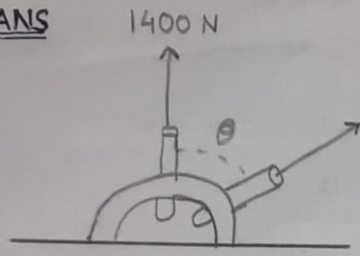
ANS



Resultant = 2000N

F_1 = 800 N

F_2 = 1400 N

θ = ?

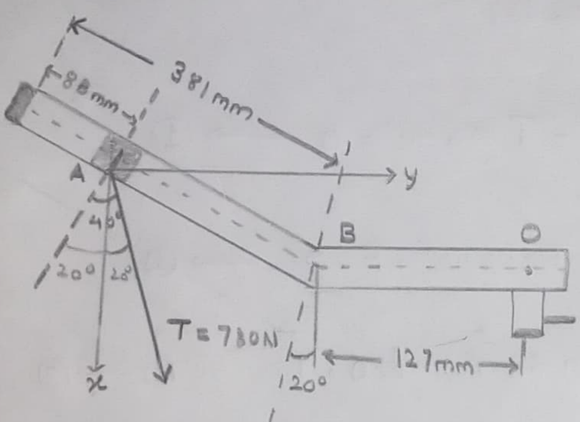
$$R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2 \cos\theta}$$

$$(2000)^2 = (800)^2 + (1400)^2 + 2(1400)(800)\cos\theta$$

$$\Rightarrow \cos\theta = 0.625$$

$$\boxed{\theta = 51.3178°}$$

ANS



$$T = T\sin 20°\,\hat{i} - T\cos 20°\,\hat{j}$$

$$\boxed{T = 266.775\,\hat{i} - 732.960\,\hat{j}\ N}$$

Force at 'point A' and point B will be equal

Moment at 'B'

$$M_B = T\sin 50\,[0.381 - 0.083]$$

$$= 780\sin 50\,(0.298)$$

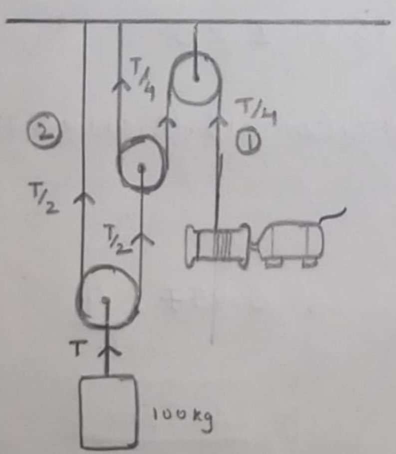
$$= \boxed{178.059\ N.m\ \ CCW}$$

Moment at 'O'

$$M_O = M_B + T\sin 50\,(0.127)$$

$$= \boxed{271.16\ N.m\ \ CCW}$$

ANS



The winch pulls the cable by 200 mm/s thus Velocity is constant

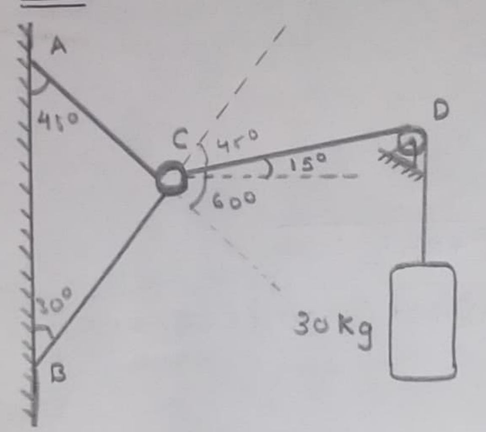
$\frac{dv}{dt} = 0$ thus acceleration is 'Zero'

