Shaikh Sir's Diploma Classes

Engineering Mechanics {22203}
Numerical Problems {Question 2-6}

Chapter	Type No	Type	Importance	N
Simple Machines	1	Problems on M.A. , V.R and Efficiency		
Simple Machines	2	Problems on Friction in Machines		
Simple Machines	3	Problems on Law of Machines		
Simple Machines	6	Problems on Screw Jack		
Simple Machines	5	Problems worm and worm wheel.		
Simple Machines	6	Problems on Weston's Differential Pulley Block.		
Simple Machines	7	Problems on Simple and differential pulley block.		
Simple Machines	8	Problems on Geared Pulley Block		
Simple Machines	9	Problems on Single and Double purchase crab		
Force System	10	Prob. on Resolving a force into perpendicular/non-perpendicular components		
Force System	11	Problems on Resultant of Two Forces		
Force System	12	Problems on Resultant of Concurrent Forces		
Force System	13	Problems on non-concurrent forces		
Force System	14	Problems on Parallel forces		
Equilibrium	15	Problems on Equilibrant of forces		
Equilibrium	16	Problems on Lami's theorem		
Equilibrium	17	Problems on Finding beam Reactions		
Centroid & C.G	18	Problems on Centroid of Standard sections		
Centroid & C.G	19	Problems on Centroid of composite area (Dam wall & other)		
Centroid & C.G	20	Problems on Centroid of Cut figures		
Centroid & C.G	21	Problems on C.G. of Composite solids		
Centroid & C.G	22	Problems on Cut solids (Frustum of cone and others)		
Friction	23	Prob on Body lying on horizontal plane & horizontal force		
Friction	24	Prob on Body lying on horizontal plane & inclined l force		
Friction	25	Prob on Body lying on Inclined plane & Parallel force		

Type 1:Problems on M.A.,V.R and Efficiency

1. **In a simple lifting machine a load of 1400 N is lifted by 50 N effort while the load moves up by 0.2 m the effort moves by 6 m. Calculate 1)M.A 2) V.R. 3) Efficiency.**

2. **In a certain lifting machine effort has to move through a distance of 1 m when load moves through a distance of 10 mm, Machine lifts a load of 1500 N with the effort of 25 N. find MA ,VR and Efficiency.**

3. **In a simple lifting machine a load of 5 kN is lifted by 45 N effort. While the load moves up by 30mm the effort moves through 4 m. Calculate MA,VR and efficiency.**

4. **In a certain lifting machine whose efficiency is 70%, effort has to move through 2m in order to move the load through 50 mm. Determine the effort required to lift a load of 2000 N.**

5. **Determine the load that can be lifted by a machine whose efficiency is 60% and effort of 50 N moves through distance of 3 m while the load moves through 40mm.**

6. **A machine has velocity ratio 30, determine the effort required to lift a load of 100N if efficiency of the machine is 30%.**

7. **In a certain lifting machine whose velocity ratio is 20 and efficiency is 60%. Determine load that can be lifted by effort of 20 N.**

Ans
1) MA=28,VR=30,Eff=93.33%
2) MA=60,VR=100,Eff=60%
3) MA=111.11,VR=133.33,Eff=83.33%
4) P=71.42 N
5) W=2250 N,
6) P=11.11 N ,
7) W= 240 N

Type 2:Problems on Friction in Machines

8. **For a certain machine having VR of 40 and efficiency 75%.Calculate the effort lost in friction while lifting a load of 3 KN.**

9. **In A certain lifting machine load of 100N is lifted by an effort of 8N and efficiency of the machine is 60%.Calculate...**
   1) effort lose in friction, 2) load lost in friction

10. **In a certain lifting machine an effort of 2N lifts a load of 30N.If the effort lost due to friction at this load is 0.5N.Find velocity ratio & efficiency of machine.**

11. **In a machine ,an effort of 6N lifted a load of 85N.If effort lost due to friction at this load is 1.3N.Find ideal effort,mechanical advantage, velocity ratio and efficiency of machine.**

12. **In a machine an effort of 200N is required to lift a certain load when its efficiency is 60%.Find the ideal effort.**

13. **In a machine the effort required to lift certain load is 150N,when efficiency is 65%.find the ideal effort.**

14. At a certain machine an effort of 18N lifts a load of 100 N at an efficiency of 65%. Find the effort and load lost in friction.

Ans
8) Pf=25N
9) Pf=3.19N,Wf=66.64 N.
10) VR=20,EFF=75%
11) Pi=4.70 N,MA=14.16 ,VR=18.08,eff=78.35%
12) Pi=120 N
13) Pi=97.5 N
14) Pf=6.29N,Wf=53.72 N

Type 3:Problems on Law of Machines

16. Velocity ratio of a machine is 50 and law of machine is P=0.033W+20 N
Find 1) Max MA 2) Max Efficiency 3) Effort to lift a load of 100 N
4) Load that can be lifted by effort of 30 N.

17. Velocity ratio of a machine is 72. The law of machine is P=1/48 W+30 N,
Find the maximum MA, max efficiency and state whether machine is reversible.

18. In a lifting machine P=0.1 W+10 ...N. If velocity ratio is 20..Find
1) Max MA 2) Max Efficiency 3) Effort to lift a load of 1 KN
4) Load that can be lifted by effort of 50 N.

19. A machine lifts a load of 400 N by effort of 60 N. It lifts load of 600 N by effort of 80 N. Find the law of Machine.

20. In a lifting machine a load of 10 KN is raised by effort of 300 N. It lifts 20 KN by 550 N effort. Find 1) Law of machine 2)Max MA 3) Max efficiency VR=50.

21. Following table shows observations on a certain machine

Load	Effort
100N	10N
200 N	14 N

Find the law of machine and maximum MA.

22. Following table gives load and effort relation for a simple machine

Load	Effort
1000N	150N
1800 N	200 N

Find the law of machine and Effort to lift load of 5 KN.

Ans
16) Max MA=30.30, Max eff=60.6%,P=23.3 N, W= 303.03
17) Max MA=48, Max eff=66.67%, Reversible machine.
18) Max MA=10, Max eff=50%,P=110 N, W= 400 N
19) P=0.1 W+20 N
20) P=0.025 W+50,Max MA=40, Max eff=80%
21) P=0.4W+6 N, max MA=25
22) P=0.0625 W+87.5 N, P=400 N.

Type 4 :Problems on Screw jack

23. A screw jack lifts a load of 30 kN has efficiency of 30%, the length of handle is 60 cm. If the pitch of screw is 15 mm. Find the effort required.

24. A screw Jack has effort wheel diameter 200 mm and pitch 5mm. A load of 1000 N is lifted by effort of 150 N. find the efficiency of the screw jack.

25. A screw jack has efficiency of 15%. It lifts a load of 2 kN by effort of 250 N. If length of handle is 60 cm. Find the pitch of the screw.

26. A screw jack lifts a load of 25 kN by an effort of 350 N at the end of a lever arm of 60 cm. If the pitch of the screw is 10 mm. Calculate the efficiency of the screw jack at this load.

27. A screw jack lifts a load of 20kN with an effort of 250 N at the end of lever of arm 50 cm. If the pitch of the screw is 10 mm, calculate the VR,MA and efficiency of the machine. State whether the machine is reversible or not.

Ans: 23) P=397.89 N
24)Eff=5.30%
25)pitch=0.07 m
26) Eff=18.95%
27)eff=25.46%, non reversible.

Type 5 :Problems worm and worm wheel

28. The following data is related to a double threaded worm and worm wheel
No of teeth on the wheel=60
DIameter of the effort wheel =30 cm
Diameter of the load drum=20 cm.. Calculate VR

29. In a single threaded worm and worm wheel, then number of teeth on the worm wheel is 60. The diameter of the effort wheel is 30 cm and that of load drum is 15 cm. Calculate the velocity ratio. If the efficiency of the machine is a45%, determine the effort required to lift a load of 5kN.

30. In a worm and worm wheel, the number of teeth on the worm are 80. The effort handle is 100 mm and load drum diameter is 400 mm. If the efficiency is 65%, determine the effort for raising a load of 5kN.

