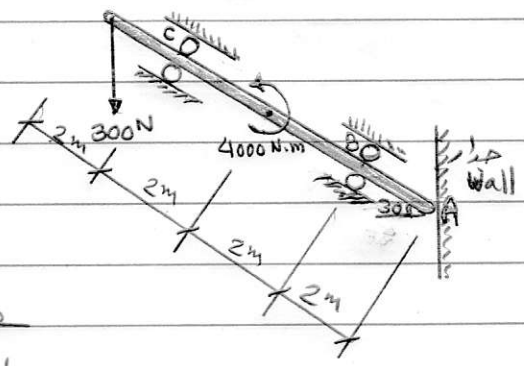
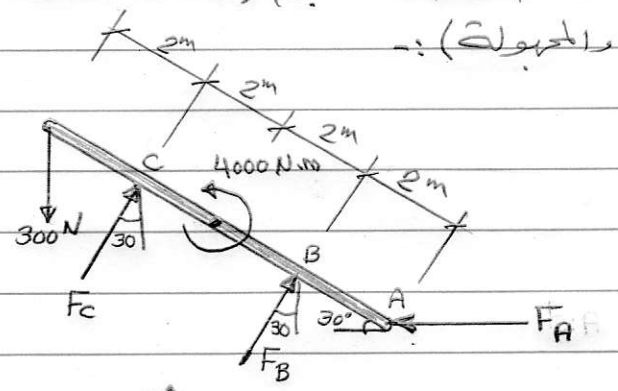
Ex: The uniform smooth rod shown in figure is subjected to a force and couple moment. If the rod is supported (يستند) at (A) by a smooth wall, and at (B) and (C) either at the top or bottom by rollers. Determine the reactions at these supports (المساند). Neglect the weight of the rod.

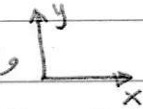


Solution :-

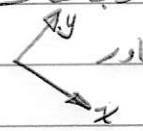
* العصا (rod) عند نقطة (A) تستند على جدار املس، لذلك فأن رد الفعل هو قوة واحدة عمودية على سطح الجدار.
* عند النقاط (B) و (C) هناك مساند نوع (roller)، اذن هناك قوة واحدة عند كل مسند عمودية على سطح الجسم.
* نرسم FBD للجسم (rod) مؤشراً عليه جميع القوى والعزوم المؤثرة (المعلومة والمجهولة) :-



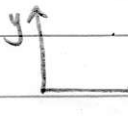
* يمكن ان نحدد المحاور ونحلل القوى الى مركباتها على هذه الاتجاهات.



* أو يمكن ان نحدد المحاور ونحلل القوى الى مركباتها على هذه الاتجاهات.

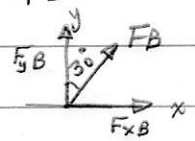


* سيتم اعتماد المحاور في الحل.



$\vec{F}_B$; $F_{xB} = F_B \sin 30$ — arm to point A = $2 \sin 30°$ m

$F_{yB} = F_B \cos 30$ — arm to point A = $2 \cos 30°$ m



$\vec{F}_C$; $F_{xC} = F_C \sin 30°$ — arm to point A = $6 \sin 30°$ m

$F_{yC} = F_C \cos 30°$ — arm to point A = $6 \cos 30°$ m

$\vec{F} = 300^N \downarrow$ — arm to point A = $8 \cos 30°$

$M = \circlearrowleft 4000^{N.m}$

$\Sigma \vec{M}_{@A} = 0$

$\therefore +(300)(8\cos 30) - (F_C \cos 30)(6\cos 30) - (F_C \sin 30)(6\sin 30)$
$- (F_B \cos 30)(2\cos 30^\circ) - (F_B \sin 30)(2\sin 30) + 4000 = 0$

$2078.46 - 4.5 F_C - 1.5 F_C - 1.5 F_B - 0.5 F_B + 4000 = 0$

$6078.46 = +6 F_C + 2 F_B$

$\therefore F_B = 3039.23 - 3 F_C$ ——— ①

$\Sigma \vec{F}_y = 0$

$-300 + F_B \cos 30 + F_C \cos 30 = 0$

$0.866 F_B + 0.866 F_C = 300 \Rightarrow \therefore F_B + F_C = \frac{300}{\cos 30}$

$\therefore F_B = 346.41 - F_C$ ——— ②

بحل المعادلتين ① و ② :

$\therefore 3039.23 - 3F_C = 346.41 - F_C$

$\therefore F_C = 1346.41^N$ نفس الاتجاه الذي تم فرضه

and $F_B = 346.41 - (1346.41) \Rightarrow \therefore F_B = -1000^N$ عكس الاتجاه الذي تم فرضه

Now; $\Sigma \vec{F}_x = 0$

$\therefore F_{xB} = F_B \sin 30 \Rightarrow \therefore F_{xB} = (-1000)(\sin 30) = -500^N$ or 500 ←

$F_{xC} = F_C \sin 30^\circ \Rightarrow \therefore F_{xC} = (1346.41)(\sin 30^\circ) = 673.2^N$ or 673.2 →

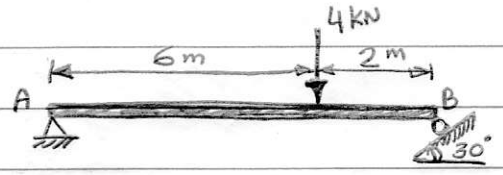
$\therefore \Sigma \vec{F} = 0$

$-F_A - 500 + 673.2 = 0$

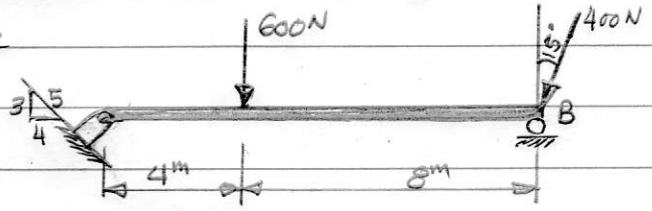
$\therefore F_A = 173.2^N$ نفس الاتجاه الذي تم فرضه

H.W

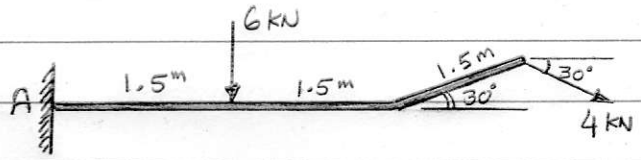
H.W. ① Determine the horizontal and vertical components of reaction at the pin (A) and the reaction of the rocker (roller) at (B) on the beam.



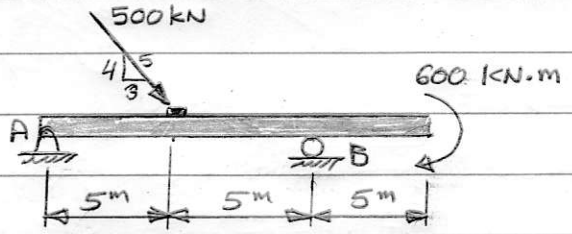
H.W. ② Determine the magnitude of the reactions on the beam at (A – pin) and (B – roller). Neglect the thickness of the beam.



H.W. ③ Determine the components of the support reactions at the fixed support (A) on the cantilevered beam.



H.W. ④ Determine the horizontal and vertical components of reaction at the supports (A) and (B). Neglect the thickness of the beam.



H.W. ⑤ Determine the components of reaction at the fixed support (A). Neglect the thickness of the beam.