1) A line AB makes an angle of 45 degrees, measured CCW from the line y= 3. What is most probably the equation of AB if the line does not pass through the origin?

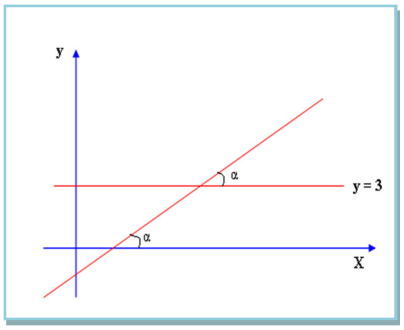
A) $y= 3x+2$ B) $y= (1/3)x-1$

C) $y= x$ D) $y= x – 3$

The Answer is D

P18 C1 NCEES Ref Manual CBT Version

Note line y=3 is parallel to x axis.



AB make 45ºCCW with y=3,

it must make

45º CCW with x axis as well, since y=3

is parallel to x axis.

m=tan(45)=1
the answer is C or D.

The line does not pass through origin. As a result answer is D.

2) Line AB has a slope of 1/6, and line BC has a slope of -3/4. The lines intercept at the point (5, 3). What is most nearly the acute angle between the lines.

A) 27 B) 50 C) 46.3 D) none of above

The Answer is C

P18 C1 NCEES Ref Manual CBT Version

$$\alpha = \arctan\left(\frac{m_2 - m_1}{1 + m_1 m_2}\right)$$

$$\alpha = \arctan\left(\frac{\frac{1}{6} - \left(-\frac{3}{4}\right)}{1 + \left(\frac{1}{6}\right)\left(-\frac{3}{4}\right)}\right)$$

$$\alpha = 46.3$$

3) Find the eccentricity of the following ellipse:

$$\frac{(x-7)^2}{29}+\frac{(y+6)^2}{4}=1$$

A) 0.93 B) 0.7 C) 0.8 D) o. 4

The Answer is A

Check NCEES ref manual CBT version (p22 C 1)

e=c/a

$c = \sqrt{b^2 - a^2} = \sqrt{29 - 4} = 5$

a^2 =29 ----> a=5.38

e=5 / 5.38

e=0.93

4) General Solution to this equation is :

$Y''+4Y'+4Y = 8\cos(x)$

A) $A\cos(2x)+B\sin(2x)$

B) $(A+Bx)e^{-2x} +(24/25)\cos(x) +(32/25)\sin(x)$

C) $(A+Bx)e^{-2x}$

D) $(A+Bx)e^{-2x} +(4/5)\cos(2x) +\sin(2x)$

The Answer is B

This problem is a nonhomogeouse problem

$Y = Y_p + Y_h$

Here you do not need to solve anything. The paricular solution must have some form of

ACosx +BSinx → according top age 27 – C1 NCEES → here ω is 1

If we carefully study the answers, the only one which contain this term is "B"

5) Consider the following circle

$x^2 + y^2 = 25$

Find the slope of a line tangent to this circle at A(-2, -4.58).

A)-.76 B)-.56
C)-0.87 D) -0.44

The Answer is D

P18 C2 NCEES Ref manual CBT Version

Point A is located on the circle. This is a very special case.
So the tangent to the circle must pass from A on the circle. But the tangent to the circle is perpendicular to the radius of circle at the point of tangency.
If slope of line tangent to the circle is M and slope of AC (C is the center of circle) is m then:

m×M = -1, but

C (0,0) center of circle & A(-2, -4.58).

$$m = \frac{Y_C - Y_A}{X_C - X_A} = \frac{0 - (-4.58)}{0 - (-2)} = 2.29$$

2.29×M=-1

M=-0.44

6) What are the equation of directircies of the ellipse represented by the equation?

$$4x^2 + 5y^2 + 40x + 40y + 160 = 0$$

A) $x = \pm 5$ B) $y = \pm 5$ C) $x = -5 \pm 5$ D) $y = -5 \pm 5$

The Answer is C

Check NCEES ref manual CBT version (p22 C 2)

Step1: The equation of ellipse is $4x^2 + 5y^2 + 40x + 40y + 160 = 0$ first complete the square

$$(4x^2 + 40x) + (5y^2 + 40y) + 160 = 0$$

$$[4(x^2 + 10x)] + 5(y^2 + 8y) + 160 = 0$$

$$[4(x^2 + 10x + 25)] - 100 + [5(y^2 + 8y + 16)] - 80 + 160 = 0$$

$$4(x + 5)^2 + 5(y + 4)^2 = 20 \qquad \frac{(x+5)^2}{5} + \frac{(y+4)^2}{4} = 1$$

The center is (-5, -4)

Step2: The eccentricity of the ellipse is $e = \sqrt{1 - \frac{b^2}{a^2}} = \sqrt{1 - \frac{4}{5}} = 0.45$

Step3: The equation of directrices are vertices are $x = h \pm \frac{a}{e}$

$$x = -5 \pm \frac{\sqrt{5}}{0.45}$$

$$x = -5 \pm 5$$

7) Line AB and BC are coplanar. Coordinates of A is (5, 6), B is (-2, 3) and C is (a,-a). What is the value of a if AC = BC?

A) -8 B) 4 C) 7 D) 6

The Answer is D

Check NCEES ref manual CBT version (p18 C 2)
(keywords: Straight line)

Step1: Let (a, -a) is the coordinates of C.

Step2: Length: $AC^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2 = (a-5)^2 + (-a-6)^2$

Length: $BC^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2 = (a+2)^2 + (-a-3)^2$

Step3: $AC^2 = BC^2$

$$(a-5)^2 + (-a-6)^2 = (a+2)^2 + (-a-3)^2$$

$$a^2 - 10a + 25 + a^2 + 12a + 36 = a^2 + 4a + 4 + a^2 + 6a + 9$$

$$2a + 61 = 10a + 13$$

$$8a = 48$$

$$a = 6$$

8) The first two roots of the following equation

$$x^4 - 3x^3 + 2x^2 - 3x + 1 = 0$$

Are:
i and -i
What are the next two roots

A) -0.384, 2.61 B) -1.876, 2.61 C) 1, -2,61 D) 0.384, 2.61

The Answer is D

Obviously if a number whether positive or negative is raised to the power of even number, the results become positive. If a negative number is raised to the power of an odd number the result is negative. When a negative number is multiplied by a negative number we get positive, so none of the answers can be negative and both must be positive. For this equation to become zero, both roots have to be positive so $-3x^3$ and $-3x$ remain negative. The only answer with both being positive is D

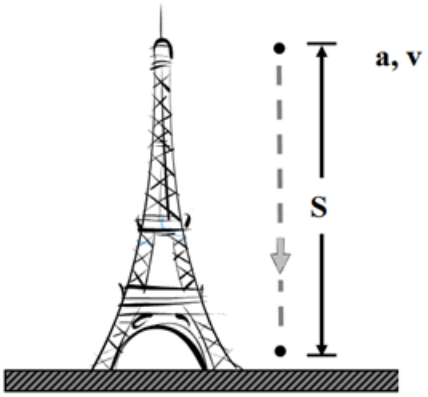
9) Particle kinematics is a study of motion. Which one of the following statement about particle kinematics is correct?