31. A worm and worm wheel carries 50 teeth on wheel, 30 cm effort wheel diameter, 60cm load wheel diameter. If the efficiency is 40%. What load can be lifted with an effort of 30N.

Ans
28) vr=45
29) VR=120,P=92.59 N
30) V.R.=40,p=192.30 N
31) VR=25,MA=10,W=300 N

Type 6:Prob. on Weston's Differential pulley block

32. A Weston's differential pulley block has diameters of pulleys 26 cm and 24 cm. It has efficiency 55%. Find
1) Effort to lift a load of 5 KN
2) Effort lost in friction.

33. A Weston's differential pulley block is used to lift load of 8 kN.It has diameters of pulleys 260 mm and 240 mm. If the efficiency of the machine is 45% find the effort required. Also find load lost in friction.

34. In a Weston's pulley block the radius of the smaller wheel is ¾ than that of the larger wheel . What load is lifted by the pulley block with an effort of 100 N at an efficiency of 50 %.

35. A Weston's differential pulley block has 12 cogs on the smaller pulley and 13 cogs on the larger pulley. The law of machine is P=W/20+20. Find the efficiency of the machine when a load of 750 N is being lifted.

36. A Weston's differential pulley block has 11 cogs on the bigger pulley and 10 cogs on the smaller pulley. by this machine loads of 400 N and 600N are lifted by efforts of 60 N and 80N respectively. find the law of machine and efficiency of machine at a load of 800 N.

Ans: 32) P= 349.65 N,Pf=157.34 N,
33) P=683.76 N,Wf=9777.76 N
34) W=400N
35) eff=50.16%
36) P=0.1W+20, eff=36.66%

Type 7:Prob. on Simple and differential wheel axle

37. In a simple wheel and axle, diameter of wheel is 150 mm and that of axle is 30 mm. If the efficiency of the machine is 60%, determine the effort required to lift a load of 50N.

38. In a differential axle and wheel, the diameter of the wheel is 40 cm and that of axles are 10 cm and 8 cm. If an effort of 50 N can lift a load of 1500 N, Find the efficiency of the machine.

39. In a differential axle and wheel, the diameter of the wheel is 30 Cm and the diameter of the axles are 12 cm and 10 cm. Find efficiency if the machine lifts a load of 1500 N with an effort of 80 N.

40. In a differential axle and wheel, the diameter of wheel is 500 mm and diameters of axle are 120 mm and 100mm. If an effort of 40 N can lift a load of 1200 N, find the efficiency of the machine and effort lost in friction

Ans: 37) P= 16.67 N.
38) vr=40 ,eff=75%.
39) vr = 30 , eff=62.5%.
40) eff=60 %, Pf=16 N.

Type 8:Prob. on Single and Double purchase crab

41. A single purchase crab has the following details :
Length of handle =40 cm
Diameter of load drum=20 cm
Number of teeth in the pinion=16

Number of teeth in the spur=80
Find 1) V.R and 2) Effort required to raise the load of 2 KN with an efficiency of 75%.

42. In a double purchase crab, the two pinions 10 teeth each and two spur wheels have 60 teeth each. The diameter of the load drum is 20 cm and that of the effort wheel is 60 cm. Find the velocity ratio.

43. In a double purchase crab, the two pinions have 12 teeth each and the two spur wheels have 72 teeth each. The diameter of the load drum is 22 cm and that of the effort wheel is 65 cm. Find the velocity ratio.

Ans **41) vr=20,p=133.33 N**
42) VR=108
43) Ans: 106.36

Type 9 :Problems on Geared Pulley Block

44. A geared pulley block is used to lift a load by and effort of 1000 N with 60% efficiency. Calculate the load lifted by the effort if
(i) cogs on effort wheel =100,
(ii) cogs on the load wheel=10
(iii) No of teeth on the pinion =20,
(iv) No of teeth on the spur=40

45. For a geared pulley block, the following data is available
(i) cogs on effort wheel =60,
(ii) cogs on the load wheel=15
(iii) No of teeth on the pinion =10,
(iv) No of teeth on the spur=90
If the max effort required to lift the load is 50 N, calculate the maximum load that can be lifted by this machine if efficiency is 70%.

Ans **44) W=1200 N**
45) W=1260 N

Type 10. Prob.on Resolving a force into perpendicular/ non-perpendicular components

A] Perpendicular(Orthogonal Components)

46. A force of 900N is acting from origin towards the point (12,5) find its orthogonal components.

47. A force of 2 kN is acting from origin towards the point (-3,-6) find its orthogonal components.

48. A force of 250 N is acting from origin towards the point (-2,4) find its orthogonal components.

49. A force of 5 kN is acting from origin towards the point (3,-4) find its orthogonal components.

50. **A force of 100 kN makes an angle of 135^0 with the positive side of x axis, Find its orthogonal components**

51. **Find the orthogonal components of the following forces.200N @ NE, 350N @30^0 west of south, 20KN due south, 40KN due west.**

52. **Find the orthogonal components of the following forces , 2kN @ NW, 3.5kN @30^0 west of north, 4.5 KN due south, 3.5 KN 40^0 south of east.**

B] Non perpendicular

53. **Resolve a force of 500N along two sides $30^0 and\ 50^0$on either sides.**

54. **Resolve force of 100n Along two sides $10^0 and\ 30^0$ on either sides.**

55. **What are components of a force of 100N in two direction on either side at 30^0each.**

56. Split a force of 120N along 40 degrees on both sides.

57. **Resolve a force of 8KN in two directions at $20^0 \& 30^0$on either side.**

Type 11. Problems on Resultant of Two Forces

58. Two forces 30N and 40N are acting at of away from the point making an angle of 30^0 with a each other Find their resultant.

59. **Two forces 100N each are acting at always from point. If the angle between them is 45^0 Find resultant in magnitude and direction.**

60. If two forces 60N each are acting at a point such that their resultant is 85N. Find angle between them.

61. Two force FA = 6N [Horizontal] and FB = 8N [Inclined] action at particle if angle between them is 70^0. Find resultant

62. Two forces acting at of away from the point have magnitudes 20KN and 25KN. If angle between them a 60^0 from resultant in magnitude and direction.

63. Find the angle between two equal forces P. such that their resultant is also P.

64. Find the angle between two force 120N each,such that their resultant is 60N

64-A. Two forces of magnitude 100 N and 300 N are acting at $50^0$to each other . Determine the resultant in magnitude and direction if

1) **Both have same sense and**
2) **Forces have different sense..**

Answers

58) R=67,66 N , angle =17.19 deg

59) R=184.70 N, angle =22.5 deg

60) angle= 89.80 deg

61) R= 11.52 N, angle 40.71 deg

62) R= 39.5 kN , Angle =33.67 deg

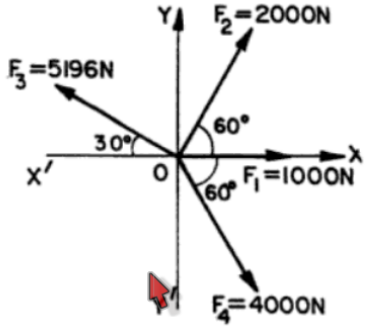
63) Angle =120 deg

64) Angle=151.04 deg

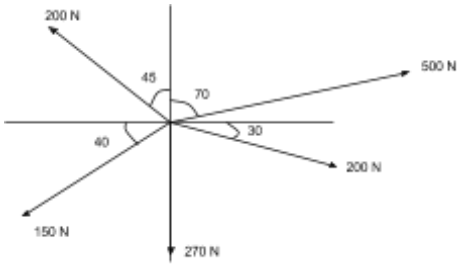
64-A) R=372.24 N, angle=38.12 deg, Opposite sense : R=247.85 N, angle=-68.00 deg

Type 12. Problems on Resultant of Concurrent Forces

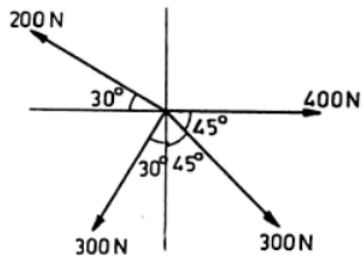
65. Find the resultant of the following forces acting at a point



