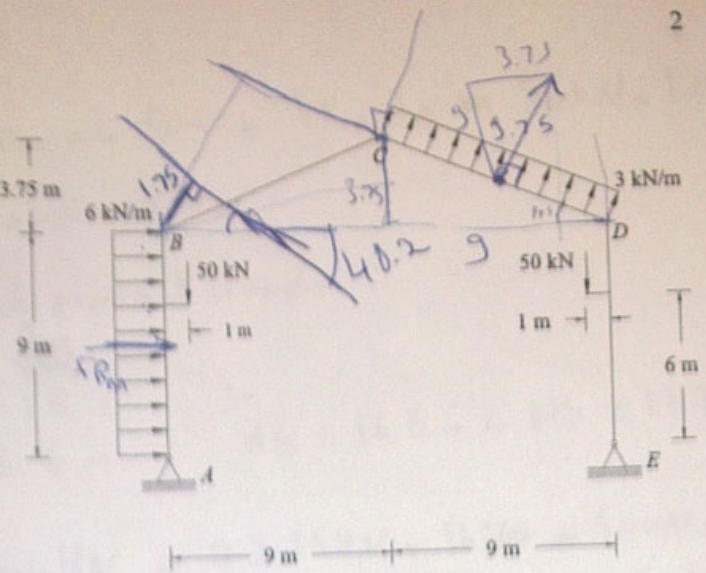
PROBLEM 1: **(30 points)**

Replace all the loading by an equivalent resultant force and specify where its line of action intersects member ***BC*** measured from point ***B***.

N.B.:

The distributed loads are perpendicular to the members on which they act.



Loading on AB:

$FR_{AB} = 6\,kN/m \times 9\,m = 54\,kN$

$\bar{x}_{AB} = \frac{9\,m}{2} = 4.5\,m$ from B, the point of application is of the center of BA.

$CD = \sqrt{3.75^2 + 9^2} = 9.75\,m$

Loading on CD:

$FR_{CD} = 3\,kN/m \times 9.75\,m = 29.25\,kN$

$\bar{x}_{CD} = \frac{9.75}{2} = 4.875\,m$

$+\uparrow \sum F_y = -50\,kN + (-50\,kN) + \left(\frac{9}{9.75} \times 29.25\,kN\right)$

$= -100\,kN + 27\,kN = -73\,kN = 73\,kN \downarrow$

$\sum f_x = 54\,kN + 29.25\,kN \times \frac{3.75}{9.75}$

$\rightarrow = 65.25\,kN \rightarrow$

$\sum F = \sqrt{F_x^2 + F_y^2} = \sqrt{73^2 + 65.25^2} = 98\,kN$

$\tan\theta = \frac{73}{65.25} \Rightarrow \theta = 48.2$, $\measuredangle 48.2°$

$\Sigma M_B \curvearrowleft = F_{R_{BA}} \times 4.5m + F_{R_0} d_B = 50kN \times 1m$
$- 50kN \times 17m$

d_B: Ration of proportional triangles.

$\frac{9}{9.75} = \frac{d_B}{18}$

$d_B = 16.6m$ $\quad d_B = 16.6 - 4.875 = 11.725$

$\Sigma M_B = 4.5 \times 54kN + 29.25kN \times 11.725 - 50kN \times 1m$
$- 50kN \times 17m$

$\Sigma M_B = 177.45 N.m$

$= 314N = 314 N.m$

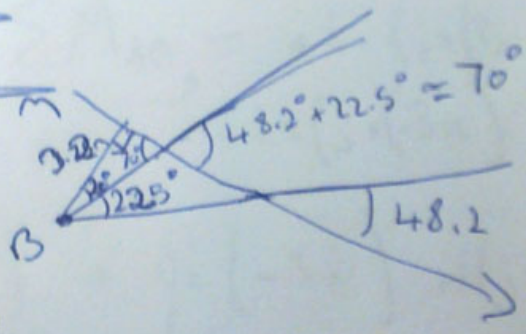
$\Sigma M_{B_1} = \int R \cdot x_1 = 98x \; kN.m$

$314 = 98x \qquad = 98x \; kN.m$

$177.45 = 98x$

$x_1 = 1.75m$

$x = 3.2m$



$\cos 20° = \frac{B_0 2}{d_B}$

the answer
$x = 1.86$

the answer is 3.4m

$\cos 20 = \frac{4}{3}$

PROBLEM 2: (40 points)

The uniform plate *ABCD* has a weight of 3 kN and is supported by hinges at *A* and *B* and the cable *CE*, and is loaded by the force at *D*. The edge of the plate to which the hinges are attached lies in the z-x plane, and the axes of the hinges are parallel to the line through points *A* and *B*. The hinges are properly aligned and thus do not exert moment reactions on the plate, and the hinge at *B* does not exert any force along line through points *A* and *B*, that is the reaction vector at *B* is perpendicular to line *AB*.

Determine the reactions exerted by the hinges on the plate, and the tension in the cable *CE*.

N.B.: the order by which the tension in the cable *CE*, and the reactions at *A* and *B* are calculated is not important.