A) Particle kinematics is the study of motion without considering of the mass of, or the forces acting on, the system.
B) Particle kinematics is the study of motion taken into account of the mass of the system.
C) Particle kinematics is the study of motion taken into account of the forces acting on the system.
D) None of the above

The Answer is A

To answer this question, you need to search for the key words and identify the appropriate section of the NCEES ref manual. In this case, the key word is "particle kinematics", then the corresponding definition can be easily found in page 68.

10) A ball is dropped from the top of a tower, and land on the ground after 10s. It is known that, the initial velocity of the ball is 0, and acceleration $a=9.8m/s^2$. According to particle rectilinear motion, what is the velocity when the ball hit the ground?



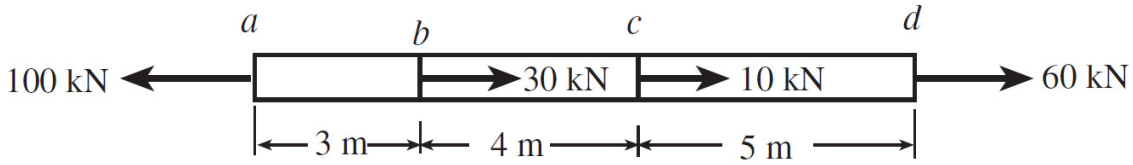
A) 98m/s
B) 9.8m/s
C) 0m/s
D) 45m/s

The Answer is A

To answer this question, just search for the key words and identify the appropriate section of the NCEES ref manual. In this case, the key word is “particle rectilinear motion”. Then one can find the corresponding equation in p68 to solve this problem.

$$v = v_0 + at = 0 + 9.8 \times 10 = 98 m/s$$

11) A steel bar ad with a constant cross-sectional area of 1,000 mm^2 is subject to four uniaxial forces as shown below. Calculate the total elongation of the bar, if E = 250 GPa.



A) 2.9 mm

B) 3.5 mm

C) 4.8 mm

D) 9.6 mm

The Answer is B

Check NCEES ref manual CBT version (p76 C 2)

(Key word: Shear Stress and Strain)

Step (1): The bar is in equilibrium since the sum of all axial forces is zero. Hence, the total elongation is determined by separating the bar into three segments, finding the elongation of each segment, and then adding these elongations.

Step 2: From equilibrium in each segment, the following axial forces are determined:

Segment ab: P1 = 100 kN

Segment bc: P1 = 70 kN

Segment cd: P1 = 60 kN

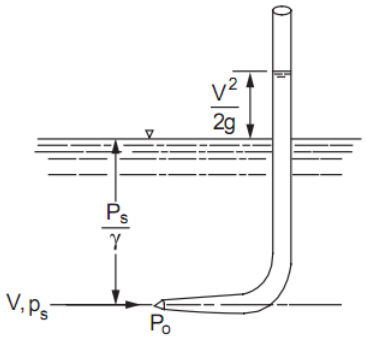
Step 3: Calculate the total elongation of the bar,

$$\boldsymbol{\delta = \delta_{ab} + \delta_{bc} + \delta_{cd}}$$

$$\boldsymbol{\delta = \Sigma \frac{PL}{AE} = \frac{(100 \times 10^3 N)(3\,m) + (70 \times 10^3 N)(4\,m) + (60 \times 10^3 N)(5\,m)}{(1000 \times 10^{-6} m^2)(250 \times 10^9 Pa)}}$$

$$\boldsymbol{= 3.52 \times 10^{-3}\ m \cong 3.5\ mm}$$

12) A Pitot tube is applied to measure water flow velocity, if the measured static pressure and stagnation pressure has a difference of 150Pa, water density 1000kg/m^3, what is the water velocity?



A) 0.8m/s B) 0.1m/s C) 0.2m/s D) 0.55m/s

The Answer is D

To answer this question, just search for the key words and identify the appropriate section of the NCEES ref manual. In this case, the key word is "pitot tube". According to Pitot tube, the measured water velocity.

$$v = \sqrt{\frac{2}{\rho}(P_0 - P_s)} = \sqrt{\frac{2}{1000} \times 150} = 0.55 m/s$$

So the water velocity is 0.55m/s

13) Water flows in a circular pipe, with inner diameter 0.6m. The shear stress distribution varies linearly, if the shear stress is $3.6N/m^2$ at 0.1m from the centerline is, what is the shear stress at the pipe surface?

A) $14.4N/m^2$ B) $3.6N/m^2$ C) $7.2N/m^2$ D) $10.8N/m^2$

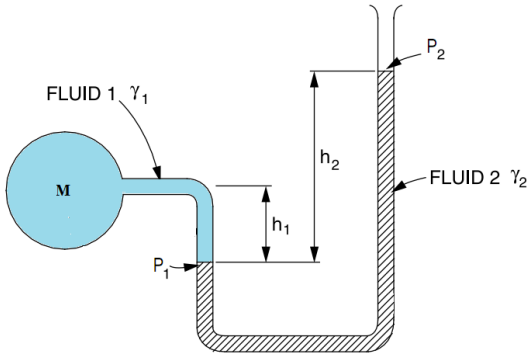
The Answer is D

To answer this question, just search for the key words and identify the appropriate section of the NCEES ref manual. In this case, the key word is "sheer stress distribution". Then one can easily found the shear stress relation with pipe radius in p101. Substitute values, got

$$\frac{\tau}{\tau_s} = \frac{r}{R} = \frac{0.1}{0.3} = \frac{3.6}{\tau_s}$$

So, the shear stress at the surface is $10.8 N/m^2$.

14) Below is a figure of manometer. It is filled with fluid 2 with density 1200kg/m^3, and is connected to a pipe carrying fluid 1 of density 800kg/m^3. If h_1=0.1m, h_2=0.2m, atmospheric pressure is 101 kpa, what is the pressure P_M of static liquid in the pipe?



A) 105.1kpa B) 92.3kpa C) 101kpa D) 102.6kpa

The Answer is D

To answer this question, just search for the key words and identify the appropriate section of the NCEES ref manual. In this case, the key word is "manometer". Then one can find the pressure of fluid in the pipe:

$$\boldsymbol{P_M + \rho_1 g h_1 = P_2 + \rho_2 g h_2}$$

Particularly,

$$\boldsymbol{\rho_1 g h_1 = 800 \times 9.8 \times 0.1 = 784 pa}$$
$$\boldsymbol{\rho_2 g h_2 = 1200 \times 9.8 \times 0.2 = 2352 pa}$$
$$\boldsymbol{P_2 = 101000 pa}$$

Therefore,

$$\boldsymbol{P_M = 101000 + 2352 - 784 = 102568 pa = 102.568 kpa}$$

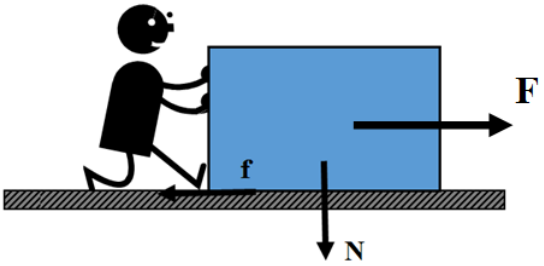
15) A force is a vector quantity, it is defined by three parameters. Which one of the following option is not included in the three parameters?