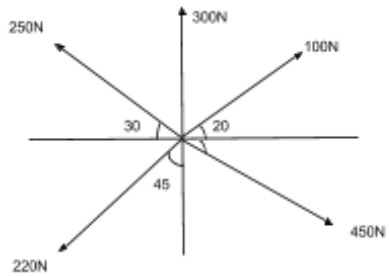
66. Find the resultant of the following forces



67. Find the resultant of the following forces system analytically



68. Find resultant of the following concurrent forces

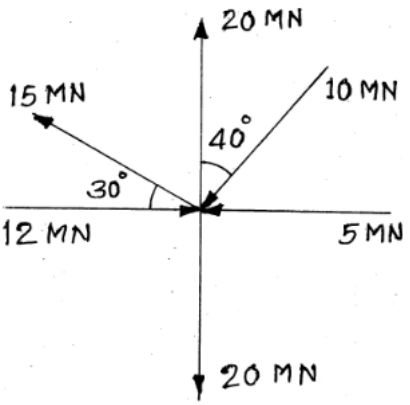


69. Five force 5KN, 7KN, 9KN, 4KN, and 3KN are acting at and away from

a point making the angles of $0^0, 30^0, 135^0, 250^0, 315^0$ x-positively, Find resultant in magnitude, direction.

69b.

b) Find the resultant of the concurrent force system shown in Fig. No. 2 in magnitude and direction by analytical method.



69 c .

a) Five forces of magnitude 1N, 3N, 5N, 7N and 9N starting from one corner of regular hexagon and acts toward its other corner taken in anticlockwise order. Determine

magnitude and direction of resultant analytically. (regular hexagon placed such that its one of the side is horizontal)

Type 13. Problems on resultant of non-concurrent forces and Moment of forces about a given point

70 A.

d) ABCD is a rectangle such that AB = 3 m and BC = 2 m. Along sides AB, CB, CD and AD, the forces of 100 kN, 200 kN, 250 kN and 150 kN are acting respectively. Find the magnitude, direction and position of the resultant of the forces from C. Use analytical method only.

A triangle ABC has its side AB = 30 cm along +ve x-axis and BC = 40 cm along –ve y-axis. Three forces of 30 N, 40 N and 50 N acts along the sides AB, BC & CD respectively. Determine magnitude and direction of resultant of such a system of forces. w.r.t. point A.

70.B.

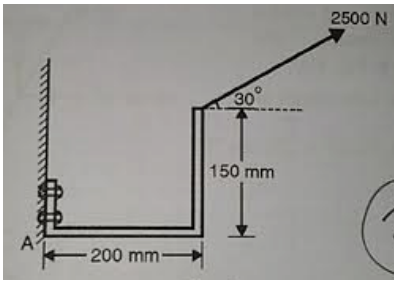
70. C Three forces equal to 20N, 40N and 60N act along AB, BC, CA sides respectively of an equilateral triangle of side 50mm. Determine resultant moment about 'A'.

71. Three forces of 1,2 and 3 N act along the three sides of an equilateral triangle of side 1m along

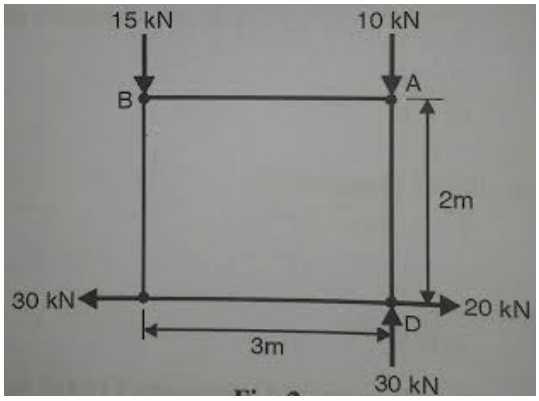
AB, BC, and CA. Find the algebraic sum of the moments of all the forces about point C.

(Ans)

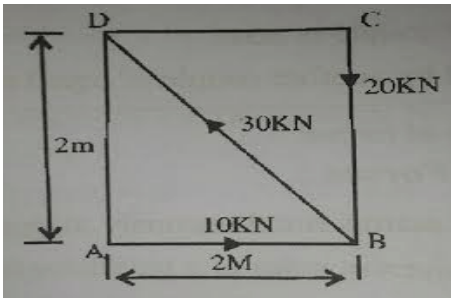
72. A force of 2500N acts on a bracket. Find moment of this force at 'A'. Refer fig



73. Calculate the moment about point B for the force system as shown in fig.

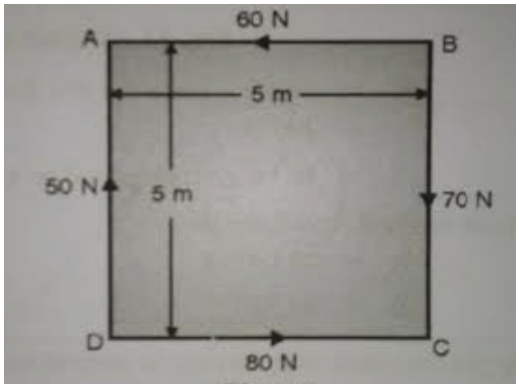


74. Determine the resultant moment of the force about point 'A' in fig

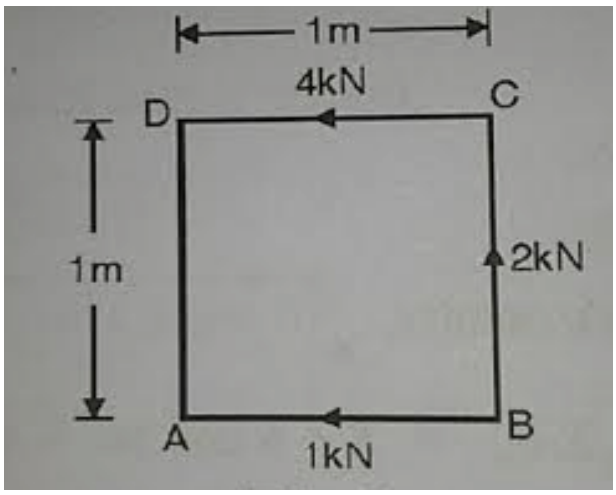


75. Calculate the moment about point 'A' for the force system shown in fig
Draw fig page no 7-7 question no 2d

76. Calculate the total moment about point 'A' for the force system shown in fig



77.A square ABCD, 1m side is acted by forces of 1 kN, 2kN and 4kN as shown in fig. Calculate magnitude and direction of resultant.



78.Four forces 6N, 4N, 2N and 1N are acting along the sides of square, AB, BC, CD, and AD respectively. Find the resultant in magnitude and direction only.

Ans :

70)C $\Sigma M_A = 1732.05\,N-mm\,(anticlockwise)$**)**

$\Sigma M_C = 0.87\,N-m\,(anticlockwise)$

(Ans = $\Sigma M_A = 74759.53\,N-m\,(anticlockwise)$**)**

(Ans = $\Sigma M_B = 40kN-m\,(anticlockwise)$**)**

(Ans = R= 11.28kN, x= 0.21m w.r.t 'A')

(Ans = $\Sigma M_A = 50\,N-m\,(anticlockwise)$**)**

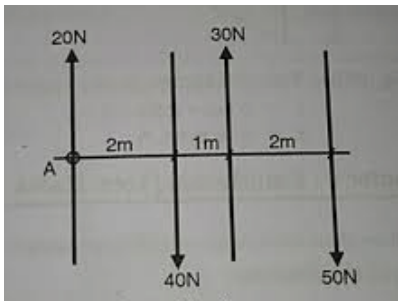
(Ans = $\Sigma M_A = 22500\,N-m\,(anticlockwise)$**)**

(Ans = R =, $\theta = 33.69^0$**)**

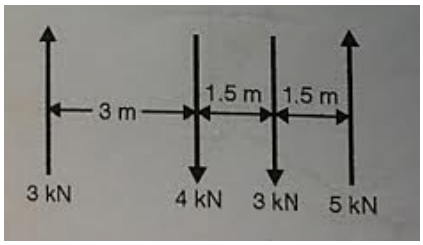
(Ans = R= 6.4N, $\theta = 51.34^0$**)**

Type 14. Problems on Parallel forces

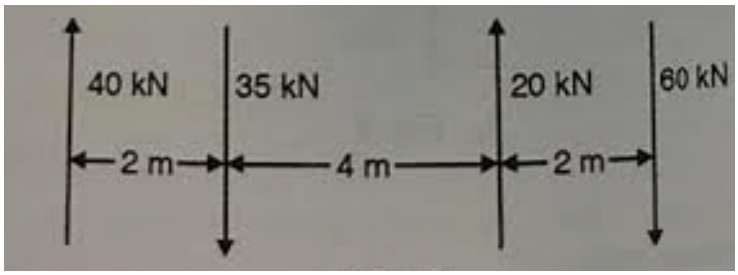
79. Locate Analytically the position of resultant for the parallel force system as shown in fig.