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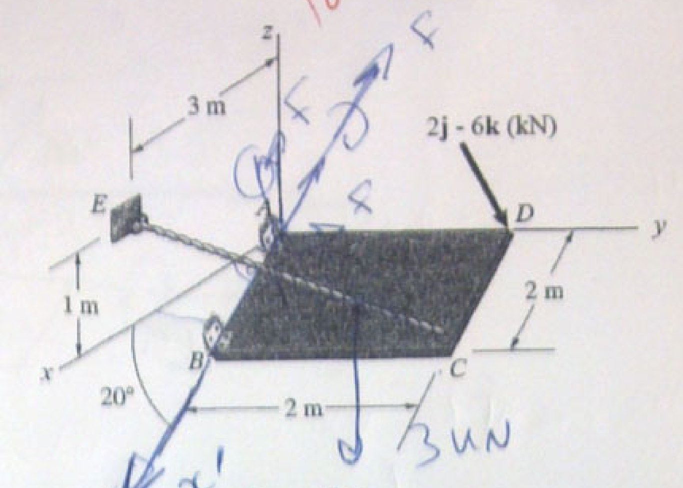


~~RCE = Using x'yz axis~~

$R_{CE} = (-10)i$

Using the x'yz axis:

$\sum M_{AB} = +i\cdot(j\times(2j-6k)) + i\cdot(j\times(-3k)) + i\cdot(j\times u_{EC}) = 0$

$\sum M_{AB} = i\cdot(-6i) + i\cdot(-3i) + i(j\times u_{EC}) = 0$

$= -9 + i\cdot(j\times u_{EC}) = 0$

$9 = i\cdot(j\times(u_i + u_j + u_k)) =$

$i\cdot(u_k + u_i) = 9$

$u_{EC} = 9$

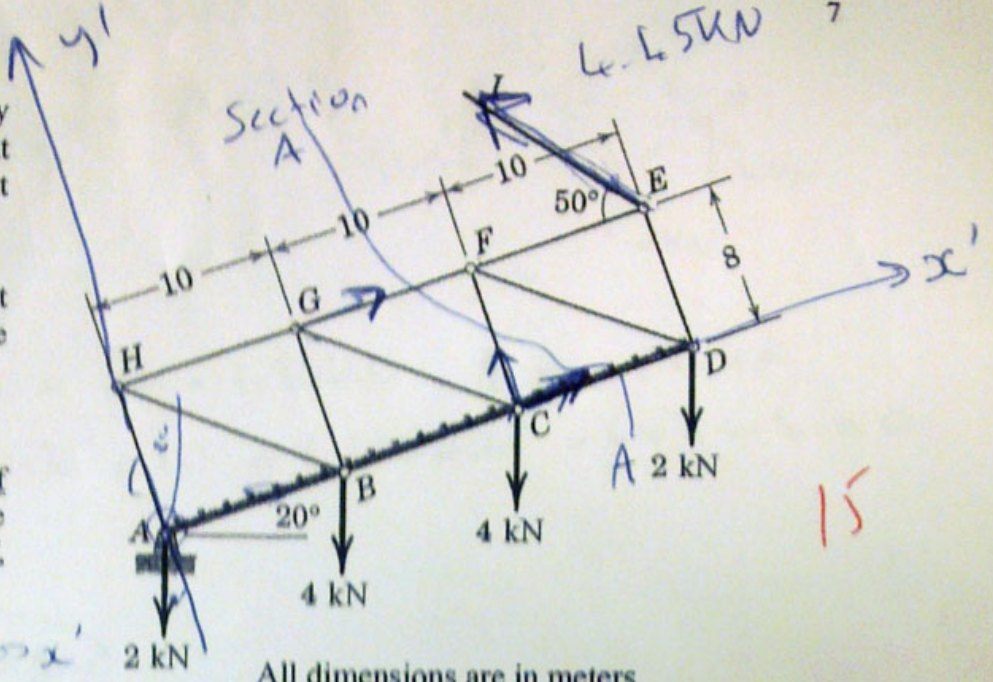
$F_{CE} = 9\ kN$

PROBLEM 3: **(30 points)**

A bridge is being raised by cable ***EI***. The four joint loads result from the weight of the roadway.

Determine the reactions at the pin-support ***A*** and the tension in cable ***EI***.

Using the method of sections, determine the forces in members ***CD***, ***CF***, and ***FG*** of the bridge.



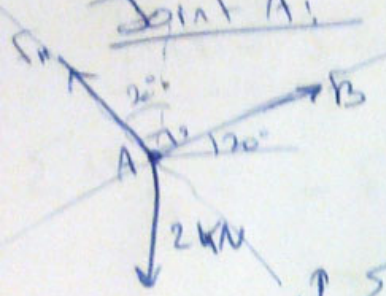
All dimensions are in meters

4.45KN

7

15

Joint A:



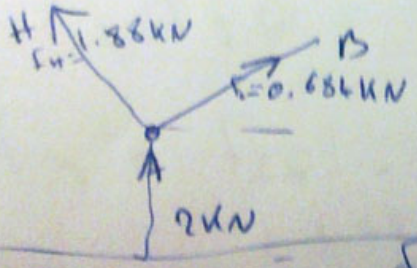
$+\uparrow \sum F_y = -2KN + F_H \cos 20° + F_B \sin 20° = 0$

$+\uparrow \sum F_{y'} = F_H - \cos 20° \times 2KN = 0$

$F_H = 1.88\,KN$

$+\nearrow \sum F_{x'} = F_B - \sin 20° \times 2KN = 0$

$F_B = 0.684\,KN$



$= F_H + 2KN \cos 20°$

$\sum F_{extaal\ y'} = 1.88KN + 2KN \cos 20° + F_{IE} \sin 50° = 0$

$F_{IE} \sin 50° =$

$= 1.88KN - 2KN \cos 20° + F_{IE} \sin 50° - 4KN \sin 20°$
$- 4KN \sin 28° - 2KN \sin 20° = 0$

$F_{IE} \sin 50° = 3.42KN$