A) Time
B) Magnitude
C) Point of application
D) Direction

The Answer is D

In this problem our assumption is you do not know anything about force and its definition. The term “vector quantity” can be picked from the body of problem, use that as key word in NCEES ref manual. You can easily see that on p63, the three parameters that defined a force is given: magnitude, point of application and direction

16) A man is trying to push a box. It is known that the weight of the box is 300kg, and the coefficient of the static friction is 0.1. What is the limiting friction f needs to be overcome to move the box?



A) 294N B) 152N C) 300N D) 30N

The Answer is A

To answer this question, we need to search for the key words and identify the appropriate section in the manual. In this case, the key word is “limiting friction”. Then one will find the corresponding equation in p64. Note in this problem N=mg

$$f \leq \mu_s N = 0.1 \times 300 \times 9.8 = 294N$$

17) There is a system of two forces, which of the following statement is not necessary to define them as a couple?

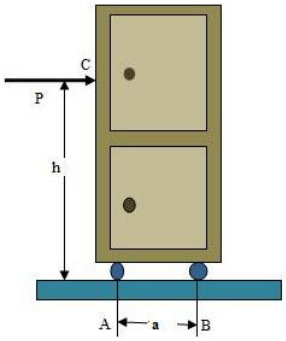
A) The two forces are equal in magnitude
B) The two forces are opposite in direction
C) The two forces are parallel to each other
D) The two forces are applied at the same time

The Answer is D

To answer this question, we need to search for the key words and identify the appropriate section in the manual. In this case, the key word is “a couple”. We see that on p63, it says, a system of two forces that are equal in magnitude, opposite in direction and parallel to each other is called a couple. So statement D is not necessary.

18) Given: cabinet weighs 100lb, h=30 in, and μs=0.4 a = 24”

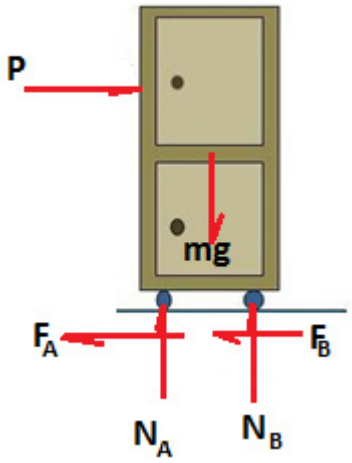
Find: the force required to move the cabinet. The casters at A and B locked, the cabinet



A) 40 lb B) 60 lb C) 100 lb D) 20 lb

The Answer is A

Step 1 : Draw Free body diagram



$N_A + N_B = mg = 100N$

$F_A = \mu_s N_A$, and $F_A = \mu_s N_B$

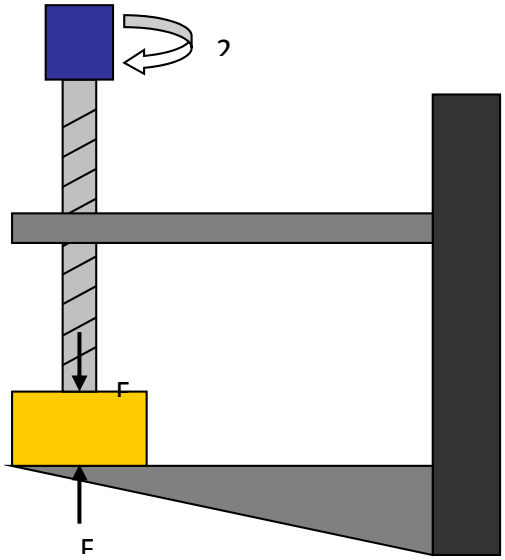
Step 2 :

$\Sigma Fx = 0 \quad P - F_A - F_B = 0 \quad P - \mu_s (N_A + N_B) = 0$

$\Sigma Fy = 0 \quad N_A + N_B - 100 = 0$

Solve for $P = 0.4 \times 100 = 40$ lb

19) A square threaded screw-jack of a clamp has a mean diameter of 12 mm and a lead of 5 mm. If the coefficient of static friction is 0.2, and the torque applied to the handle is 2 N•m, determine the compressive force on the wood block.



A) 918 N B) 975 N C) 488 N D) 3476 N

The Answer is B
P64 C1 NCEES Ref Manual CBT Version

Step 1: Use the screw-jack equation for a square thread under a condition of tightening.

$$M = \mathrm{Pr}\tan\left(\alpha + \phi\right)$$

Step 2: Calculate the pitch angle of the thread, α.

$$\alpha = \tan^{-1}\left(\frac{l}{2\pi r}\right) = \tan^{-1}\left(\frac{5\,mm}{2\pi\left(6\,mm\right)}\right)$$

$$\alpha = 7.56^{\circ}$$

Calculate ϕ.

$$\phi = \tan^{-1}\mu_s = \tan^{-1}0.2$$

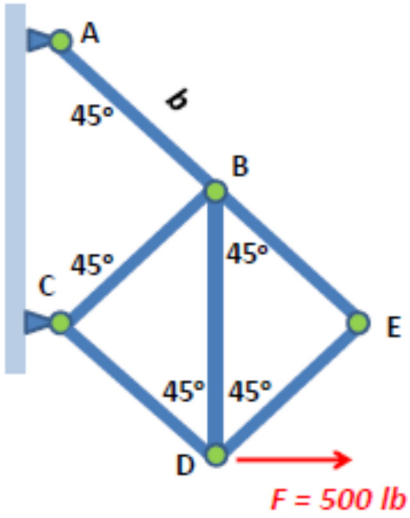
$$\phi = 11.31^{\circ}$$

Step 3: Substitute into the screw-jack equations and solve for P.

$$2\,N\mathrm{g}m = \left(P\right)\left(0.006\,m\right)\tan\left(7.56^{\circ} + 11.31^{\circ}\right)$$

$$P = 975\,N$$

20) Determine the force in member CD in the plane truss shown below. Joint A and C are pinned.

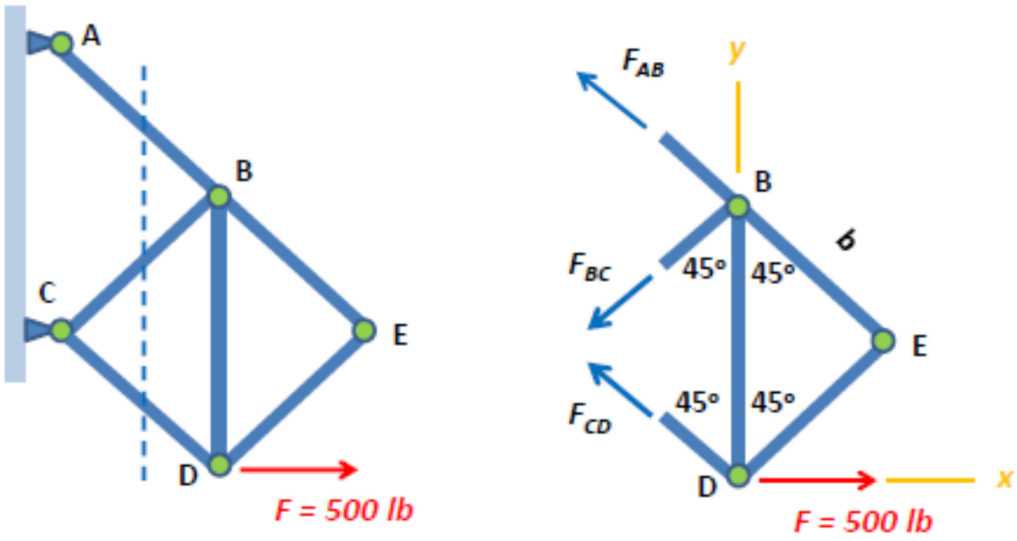


A) 500 lb (tension)
B) 707.1 lb (compression)
C) 707.1 lb (tension)
D) 500 lb (compression)

The Answer is C

P64 C2 NCEES Ref Manual CBT Version

Step 1: Section the truss as shown below. Isolate the right section and plot the free-body diagram. Assume the unknown member forces are tensile forces. Set the Cartesian coordinate system with the original point at joint D.