80. Find the resultant of parallel forces as shown in fig by graphical method and shown its position on fig.



82. Calculate resultant in magnitude, direction and position with respect to 40kN force for the parallel force system shown fig.



83. Six parallel forces of magnitude 1 kN,1.5 kN,1.8 kN,2.0 kN,2.4 kN and 2.7 kN are acting at 1,3,5,7,8m from first force. Forces of first third and fifth are acting upwards while other are acting downwards find the resultant .

84. Determine analytically the resultant of the coplanar parallel forces acting vertically upwards 40N, 20N at 30mm, 30N at 50mm and 60N at 70mm. All distance are taken from first force towards right.

Ans:

79. R= $40\,N\downarrow$**, X = 6m**

80. R = 1kN$\uparrow$**, X = 4.5m**

81. R =100 N $\uparrow$**, X = 19 m**

82. R =35$\downarrow$**, X = 12.29 m**

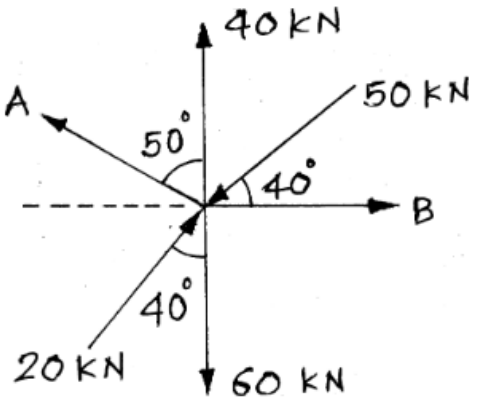
83. R = -1 kN, a = 10.9 m from first force

84. R = 150N $\uparrow$

Type 15. Problems on Equilibrant Force

85.

a) Find the magnitude of the forces A and B for the force system which is in equilibrium as shown in Fig. No. 3.



Type 16. Problems on Lami's theorem

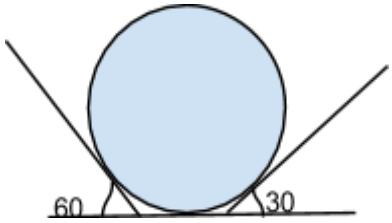
84. **A bulk weighing 100N is hanging from ceiling. A force 'P' applied horizontally making the string inclined at an angle of 60^0 with vertical Find 'P' and tension in string.**

85. **An electric bulb weighing 25N hangs from a ceiling by two strings AC & BC. Where AC is inclined at 60^0 to the ceiling & BC at 40^0 to the vertical wall at 3 determine the force in the string AC & BC**

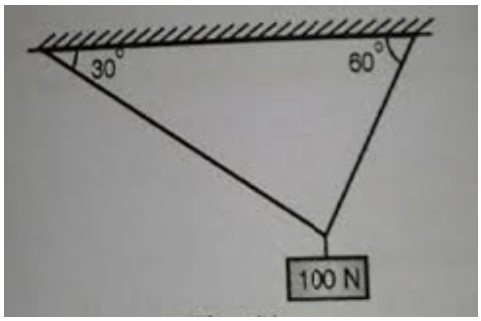
86. **A bulb weighing 40N is tied to ceiling by two strings one string making 35^0 & other 55^0 with ceiling lind tension in string.**

87. **A sphere ball of weight 100N is hung to ceiling by means of rope. A force is applied horizontally which makes rope inclined at 65^0 with ceiling. Find tension in the rope and force applied**

88. Cylinder B weighing 50N rests as shown in fig. Find the reactions at the surface of contact of cylinder.

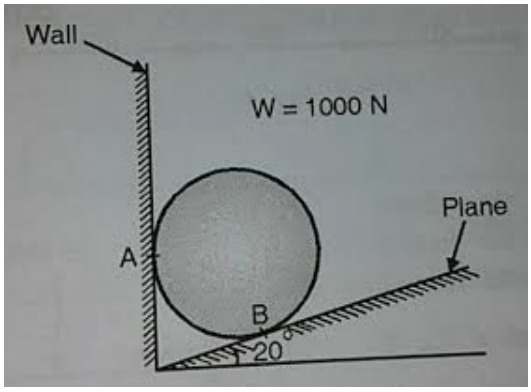


89. A Weight 100 N is attached by two string. calculate the tension in the string use fig.



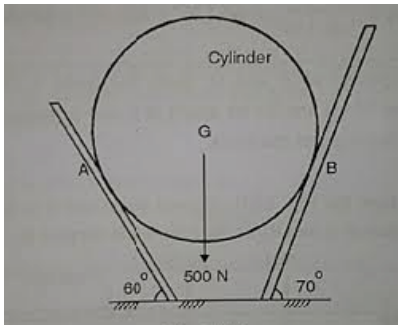
(Ans = T_1= 50N, T_2= 86.60 N)

90. A sphere having 300 mm as radius and 1000N as weight against a well and on a inclined plane
as shown in fig. Calculate the reactions given by the wall and the plane.



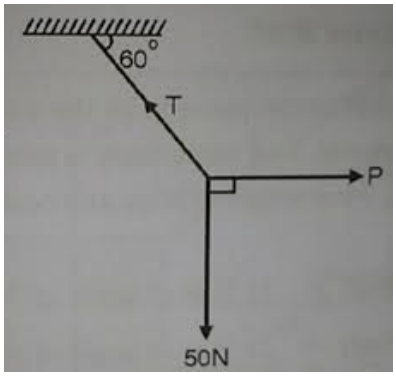
(Ans =R_A= 363.97N, R_B= 1064.18N)

91. A cylinder weighing 500N is resting on smooth channel as shown in fig. Determine reaction offered by channel surfaces.



(Ans = R_B=565.26N, R_A=613.34N)

92. A hroizontal force p as shown in fig. keep the weight of 50N in equilibrium. Find 'P' and tension
is string.



(Ans = P = 28.87N, T = 57.74N)

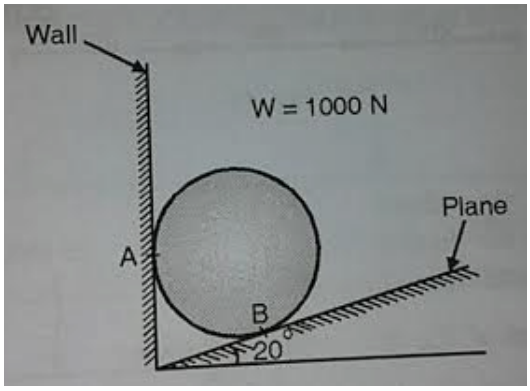
93. **An electric light fixture weighing 20N hangs from a point 'C' by two strings AC and BC. AC is inclined at 60^0 to the ceiling and BC at 40^0 to the vertical wall. Determine the forces in the strings AC and BC.**

(Ans = T_{AC} = 13.68N, T_{BC} = 10.64N)

94. A body of wt 50kN is hung by means of a string to the ceiling. determine the pull required and

tension in the string when string has an inclination 70^0 with the ceiling and pull is applied at 30^0 with the horizontal. (Ans = P = 17.36kN, T = 43.97kN)

95. A sphere having 300 mm as radius and 1000N as weight against a well and on a inclined plane as shown in fig. Calculate the reactions given by the wall and the plane.