$$T = 100 \times 9.81 = 981\ N$$

Tension in cable 1 is T/4

$$\Rightarrow \boxed{245.25\,N}$$

ANS



Tension in $CD = 30\cancel{0} \times 9.81$

$T_{CD} = 294.3\ N \longrightarrow (1)$

Tension in $AC = 294.3 \cdot \cos 60°$

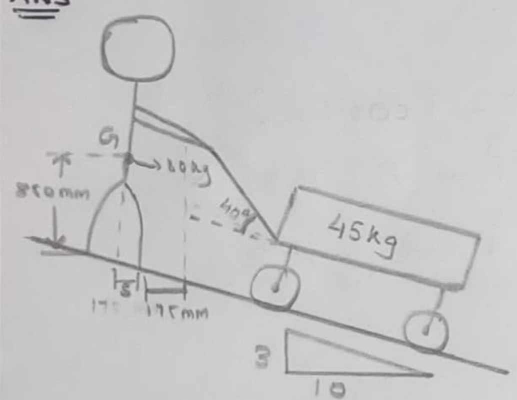
$= 147.15$

$\boxed{T_{AC} = 147.15\ N}$

Tension in $BC = 294.3 \cdot \cos 45°$

$\boxed{T_{BC} = 208.101\ N}$

ANS



$\tan\theta = \frac{3}{10}$ $\quad \theta = 16.667°$

$\Sigma F_y = 0$

$N - 82\cos 16.67° - T\sin 40° = 0 \longrightarrow (1)$

$\Sigma F_x = 0$

$82\sin 16.67° + T\cos 40° - F = 0 \longrightarrow (2)$

$\Sigma M_c = 0$

$82 \cdot S - (175 \cdot T\sin 56.7°) - (850 \cdot T\cos 56.7°) \longrightarrow (3)$

$\Sigma F_x = 0$

$45\sin 16.7° - T\cos 40° = 0$

$T = 16.84\ kg$

$F = 82\cos 16.67 + 16.84\cos 40°$

$= 91.45\ kg$

$N = 82\sin 16.667° + 16.84\cos 40°$

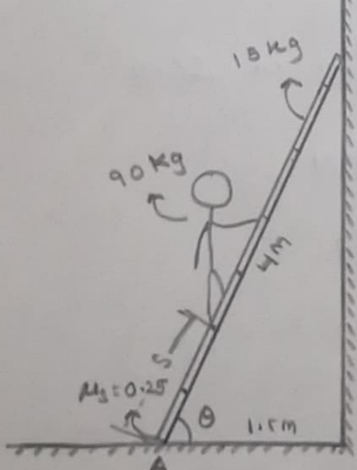
$= 36.41\ kg$

$\mu = \frac{N}{F} = \frac{36.41}{91.45} = \boxed{\mu_s = 0.4094}$

$82 \cdot S = 16.84 \cdot 175 \cdot \sin 56.7° + 16.84 \cdot 850 \cdot \cos 56.7°$

$\boxed{S = 125.87\ mm}$

ANS



$\Sigma F_y = 0 \Rightarrow N_A - 90 \times 9.81 - 15 \times 9.81 = 0$

$N_A = 1030.05\ N$

$\rightarrow 0.25(N_A)(3.71) - N_A \cdot (1.5) + 90 \times 9.81(x) + 15 \cdot (9.81) \times 0.75 = 0$

$x = 0.543\ m$

$\Rightarrow d = 1.5 - x = 0.957\ m$

$\cos\theta = \frac{4}{1.5} = S = \frac{d}{\cos\theta} \Rightarrow 0.957 \cdot \frac{4}{1.5}$

$= \boxed{2.55\ m}$

Python Program for questions 2, 4, 5

In [2]:
```
#Pgm 1
import math
F1 = float(input("Enter the magnitude of F1 (in N): "))
F2 = float(input("Enter the magnitude of F2 (in N): "))
R = float(input("Enter the resultant force (in N): "))
cos_theta = (R**2 - F1**2 - F2**2) / (2 * F1 * F2)
if -1 <= cos_theta <= 1:
    theta = math.degrees(math.acos(cos_theta))
    print(f"The angle between the forces is: {theta:.4f} degrees")
else:
    print("The given values do not form a valid triangle.")
```

```
The angle between the forces is: 51.3178 degrees
```