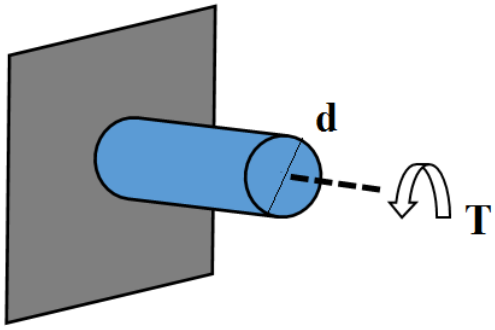
Step 2: Apply the equation of equilibrium for moment relative to joint B. Note CBD is a right triangle and angle C=90

$$\sum M_B = 0 \Rightarrow F(\sqrt{2}b) - F_{CD}(b) = 0 \Rightarrow F_{CD} = 707.1 \text{ lb}$$

F_{CD} is positive, so it is a tensile force.

Force in member CD is 707.1 lb (tension)

21) It is known that the polar moment of inertia $J=\pi D^4/32$, what is the torsion stress in a shaft 8in in diameter if the applied torque is T=250ft-lb?



A) 2.5psi B) 30psi C) 5psi D) 60psi

The Answer is B

To answer this question, just search for the key words and identify the appropriate section of the NCEES reference manual. In this case, the key word is "torsion stress". Then one will find the corresponding equation in p78.

$$\tau = \frac{Tr}{J} = \frac{32Tr}{\pi D^4} = \frac{32 \times 250 \times 12 \times 4}{3.14 \times 8^4} = 30psi$$

22) The Euler's formula is applied to calculate critical axial load for long column, see below. Particularly, K is effective length factor to account for end supports. If the end supports is a fixed-pinned, what is K?

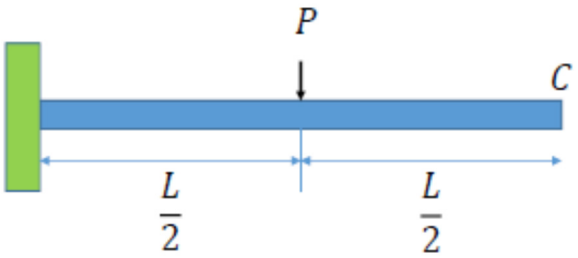
$$\mathbf{P_{cr} = \frac{\pi^2 EI}{(Kl)^2}}$$

A) 2.0 B) 0.7 C) 0.5 D) 1.0

The Answer is B

To answer this question, just search for the key words and identify the appropriate section of the NCEES reference manual. In this case, the key word is “effective length Factor”. Then one will find the corresponding values for K in p158 to solve this problem.

23) Find the deflection at point C for the 2 m long beam shown?



$I = 500 \times 10^6\ mm^4$ $E = 200\ GPa$ $P = 50\ kN$ $L = 2\ m$

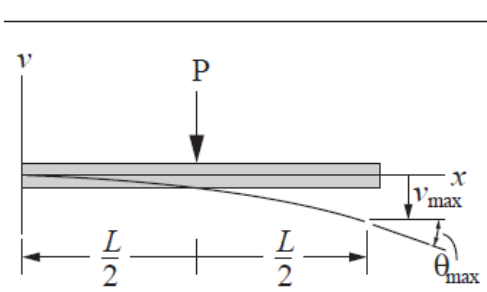
A) -0.417 mm
B) -5.5 mm
C) -50 mm
D) -6 mm

The Answer is A

P82 NCEES Reference Manual CBT version

(Key words: cantilever beam, deflection)

Step 1: The deflection at the end of cantilever beam is the maximum. According to the table in page 82 NCEES Ref Manual, it can be seen.



	$\theta_{max} = \frac{-PL^2}{8EI}$	$v_{max} = \frac{-5PL^3}{48EI}$

Step 2

$$y_{max} = \frac{-5PL^3}{48EI} = \frac{-5(50\text{kN})(2\text{ m})^3}{(48)\left(200 \times 10^6 \frac{\text{kN}}{\text{m}^2}\right)(500 \times 10^6 \text{mm}^4) \times 10^{-12}(\frac{m^4}{mm^4})}$$

$$y_{max} = -0.000417\text{ m} \qquad (-0.417\text{ mm})$$

24) A shaft is subjected to a torque T. The strain at the outside of the shaft is 3.2×10^{-3}. What's the strain at the center of the shaft?

A) 3.2×10^{-3}

B) 1.6×10^{-3}

C) 0

D) -3.2×10^{-3}

The Answer is C

P78 C1 NCEES Reference Manual CBT version

(Key words: torsional strain, circular solid shaft)

The torsional strain in a circular solid shaft of radius r is calculated as

$$\gamma_{\phi z} = r\frac{d\phi}{dz}$$

At the center of the shaft, the torsional strain is

$$\gamma_{\phi z} = 0 \times \frac{d\phi}{dz} = 0$$

EIT Style

The torsional strain, varies in direct proportion to the radius, from zero strain at the center to the greatest strain at the outside of the shaft. The only answer with zero strain at the center of the shaft is C.

25) A steel rod with the cross sectional area of 0.5 in^2 is under a tensile stress of 50 kpsi. Find the length of rod if the potential energy stored in the rod is 30 lb·ft.

A) 16.7 ft
B) 1670 in
C) 12 in
D) 1.67 ft

The Answer is B

P79 C2 and P80 NCEES Reference Manual CBT version

(Key words: Elastic strain energy, Material properties)

Step 1: The Modulus of Elasticity of steel is $E = 29$ Mpsi (P80)

Step 2: The strain Energy per unit volume is:

$$\frac{U}{V} = \frac{\sigma^2}{2E}$$

Therefor the strain energy of an axially loaded rod can be calculated as

$$U = \frac{\sigma^2 AL}{2E} \quad => \quad L = \frac{2EU}{\sigma^2 A}$$

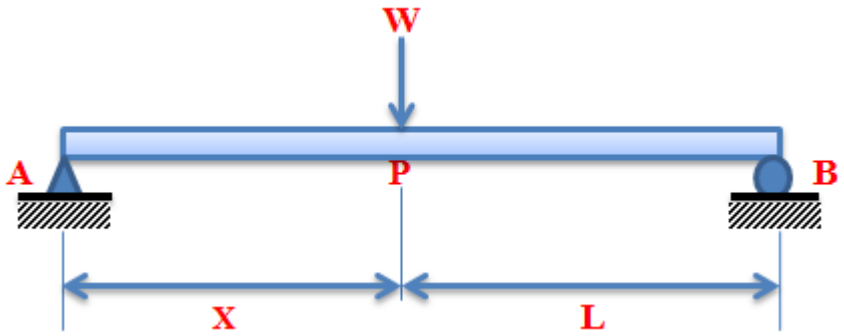
Step 3: Calculate the length of rod

$$L = \frac{2EU}{\sigma^2 A} = \frac{2\left(29 \times 10^6 \frac{lb}{in^2}\right)(30\ lb \cdot ft)(12\frac{in}{ft})}{\left(50 \times 10^3 \frac{lb}{in^2}\right)^2 (0.5\ in^2)}$$

$$L = 1670\ in$$

26) From the following statements which one describes the shear diagram for this beam?