(Ans = R_A = 363.97N, R_B = 1064.18N)

96. Q7. A body of weight 100N is suspended by two strings of 4m and 3m lengths attached at the same horizontal level 5m apart. Find the tension in the strings.

(Ans = T_1 = 60N, T_2 = 80N)

97. **An electric bulb of weight 10N hangs vertically from a ceiling. Its wire is pulled by a horizontal force 'P' such that its wire will make an angle of 10^0 with vertical. Find force 'P' and tension in wire.**

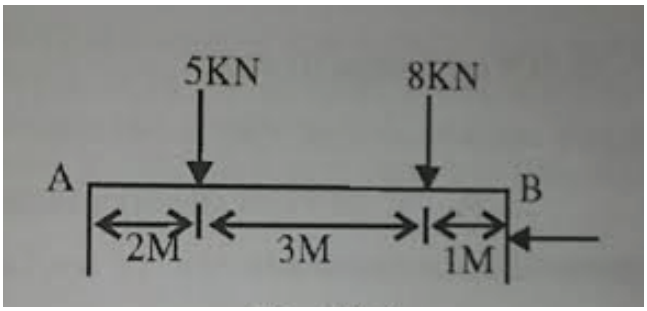
(Ans = T = 10.15N, P = 1.76N)

98. **Two men carry a weight of 2 kN by means of two ropes fixed to the weight. One rope is inclined at 45^0 and other at 30^0 with their vertices. Find the tension in each rope.**

99. **Two men carry a weight 670 N by means of ropes fixed to the weight. One rope is inclined at 40^0 and other at 50^0 with their vertices. Find the tension in each rope.**

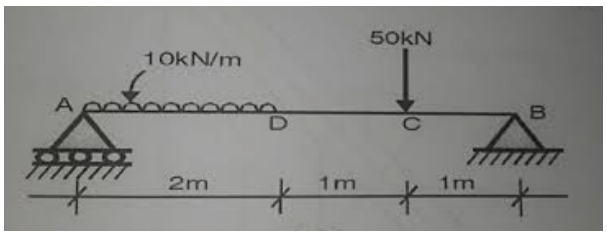
Type 17. Problems on Beam Reactions

100. Find the beam reaction analytically as shown in fig.

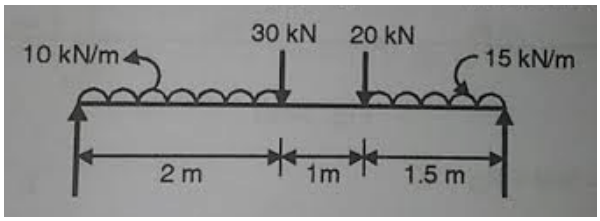


101.A beam AB of 9m span is simply supported at the ends. The Beam carries point load of 2kN upwards at 2m from. A And uniformly distributed load of 1000N/m downwards on a length of 6m form B. Determine the support reactions analytically.

102. Calculate graphically the reactions of beam at the support as shown in fig.



103.Find out the support reactions of the simply supported beam shown in fig. analytical method.

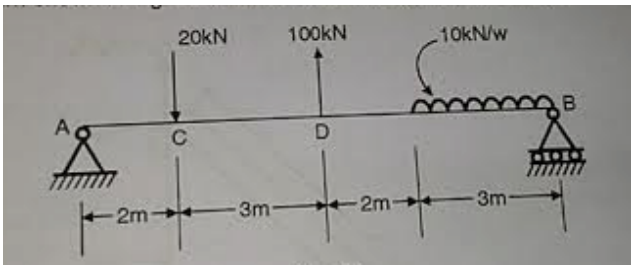


104.A beam ABCDE is supported at A and D and carries ud/between AD of magnitude 60N/m and downward load of magnitude 40N at E. Compute the reactions RA and RD analytically. Take AB = BC = CD=2m and DE=1m

105.A simply supported beam of span 10m, carries two concentrated loads of 60kN and 40kN at 2m and 5m respectively from LHS in additions to this beam also carries a UDL of 16kN/m over 5m from RHS. Calculate support reactions by analytical method.

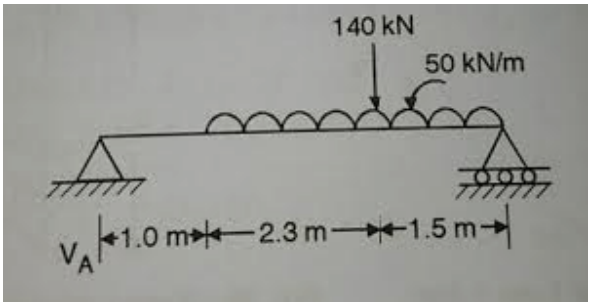
106.A simply supported beam of span 10m, carries two concentrated loads of 60kN and 40kN at 2m and 5m respectively from LHS in additions to this beam also carries a UDL of 16kN/m over 5m from RHS. Calculate support reactions by analytical method.

107. For the beam shown in fig. Calculate support reaction by analytical method.

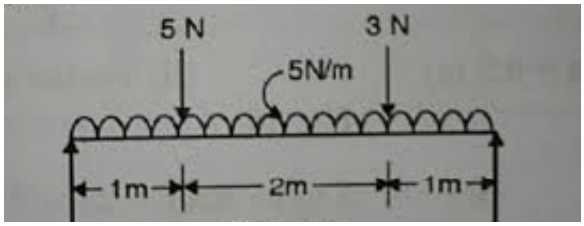


108.A beam ABCD, supported at A and D, such that /(AB) = /(BC) = 1m and /(CD) = 2m Concentrated loads of 15kN and 20kN acting at B and C respectively and span CD subjected to UDL of 10kN/m. Find support reactions.

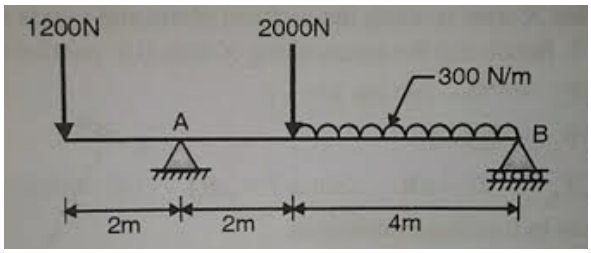
109. Determine the reactions at the supports of the simply supproted beam shown in fig. Analytically



111. Find the reactions by analytical method for the beam as shown in fig

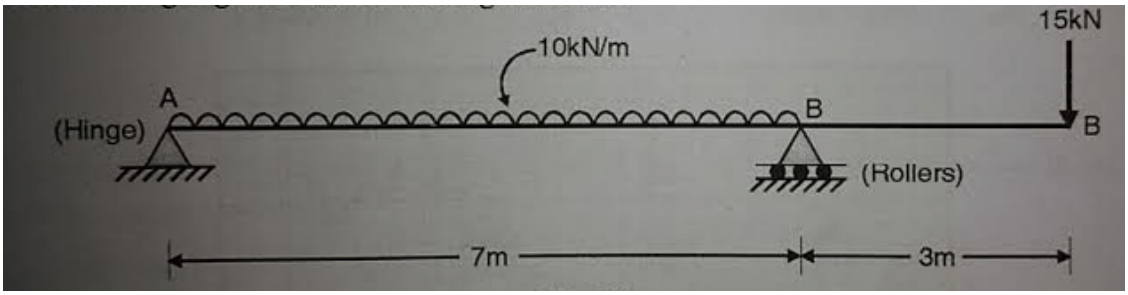


112. Using analytical method, calculate suppoert reactions for the beam laoded as shown in fig.

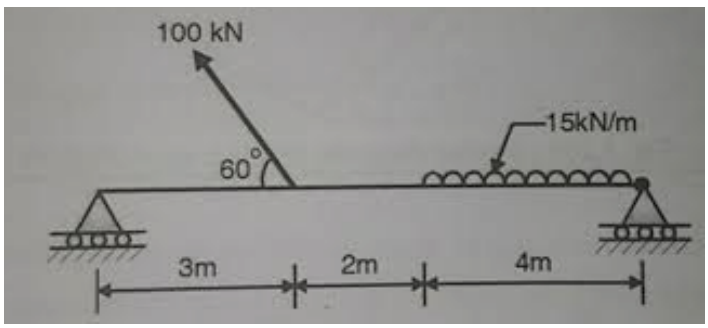


113. A beam ABC hinged at A and roller supported at B. Span AB is 7m and overhang BC is 3m

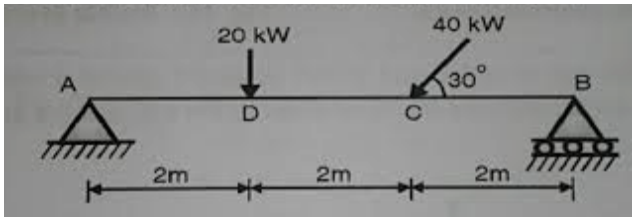
Beam carries UDL of 10kN/m over span AB along with concentrated load of 15kN at C. Calculate support reaction.