In [16]:
```
#Pgm 2
from math import sin, cos, tan, radians
tension = float(input('Enter The Tension T: '))

#To Find Tension T in Vector Form
print(f'The Tension T in vector Form: {'{:.2f}'.format(tension * sin(radians(20)

#To Calculate Moment at Mb and Mo
M_b = float('{:.2f}'.format((tension * sin(radians(50)) * (0.298))))
print(f'Moment at B: {M_b}')
print(f'The Moment at O: {'{:.2f}'.format(M_b + (tension * sin(radians(50)) * (0
```

```
The Tension T in vector Form: 266.78i - 732.96j N
Moment at B: 178.06
The Moment at O: 253.94
```

In [3]:
```
#Pgm 3
mass = float(input("Enter the mass of the load (in kg): "))
num_segments = int(input("Enter the number of cable segments supporting the load

g = 9.81  # Acceleration due to gravity in m/s^2

total_tension = mass * g  # Total tension in the system
tension_per_segment = total_tension / num_segments  # Tension per segment

print(f"Total tension in the cable system (T): {total_tension:.2f} N")
print(f"Tension in each segment (T/{num_segments}): {tension_per_segment:.2f} N"
```

```
Total tension in the cable system (T): 981.00 N
Tension in each segment (T/4): 245.25 N
```

In [6]:
```
#Pgm 4
import math

weight = float(input("Enter the weight of the object (kg): "))
angle_AC = float(input("Enter the angle between AC and vertical (degrees): "))
angle_BC = float(input("Enter the angle between BC and vertical (degrees): "))

g = 9.81

T_CD = weight * g
print(f"Tension in CD (T_CD): {T_CD:.2f} N")
T_AC = T_CD * math.cos(math.radians(angle_AC))
```

```
print(f"Tension in AC (T_AC): {T_AC:.2f} N")
T_BC = T_CD * math.cos(math.radians(angle_BC))
print(f"Tension in BC (T_BC): {T_BC:.2f} N")
```

```
Tension in CD (T_CD): 294.30 N
Tension in AC (T_AC): 147.15 N
Tension in BC (T_BC): 208.10 N
```

In [14]:

```
#Pgm 5
from math import sin, cos, tan, radians
man_weight = float(input('Enter the weigth of the Man: '))
cart_weight = float(input('Enter the weigth of the Cart: '))

theta = 16.667

# To find T
T = float('{:.2f}'.format((cart_weight * sin(radians(theta))) / cos(radians(40))

#To Find N
N = float('{:.2f}'.format(man_weight * sin(radians(theta)) + T * cos(radians(40)

#To Find F
F  = float('{:.2f}'.format(man_weight * cos(radians(theta)) + T * cos(radians(40

#To Find Mu
print(f"The Co-efficient of Friction is: {'{:.3f}'.format(N/F)}")

#To Find Distance
dist = '{:.2f}'.format((T * 175 * sin(radians(40 + theta)) + T * 850 * cos(radia
print(f"The Minimum Distance is: {dist}")
```

```
The Co-efficient of Friction is: 0.398
The Minimum Distance is: 126.02
```

In [17]:

```
#Pgm 6
from math import sin, cos, tan, radians
painter_weight = float(input('Enter mass of the painter: '))
ladder_weight = float(input('Enter the mass of the ladder: '))
ladder_height = float(input('Enter Ladder Height: '))
static_friction = float(input('Enter the Co-Efficient of static friction: '))


#To Find Na
N_a = painter_weight * 9.81 + ladder_weight * 9.81

#To Find X
X = (N_a * 1.5 - ladder_weight * 9.81 * 0.75 - static_friction * N_a * 3.71 ) /
X = float('{:.3f}'.format(X))
D = 1.5 - X
cosine_of_ladder = ladder_height / 1.5

#To Find Distance S
S = D * cosine_of_ladder

print(f'The Maximum Distance that Painter Can Climb without Sliping is: {'{:.2f}
```

```
The Maximum Distance that Painter Can Climb without Sliping is: 2.55 m
```