$W = 6\ kN$ $L = 2\ m$ $x = 1\ m$



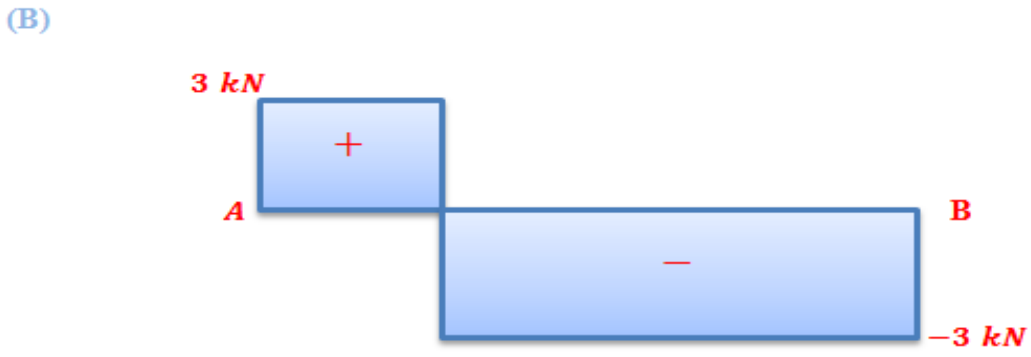
A) The shear diagram is an inclined line
B) The shear diagram drops at distance x from positive to negative
C) The shear diagram is a horizontal straight line.
D) The shear diagram is composite of inclined and horizontal line

The Answer is B

P78 C2 NCEES Reference Manual CBT version

(Key words: simply supported beam, shear)

The shear diagram for a simply supported beam subject to a concentrated load at the distance x from the left pinned support is shown as below



Answer "A" is not correct: The shear diagram contains two straight lines.

Answer "B" is correct: The shear diagram contains two straight lines and it drops from positive to negative at distance x. Note the reaction at A is less than P.

Answer "C" is not correct: The shear diagram contains two straight lines.

Answer "D" is not correct: The shear diagram contains two straight lines.

27) A beam at the section shown can carry moment M = 12 KN·m and shear force V= 5 KN find the uniform load w. If P = 2 KN and C= 2 m

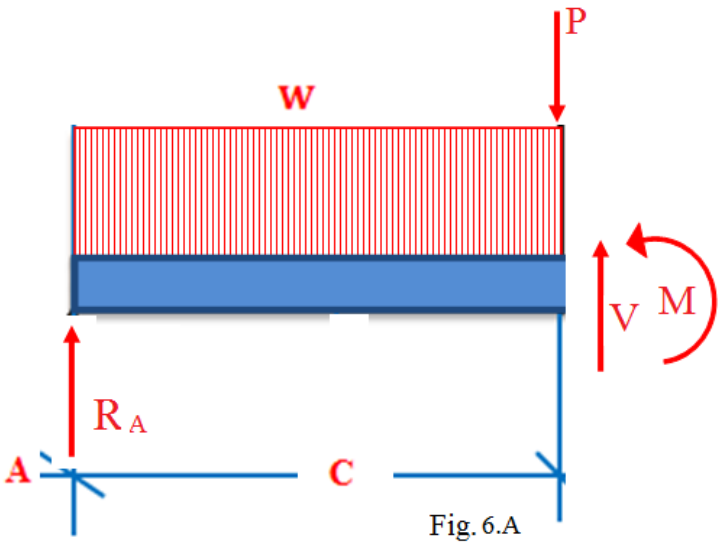


Fig. 6.A

A) 5 KN
B) 15KN
C) -5 KN
D) 9 KN

The Answer is D

P78 C2 NCEES Reference Manual CBT version

(Key words: beam, moment, shear force)

Step 1: Using the Free-Body-Diagram:

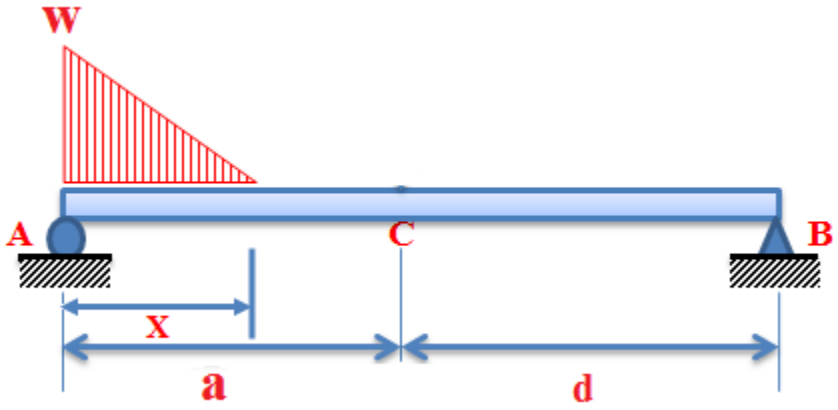
$$\sum M_{(A)} = 0$$

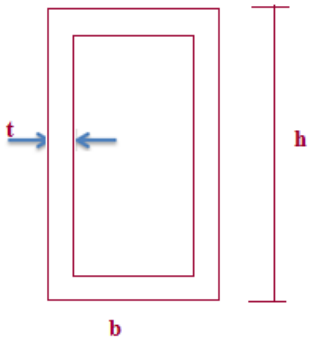
$0 = M - w\,(C)(C/2) - P\,(C) + V\,(C)$

$0 = 12 - w(2)(1) - 2(2) + (5)(2)$

$$w = (12+6)/2 = 9 \text{ KN}$$

28) Find the maximum tensile bending stress at point C on the beam shown below. $W = 10\ \frac{kN}{m}$, $x = 3$ m, $a = 5$ m, and $d = 5$ m. For the cross section: b= 60 mm, h= 120 mm and t= 10 mm.





A)85 MPa B) 100 MPa
C) 120 MPa D) 660 MPa

The Answer is A

P78 C2 NCEES Reference Manual Edition CBT version

(Key words: simply supported beam, stress)

Step 1: Find the reactions:

$\Sigma M_{(A)} = 0$

$(R_B \times 10) - w\,(x/2)\,(x/3) = 0$

$R_B = [10 \times (3^2/6)] / 10$

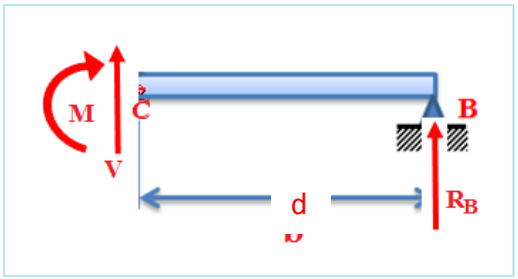
$R_B = 1.5$

Step 2: Find the moment at C:

$\Sigma M_{(v)} = 0$

$M = R_B\,(d)$

$M = 1.5\,(5) = 7.5$ KN-m



Step 3: Calculate moment of inertia, I.