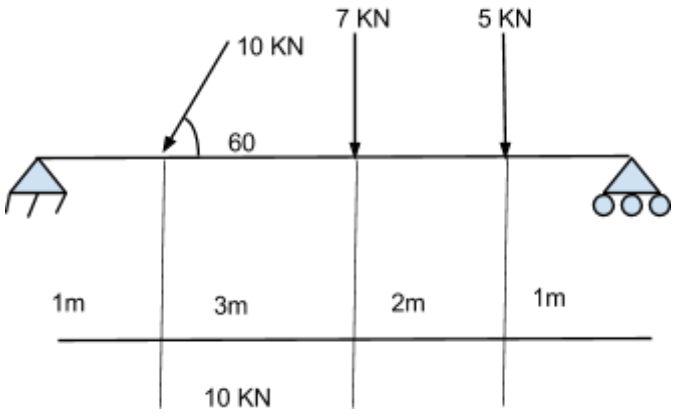
114. Using analytical method, obtain support reactions of a loaded beam as shown in fig.



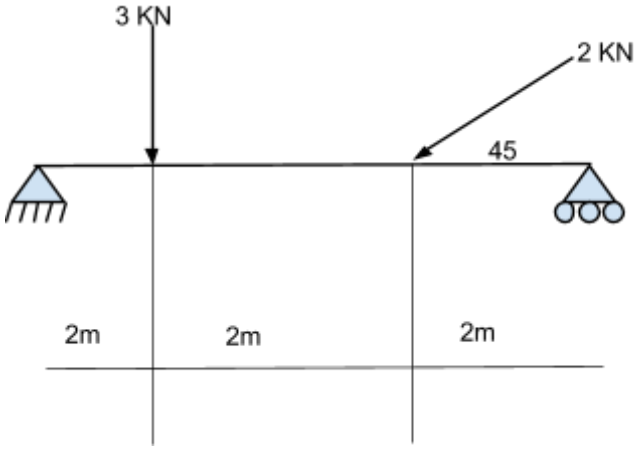
115. Calculate the reaction of beam at the support as shown in fig.



115-B. Find the beam Reactions



115 C- Find the beam Reactions



101. Ans = R_3**=8.33N,** R_A**= 4.66N**

102. Ans R_A**= 444.445 N,** R_B**= 3555.555N**

103. Ans = R_A**=27kN,** R_B**= 43kN**

104. Ans = R_B**= 49.86kN,** R_A**= 42.64kN**

104. Ans = R_D**= 226.67N,** R_A**= 173.33N**

106. Ans = R_B**= 92kN,** R_A**= 88kN**

107. Ans = R_B**= 92kN,** R_A**= 88kN**

108. Ans = R_B**=20.5kN**$\downarrow$**,** R_A**=29.5kN**$\downarrow$

109. Ans = R_D**=28.75kN,** R_A**=26.25kN**

110. Ans = R_B**=211.04kN,** R_A**=118.96kN**

111. Ans = R_B**=13.5N,** R_A**=14.5N**

112. Ans = R_B**= 1066.67N**$\uparrow$**,** R_A**= 3333.33N**$\uparrow$

113. Ans = R_B**=56.43kN,** R_A**=28.57kN**

114. Ans …….

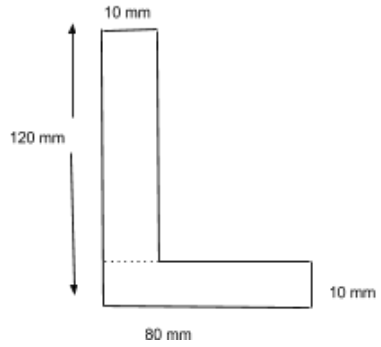
115. Ans = R_A**= 40kN,** R_B**= 20kN**$\uparrow$

115 B = R_B **=8.33 KN,** R_A **=13.30 KN**

115 C Ans = R_B = 1.94 KN, R_A = 2.84 KN

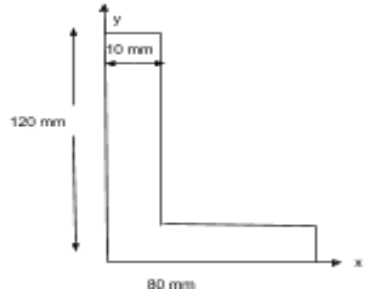
Type 18. Problems on Standard sections (I,L,C channel)

116. Locate the centroid of the L-section show in fig having the flange 10 x 80mm and web 10 x 120 mm.



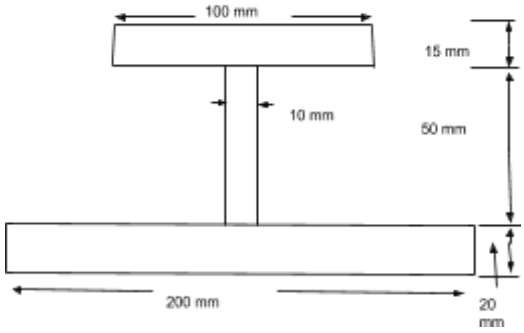
117. A T-section has the following dimensions:
flange : 20 mm x 10 mm
web : 10 mm x 300 mm
overall depth : 310 mm T-section.

118. Locate the centroid of the L-section shown in fig having the flange 10 x 80 mm and the web 10 x 120 mm.



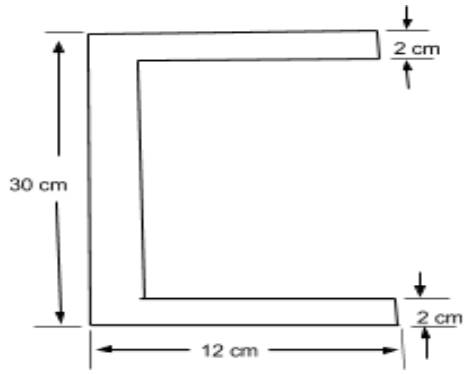
119. Locate the centroid for the "T" section 100 mm x 100 mm x 10 mm having depth of the 10 mm.

120. Fig shown an unsymmetrical I-section. calculate the centroid and locate it on the sketch.



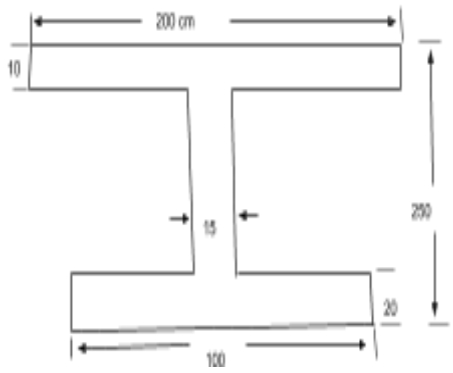
121. A 'T' section has flange of 200 x 20 mm and web of 15 x 240 mm. Find the position of centroid.

