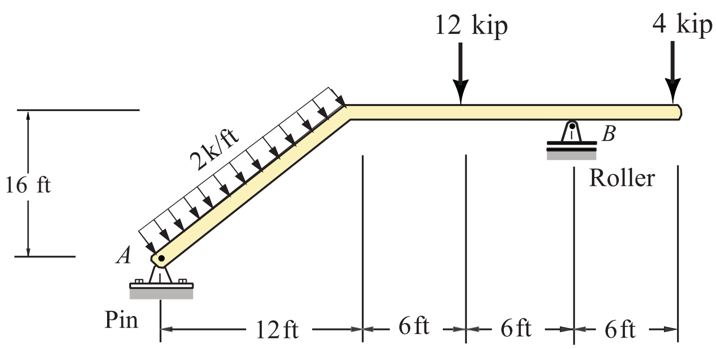


Answers

$A_x = 24$ k ←
$A_y = 9$ kip ↑
$B_y = 15$ kip ↑

(2)

FR-355

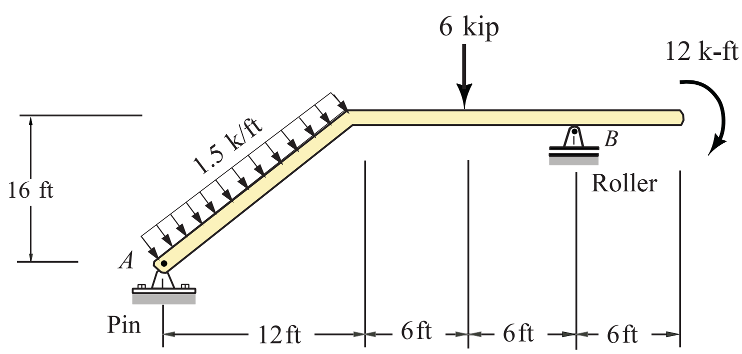


Answers

$A_x = 32.0$ k ←
$A_y = 9.33$ k ↑
$B_y = 30.67$ k ↑

(3)

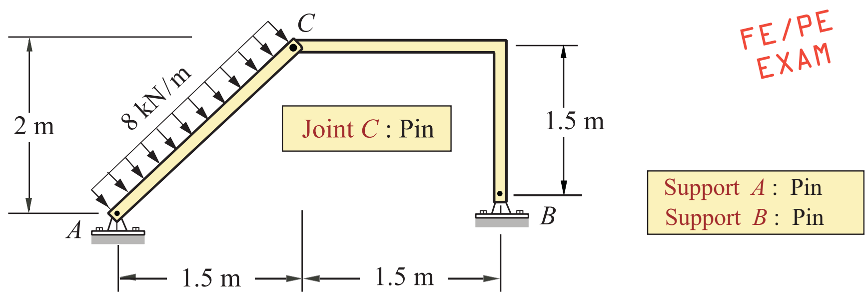
FR-356



Answers

$A_x = 24.0$ k ←
$A_y = 6.5$ k ↑
$B_y = 17.5$ k ↑

Problem: (Frame with internal hinge)



The frame shown has an internal pin at C. Using the given load and support conditions, answer the following questions:

(1) the vertical support reaction (kN) at the left support, A_y

(A) 3.26
(B) 4.86
(C) 5.44
(D) 6.75

(2) the horizontal support reaction (kN) at the left support, A_x

(A) 5.48
(B) 6.15
(C) 7.34
(D) 8.86

(3) the vertical support reaction (kN) at the right support, B_y

(A) 5.22
(B) 6.34
(C) 7.14
(D) 8.20

(4) the maginute of the axial load (kN) in AC is most nearly, N_{AC}

(A) 1.00
(B) 1.43
(C) 2.05
(D) 2.65

FRMC-30
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