I = I (outside rectangle) – I (inside rectangle)

$$I = \frac{bh^3}{12}$$

$$I = \left(\frac{1}{12}\right)(60)(120)^3 - \left(\frac{1}{12}\right)(40)\,(100)^3$$

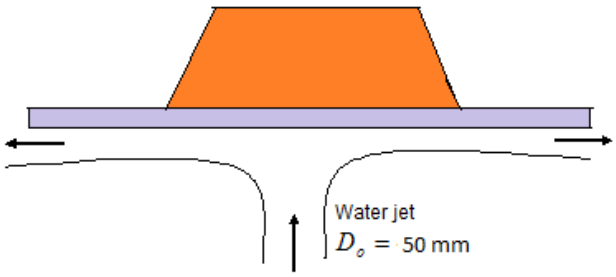
$$I = 53.07 \times 10^5\ mm^4$$

Step 4: Calculate maximum stress:

$$\sigma = \frac{Mc}{I} = \frac{(7.5\ kN \cdot m)(0.06\ m)}{(53.07 \times 10^5 mm^4)\left(\frac{1\ m}{1000\ mm}\right)^4}$$

$$= 85\ MPa$$

29) In the figure below, a platform rests on a steady water jet. The total weight supported is 800 N. Determine the jet velocity.



A)18.4 m/s
B)20.2 m/s
C)16.8 m/s
D)22.3 m/s

The Answer is B

Check NCEES Reference manual cbt Version p.103 C2

$\sum F = Q_2\rho_2 v_2 - Q_1\rho_1 v_1$ $\quad\quad$ $F = \rho Q(v_2 - v_1)$

$Q = Av_1 = (\pi/4)(0.050\ m)^2 v_1 = 0.00196 v_1$

$800\ N = (1000\ \frac{kg}{m^3})(0.00196 v_1)(v_1)$ $\quad\quad$ $V_1 = 20.2\ m/s$

30) Water is flowing in a 3 ft diameter pipe. Determine the hydraulic radius of the flow. Assume the pipe is flowing completely full.

A)0.25 ft
B)0.50 ft
C)0.75 ft
D)1 fr

The Answer is C

Check NCEES Ref Ma VBT Version P102 C2

$$R_H = \frac{\text{Cross sectional area}}{\text{Watted pierameter}} = \frac{D_H}{4} = \frac{3}{4} = 0.75$$

31) A brick weighs 8 lbs in air and 5.5 lbs in water. Determine the volume of the brick.

A)1.09 ft^3 B)0.04ft^3 C)0.50 ft^3 D)0.83 ft^3

The Answer is B

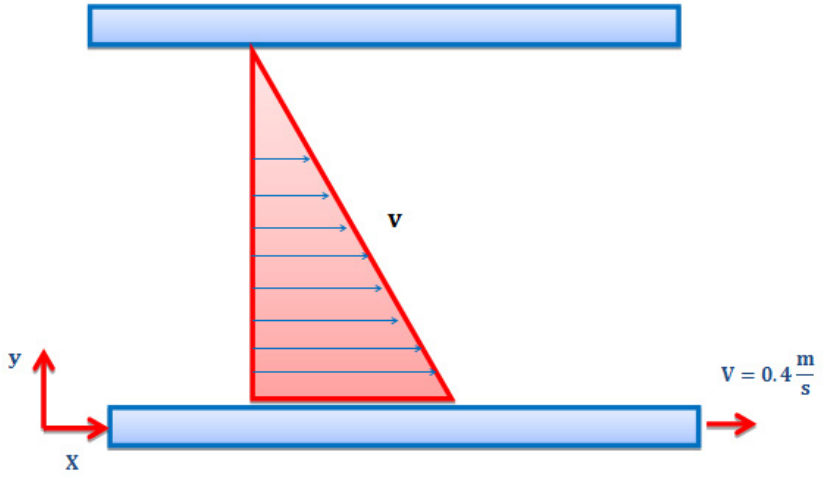
$F_B = W_{\text{in air}} - W_{\text{in liquid}}$ = 8 lbs. – 5.5 lbs = 2.5 lbs

$F_B = \gamma_w \cancel{V}$

2.5 lbs = 62.4 lbf/ft³*$\cancel{V}$

$\cancel{V}$ = 2.5 lbs/62.4lbf/ft³ = 0.04 ft³

32) In the figure below, the upper plate is fixed and the lower plate moves to the right at 0.4 m/s. The distance between the two plates is 0.001 m, the viscosity of the fluid is 4 x10^{-4}Pa·s, and the velocity profile is linear. Determine the shear stress, T_{xy}, in the fluid.



A) 0.45 Pa B) 0.16 Pa C)0.27 Pa D)1.37 Pa

The Answer is B

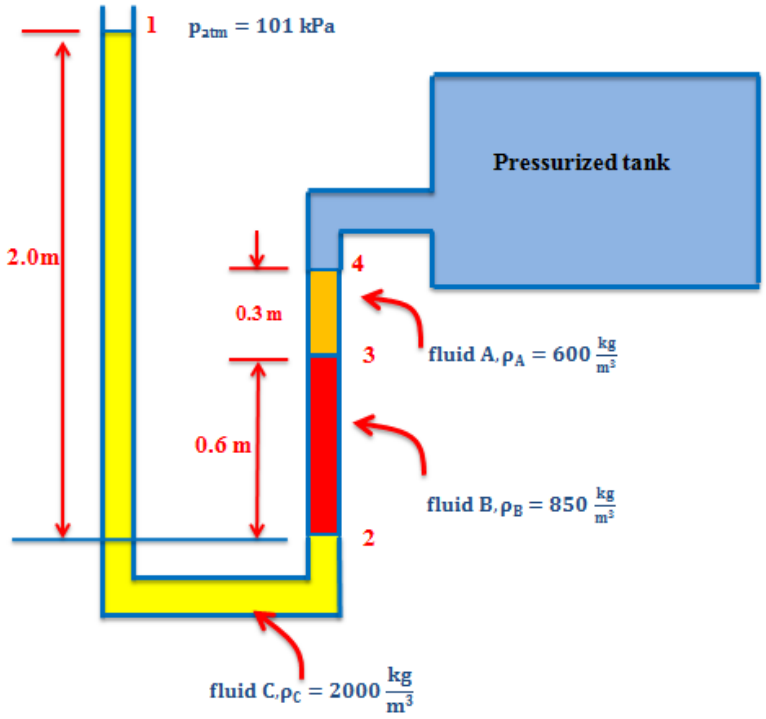
Check NCEES Reference manual Edition CBT versionp.p99, C1

$$\tau_t = \mu \frac{dv}{dy}$$

$$\frac{dV_x}{dy} = \frac{\Delta V_x}{\Delta y} = \frac{0.4\frac{m}{s}}{0.001m} = 400s^{-1}$$

$$T_{xy} = (0.0004\ \ Pa\quad \dot{}s\quad\ )\left(400\frac{1}{s}\right) = 0.16Pa$$

33) Using the figure below, determine the pressure in the tank.