122. Find the centroid of channel section 30 cm x 12 cm 2 cm as shown in fig



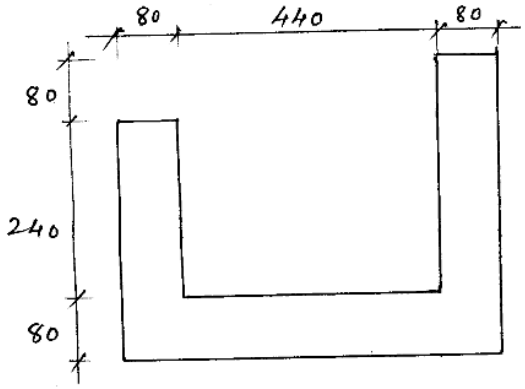
123. Find the position of centroid of an unequal angle section 100 mm x 75 mm x 10 mm

124. Find the centroid of the I-section shown in fig



124.b.

Locate the position of centroid for the lamina shown in Figure No.10 with respect to extreme left edge of lamina.



116 Ans = $G(\bar{x},\bar{y}) = 19.74\,mm, 39.74\,mm$

117 Ans = $G = (\bar{x},\bar{y}) = 100\,mm, 159.68\,mm$

118 Ans = $G = (\bar{x},\bar{y}) = 19.74\,mm, 39.74\,mm$

119 Ans = $G(\bar{x},\bar{y}) = G(50\,mm, 71.32\,mm$

120 Ans = $G = (\bar{x},\bar{y}) = 100\,mm, 29.79\,mm$

121 Ans= $\bar{x} = 100\,mm,\ \bar{y} = 188.42\,mm$

122 Ans = $\bar{x} = 3.4\,cm,\ \bar{y} = 15\,cm$

123 Ans = $\bar{x} = 32.37\,cm,\ \bar{y} = 19.77\,cm$

124 Ans = $G(\bar{x},\bar{y}) = (100\,mm, 128.63\,mm$

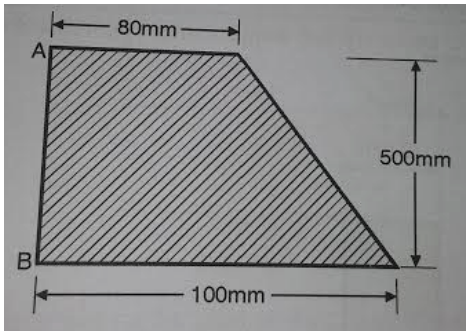
124.b. and $\bar{x} = 317.92mm\ \&\ \bar{Y} = 128.27mm$

Type 19. Problems on Centroid of composite area (Dam wall & other)

125. A retaining wall of height 5m has one side vertical. The top width is 1m and bottom width is 3m. Find centroid.

126. Find the centre of gravity of the dam wall having top 2.1m, bottom 5.0m, height 6m and face of the wall on upstream side is vertical.

127-A. Find the centroid of shaded area shown in fig. with respect to B.



127-B. A dam wall has top width of 5m and bottom width of 11 meters, the height of wall is 9 meters. find the centroid of the wall is left side of wall is vertical and right side is inclined.

125 Ans = $G(\overline{x},\overline{y}) = G(1.085m, 2.085m)$

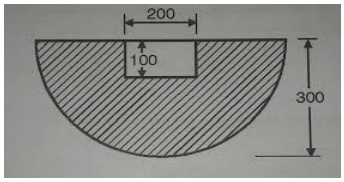
126Ans = $G(\overline{x},\overline{y}) = (1.88m, 2.59m)$

127Ans = $\overline{x}$ **= 45.19 mm with respect to AB**

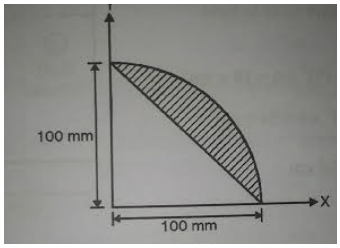
Type 20. Problems on Centroid of Cut figures

128. A square hole is punched out of a circular lamina, the diagonal being the radius of the circle. Find the C.G. of the remainder if radius of the lamina is 100 mm.

129. Locate the position of centroid for a shaded lamina as shown in fig.

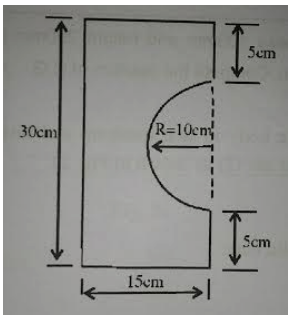


130. Locate the centroid of the shaded area shown in fig. only $\overline{x}$ **is to be a calculated.**

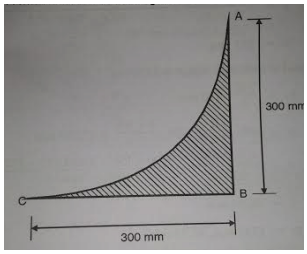


131. From a plate of 250mm x 100mm a semicircle of 160mm diameter is cut. The centre of the semicircle lies on the bottom edge and also bisects it. 250mm side is horizontal. Determine the centroid of the remainder.

132. Find centroid of the plate in fig.



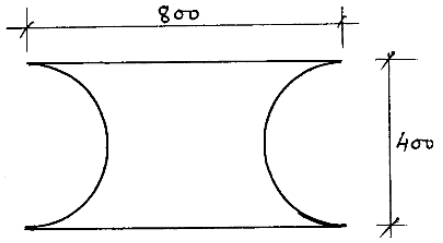
133. Find the centroid of remainder as shown in fig



134. From a circular lamina 300mm diameter,a square hole is drilled such that the diagonal of the square is the radius of the circle. Find the centroid of the remaining figure.

134 b.

Locate the position of centroid for the lamina shown in Figure No.12.



128 Ans = $G(\overline{x},\overline{y}) = G(90.54mm, 100mm)$

129 Ans = $G(\overline{x},\overline{y}) = (300unit, 159.94unit)$

130 Ans = $\overline{x} = 58.4mm$

131 Ans = $G(\overline{x},\overline{y}) = G(125mm, 60.79mm)$

132 Ans = $\overline{x} = 5.67\,cm\ from\ OB$

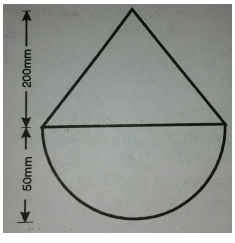
133 Ans = G = (x,y)= (233mm, 66.99mm)

134 Ans = $G(\overline{x},\overline{y}) = (135.8mm, 150mm)$

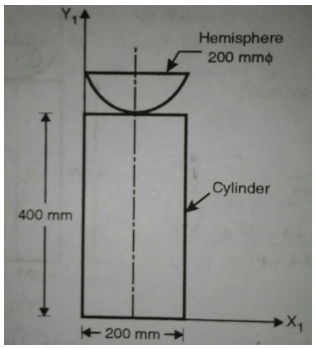
Type 21.Problems on composite solids

135. A solid formed with a cone of base 100 mm height 200 mm joins to base with cylinder of base 100 mm and height 200 mm, compute the position of C.G

136. A solid body is composed of a cylinder of diameter 200 mm and height 200 mm and hemisphere at its one end. Determine the position of centre of gravity if density of hemisphere and cylinder is uniform.



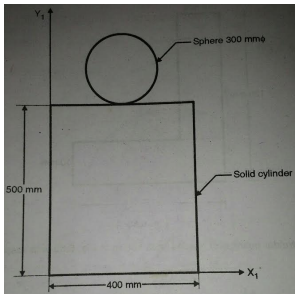
137. A right circular cone of base diameter 100 mm and height 200 mm is placed on the base of a hemisphere of the same diameter. Calculate its centre of gravity.



138. Find the centre of gravity for the solid shown in fig with the reference to $x_1 and\, Y_1 axes$

139. A solid cone of 150mm diameter and 280mm height is kept over a hollow cylinder of 150mm outside and 90mm inside diameter and height 220mm. Find the position of the centre of gravity.

140. Find the centre of gravity of composite solid shown in fig w.r.t $X_1 and\, Y_1 axes$



141. A solid cone of 200mm diameter and 280mm height is kept over a hollow cylinder of 200 mm outside and 90mm inside diameter and height 220mm Find the position of the center of gravity w.r.t $X_1 and\, Y_1\, axes.$

141.(c) A solid body is formed by joining the base of a right circular cone of height 12 cm to the equal base of right circular cylinder of height 4 cm. Calculate the distance of center of mass of the solid from its bottom face.