A)113 kPa B) 201kPa C)98 kPa D)134 kPa

The Answer is D

Check NCEES Reference manual CBT version p.99, C2

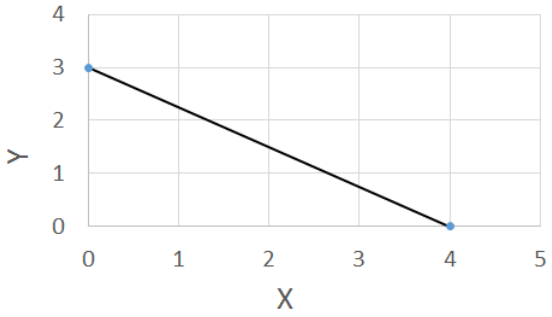
$$P_1 - P_2 = -\gamma(z_1 - z_2) = -\gamma h = -\rho g h$$

$$P_2 - P_1 = \rho_c g(z_1 - z_2)$$
$$P_3 - P_2 = \rho_B g(z_2 - z_3)$$
$$P_4 - P_3 = \rho_A g(z_3 - z_4)$$
$$P_4 - P_1 = (P_4 - P_3) + (P_3 - P_2) + (P_2 - P_1)$$
$$P_4 = P_1 + g(\rho_c(z_1 - z_2) + \rho_B(z_2 - z_3) + \rho_A(z_3 - z_4))$$

= 101000 Pa +
(9.81 m/s²)[(2000 kg/m³)(2m) + (850 kg/m³)(-0.6m) + (600 kg/m³)(-0.3m)]

= 133,471 Pa = 134kPa

34) There are two points (4, 0) and (0, 3) located on a straight line. What is the equation straight line?



A) y=-0.75x+3
B) y=4x+3
C) y=3x+4
D) y=0.75+3

The Answer is A

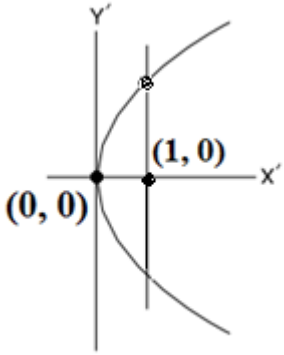
In this problem our assumption is you do not know anything about straight line. The term "straight line" can be picked from the body of problem, use that as key word in NCEES ref manual. You can easily see that on p18, the standard form of a straight line is

$$\boldsymbol{y = mx + b}$$

Substitute (4, 0) and (0, 3) into the equation of line, solve for m=-0.75, b=3. So the equation of the straight line

$$\boldsymbol{y = -0.75x + 3}$$

35) As shown in the figure below, the center of a parabola is (0, 0), and focus (1, 0), what is the equation parabola?



A) $y^2=4x$ B) $y^2=0.25x$ C) $y=4x^2$ D) $y=0.25x^2$

The Answer is A

To answer this question, we need to search for the key words and identify the appropriate section in the manual. In this case, the key word is "parabola". We see that on p22, the equation of a parabola with (h, k) on the center and focus (p/2, 0) is

$$(\boldsymbol{y-k})^2 = \boldsymbol{2p(x-h)}$$

Since center is (0, 0), then h=k=0. The focus is (p/2, 0) is (1, 0), then p=2
So the equation of the parabola is

$$\boldsymbol{y^2 = 4x}$$

36) The general form of the conic section equation is shown below, where not both A and C are zero. If $B^2-4AC=0$, what conclusion can be drawn?

$Ax^2+Bxy+Cy^2+Dx+Ey+F=0$

A) The conic is an ellipse

B) The conic is a parabola

C) The conic is a circle

D) The conic is a hyperbola

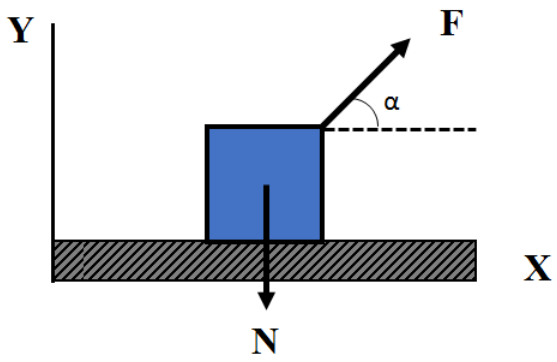
The Answer is B

To answer this question, we need to search for the key words and identify the appropriate section in the manual. In this case, the key word is "conic section equation". We see that on p23, the general form of a the conic section equation is

$$\boldsymbol{Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0}$$

Where not both A and C are zero. If B^2-4AC=0, the conic is a parabola.

37) A box is at rest on the horizontal surface, the weight of the box is 500kg. If a towing force of F=300N acting at an angle of α=45° is applied to the box for 10s. According to impulse and momentum, what is the final velocity of the box?



A) 4.2m/s B) 6m/s C) 8.3m/s D) 2.3m/s

The Answer is A

To answer this question, just search for the key words and identify the appropriate section of the NCEES ref manual. In this case, the key word is "impulse and momentum". Then one can easily find in p71, the corresponding equations are given
, $\sum \boldsymbol{m_i}(\boldsymbol{v_i})_{\boldsymbol{t_2}} = \sum \boldsymbol{m_i}(\boldsymbol{v_i})_{\boldsymbol{t_1}} + \sum \int_{\boldsymbol{t_1}}^{\boldsymbol{t_2}} \boldsymbol{F_i dt}$, in this case, the equation in x-direction becomes

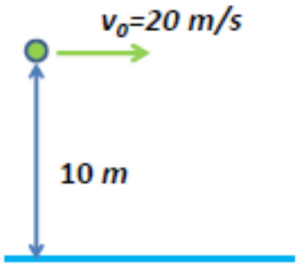
$$\boldsymbol{mv_2 = mv_1 + Fcos\alpha(t_2 - t_1)}$$

Substitute values, got

$$\boldsymbol{500v_2 = 0 + 300cos45(10 - 0)}$$

So, v2=4.2m/s

37) At the height of 10 m, a stone is thrown horizontally with a speed of 20 m/s as shown below. What's the stone's speed when it hits the ground?



A) 20 m/s
B) 24.42 m/s
C) 14.01 m/s
D) 10 m/s

The Answer is B

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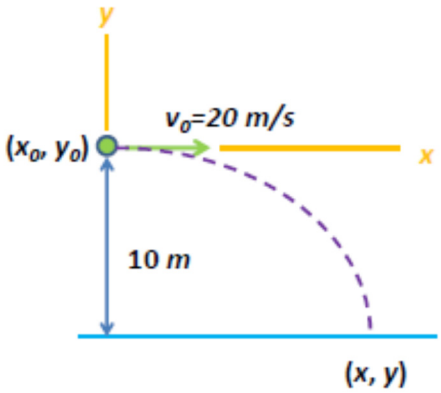
(Key words: projectile motion)

Step 1: Set the Cartesian coordinate system as shown right: $x_0 = 0, y_0 = 0, \theta = 0, y = -10$



$$V_{x0} = \frac{20m}{s}\ , \qquad V_{y0} = 0$$

Step 2: Find the time when the stone hits the ground

$$y = -\frac{gt^2}{2}$$

$$\Rightarrow -10 = -\frac{(9.8\frac{m}{s^2})t^2}{2}$$

$$\Rightarrow -4.9\,t^2 = -10$$

$$\Rightarrow \quad t = 1.43\ s$$

Step 3: Calculate the speed of the stone at time $t = 1.43\ s$

$$v_x = v_0\cos(\theta) = \left(20\frac{m}{s}\right)\cos(0) = 20\frac{m}{s}$$

$$v_y = -gt + v_0\sin(\theta) = -\left(9.8\frac{m}{s^2}\right)(1.43\ s) + \left(20\frac{m}{s}\right)\sin(0) = -14.01\frac{m}{s}$$

$$v = \sqrt{v_x^2 + v_y^2} = 24.42\frac{m}{s}$$

$$v = 24.42\frac{m}{s}$$

38). A 10-lbf ball has a circular motion on a horizontal surface with the speed of 4 ft/s. If the radius of the circle is 1 ft, determine the normal component of the total force acting on the ball.

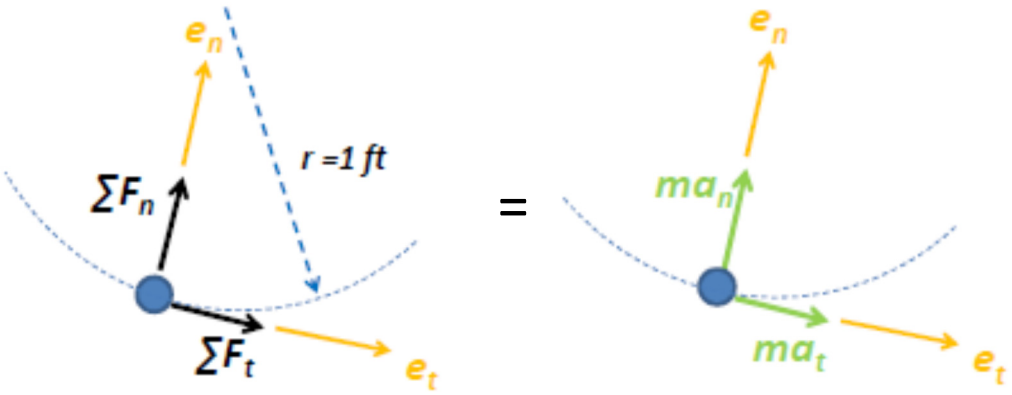
(A) 2.95 lbf
(B) 40 lbf
(C) 160 lbf
(D) 4.96 lbf

The Answer is D

P70 C2 NCEES Reference Manual CBT version

(Key words: normal and tangential kinetics for planar problems)

Step 1: Set the normal and tangential directions, and plot the free body diagram and the effective force diagram

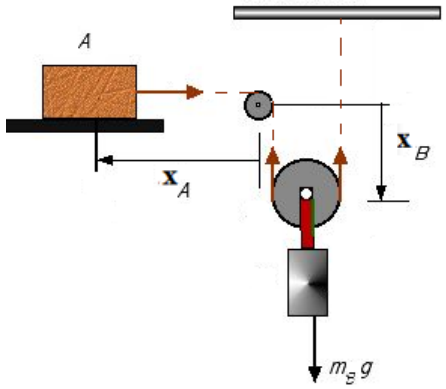


Step 2: Apply the equation of motion in the normal direction

$$\sum F_n = ma_n = m\left(\frac{v_t^2}{r}\right) = m\left(\frac{v^2}{r}\right) = \left(\frac{10\ \text{lbf}}{32.2\frac{\text{ft}}{\text{s}^2}}\right)\left(\frac{1}{1\text{ft}}\right)\quad\left(4\frac{\text{ft}}{\text{s}}\right)^2$$

$$\sum F_n = 4.96\ \text{lbf}$$

39) In the illustration, the two pulleys and the horizontal surface are frictionless. The cord connecting the masses m_A and m_B is weightless. At time t=0.6sec, the acceleration of m_B is $4m/s^2$ what is the acceleration of m_A at this instant? Assume the system is released from rest.



A) $8m/s^2$

B) $4m/s^2$

C) $2m/s^2$

D) $9.81m/s^2$

The Answer is A

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Step 1: Since the length of the cord is constant and taking the pulley center as reference point we can get

$$x_A + 2x_B = constant$$

Step 2: Taking two time derivative of displacement we get the acceleration

$$a_A + 2a_B = 0$$
$$a_A = -2a_B$$

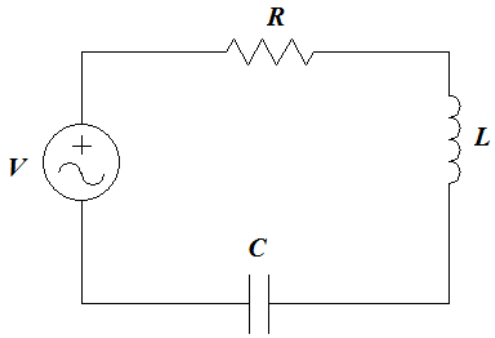
Step 3: Substituting for $a_B = 4m/s^2$ we get

$$a_A = -(2)\left(\frac{4m}{s^2}\right) = -8m/s^2$$

The minus sign shows that the acceleration of A is in the opposite direction of the displacement and since we're concerned with the magnitude then take the absolute value of a_A

$$\boldsymbol{a_A = \left|-8m/s^2\right| = 8m/s^2}$$

40)What value of capacitance will cause the circuit shown below have a resonant frequency of 2 MHz?(L = 5μH R=8 Ω)



A) 5.4 μF B) 7.6 nF C) 3.4 nF D) 1.26 nF

Answer is (D)

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We assume that you do not know anything about **resonant frequency**. We take **resonant frequency** as a keyword from body of the question and type on your search box and press find. Then you can see the following equation which shows the relationship among resonant frequency, C, and L.

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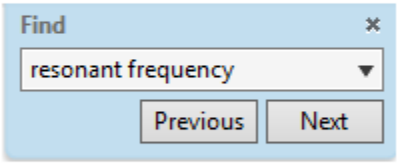
RESONANCE

The radian resonant frequency for both parallel and series resonance situations is

$$\omega_0 = \frac{1}{\sqrt{LC}} = 2\pi f_0 \text{ rad/s}$$



Series Resonance

$$\omega_0 L = \frac{1}{\omega_0 C}$$

$$Z = R \text{ at resonance}$$

$$Q = \frac{\omega_0 L}{R} = \frac{1}{\omega_0 CR}$$

$$BW = \frac{\omega_0}{Q} \text{ rad/s}$$

Now we only plug in the values in the formula.
L = 5μH and f_0=2 MHz

$$\omega_0 = \frac{1}{\sqrt{LC}} = 2\pi f_0$$

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

$$C = \frac{1}{L(2\pi f_0)^2} = \frac{1}{(5 \times 10^{-6})(2\pi \times 2 \times 10^6)^2} = 1.26\, nF$$