135 Ans = $G(\overline{x},\overline{y}) = (50\,mm, 137.5\,mm$

136 Ans = $\overline{x} = 100\,mm,\ \overline{y} = 134.5\,mm$

137 Ans = $G\,(50\,mm, 77.08mm)$

138 Ans = $G(\overline{x},\overline{y}) = G(100mm, 237.5mm)\ w.r.t\ X_1Y_1\ respectively$

139 Ans = $G\,(\overline{x},\overline{y}) = G\,(75mm, 181.75mm)$

TYPE 22 Problems on Cut solids (Frustum of cone and others)

140. The frustum of a solid cone has a top diameter of 300mm and that of its base is 450mm. Locate the c.g. of this frustum of cone, if its height is 650mm.

141. From a cylinder of 600mm diameter and 1200mm height an inverted hemisphere is cut off co-axially from top. Locate the position of centre of gravity $\overline{y}$ **from bottom.**

142. A cone of diameter 400m and height 400mm is cut off from a cylinder of diameter 400mm and height 600mm. Find the C.G. of the remainder.

143. From a cylinder having 200mm as base and 300mm as height a cone with same base and height is cut off from bottom. Calculate the C.G. of remaining solid w.r.t to base.

144. A cylinder has a height of 1000mm and diameter of 250mm. It is hollow upto 400mm from top end with internal diameter 160mm. Find centre of gravity w.r.t bottom, if solid is symmetrical about vertical axis.

145. A solid cube of 50mm side has a hemispherical cut of 50mm dia at top. Find center of gravity of remainder.

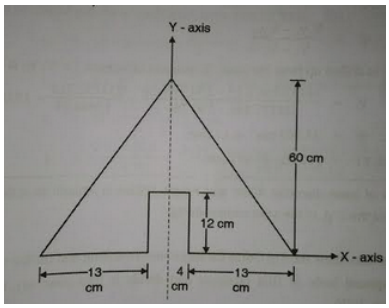
146. A cone has base 120mm and height 200mm. A hole from the base is drilled into it of 60mm diameter upto a depth of 50mm. Find C.G. of the remaining volume of cone.

147. A solid cone 500mm height and 200mm base diameter. If portion above half of its height is removed determine C.G. of remaining body.

148. The frustum of a cone has top diameter 40cm and cottom diameter 60cm, with height 18cm,

Calculate c.g.

149. A solid cone of height 60cm Q has a centrally located cylindrical groove of diameter 4cm and length 12cm measured from base of cone. If the diameter of the cone is 30cm, Find the c.g. of cone (refer fig)



142 Ans = $G(\bar{x},\bar{y}) = (200\,mm, 357.096\,mm)$

143 Ans = $G(\bar{x},\bar{y}) = (150\,mm, 187.5\,mm)$

144 Ans = $G(\bar{x},\bar{y}) = (125\,mm, 441.22\,mm)$

145 Ans = $G(\bar{x},\bar{y}) = (25\,mm, 19.46\,mm)$

146 Ans = $G(\bar{x},\bar{y}) = (60\,mm, 55.77\,mm)$

147 Ans = $\bar{y} = 38.21mm$

148 Ans = $G(\bar{x},\bar{y}) = (30cm, 7.82cm)$

149 Ans = $G(\bar{x},\bar{y}) = (15cm, 15.097\,cm)$

Type 23: Prob on Body lying on horizontal plane & horizontal force

150. A body weighing 25KN is placed on horizontal plane having $\mu = 0.68$. calculate normal reaction limiting force of friction, horizontal force to move and angle of friction.

151. A block weighing 200N is just a point of moving on horizontal place, by a horizontal force p , Find force of coefficient = 0.26 also find angle of friction.

152. Parcel is resting on horizontal plane having co.friction = 0.33 A force of 300N is required horizontal just move the parcel. Find weight of parcel.

153. A block weighing 1KN is resting on horizontal plane, It can be moved by horizontal force of 360N calculate angle of friction and coefficient of friction.

154. A body weighing 50N is resting on horizontal plane can be just moved by. A force of 13N find angle of friction.

150. Ans = R= 25000N, P= 17000N, F= 17000N, angle of friction=34.21

151. Ans = R= 200N, P= 52N, F= 52N, $\phi = 14.57^0$

152. Ans = W = 909.09N, $\phi = 18.26^0$

153. Ans = R= 1000N, $\mu = 0.36\,N$

154. Ans = μ**= 0.26,** $\phi = 14.57^0$

Type 24 : Prob on Body lying on horizontal plane & inclined force

155. A block weighing 100N is resting on table A force of 30N in inclined at 40^0 horizontal is required The just move the block. Calculate coefficient of friction between table.

156. A body weight 100N resting of rough horizontal plane It was found that pull of 30N inclined 60^0 to horizontal to required just move the body this find μ.

157. A solid block 100N rest on horizontal take μ= 0.30 determined force acting at 40^0 to horizontal to required to block.

158. A block weighing 150N is resting on rough horizontal plane having μ= 0.19 Find force to applied at 30^0up to the plane moved the body

159. A block weighing 40KN resting on rough horizontal plane. Can be moved by a force of 20KN apply any $40^0$with horizontal force. find coefficient of friction.

160. A block weighing WN is resting on rough horizontal plane having $\mu = 0.3$ It is just moved by a force of 40N acting at an angle of 20^0 to horizontal Find W

155.Ans = R= 80.72N, $\mu = 0.28$
156.Ans = R= 74.02, $\mu = 0.202$
157. Ans = P = 31.32N
158. Ans = P = 29.70
159. Ans = R = 27144.25, $\mu =$**0.564**
160. Ans = W= 137.73N

Type 25:Prob on Body lying on Inclined plane & Parallel force

161. A block weighing 500N is resting on an inclined to plane making angle of 22^0 with horizontal If $\mu = 0.25$ Find force to be applied parallel to be applied parallel to plane just move the body up. the plane.

162. A block weighing 1200N is resting on inclined to plane making 20^0 It just moving up by force P.N Find P If $\mu = 0.18$

163. A block weighing 36N. Is resting on 30^0 inclined to pane A force of 23N is required to just move the place up. Find μ

164. A body having 200N resting on 15^0 inclined to plane. A force of 40N is required two stop the body moving down Find μ

165.A force of 250N pulls a body of weight 500N up inclined plane the force being applied parallel to the plane. If the inclined of plane with horizontal is 15^0. Find coefficient of friction.

166. A body of weight 500N is lying on a rough plane inclined at an angle of 25^0 with the horizontal. It is supported by a force P parallel to the plane Determine minimum value of P for which equilibrium can exist is the angle of friction is 20^0

167. A body weight 100N rest on plane making angle of 10^0 with horizontal, and horizontal force of 30N is required to just move the body up Find coefficient of friction.

168. A block weight W N rest on 30^0 inclined plane coefficient of friction 0.25 A force of 72N required to just move the block up.

169. A block resting on 30^0 inclined to plane. A pull up 80N is required to support the body to keep it in equilibrium. If μ=0.95. calculate weight of the body .

170. A healing stone (block) of mass = 450kg is on a hill to slope 40^0 is μ= 0.65 is stone stable.

171. A being stone of mass = 200 kg is resting on a slope of 25^0 inclined and coefficient friction between ground and stone is 0.33 is stone stable

161. Ans = R= 463.59N, P= 303.20N
162. Ans = R= 1127.63N, P= 613.39N
163. Ans =R= 31.17N, $\mu = 0.16$
164. Ans = R= 193.18N, $\mu = 0.06$
165. Ans = R= 482.96N, $\mu = 0.24$
166. Ans = P= 48.17 N
167. Ans = R= 98.48N, μ= 0.128
168. Ans = W= 100.48N
169. Ans = W= 60.74 N
170. Ans = 2837.58 > 2198.100N- Stone is not stable
171. Ans = 829.17N > 586.79N - Stone is not stable