Equilibrium of force system اتزان نظام القوى

Definition and meaning of equilibrium تعريف ومعنى الاتزان
Such bodies بعض الاجسام **are said to be** يقال انها **in equilibrium** في حالة اتزان

Equilibrium الاتزان **is the term** مصطلح **used** يستخدم **to designate** وصف **the condition** حال **where the resultant** محصلة القوى **of system of farce is zero . A body is said to be in equilibrium when Resultaut** محصلة **of force system** نظام القوى **acting on body is zero – the physical meaning** المعنى الفيزياوي **of equilibrium the body either** أما **at (rest) or moving on straight line** يتحرك على خط مستقيم **with constant velocity** سرعة ثابتة .

Equilibrium of concurrent forces اتزان القوى الملتقية

When the concurrent forces are in equilibrium the resultant of concurrent force is zero (R = 0)
So we applied .

$$R_X = 0$$
$$R_Y = 0$$

Equilibrium of none concurrent forces اتزان القوى غير الملتقية

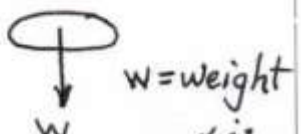
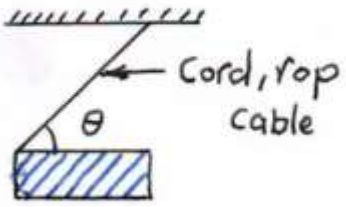
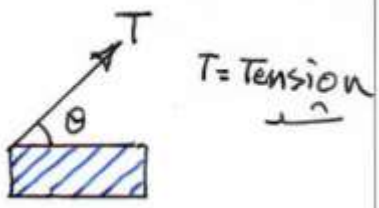
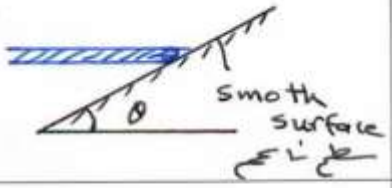
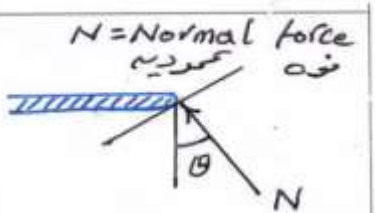
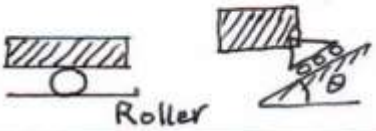
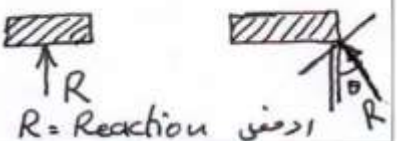
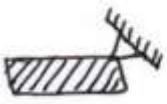
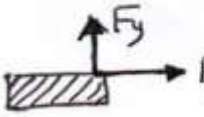
When the none concurrent forces are in equilibrium the resultant of the non concurrent forces is zero (R = 0) . so we

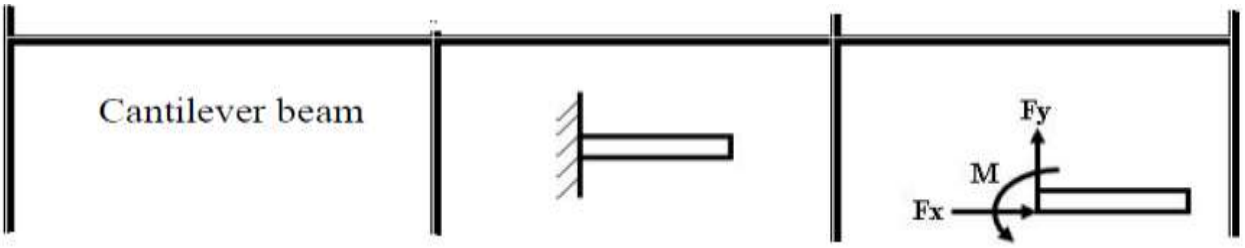
applied there equation to solve problem .

$$RX = 0$$
$$RY = 0$$
$$\sum M = 0$$

Free body Diagram رسم الجسم الحر

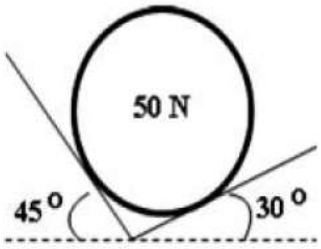
Problems مسائل in mechanics الميكانيك always دائما involve يحتوي the interaction ارتباط of bodies الأجسام up on one another على بعضها successful solution الحلول الناجحة of these problems المسائل generally عموماً requires يتطلب that the bodies be isolated تنفصل from one another عن بعضها so that the forces involved تتضمن may be Analized and unknown forces determine . An isolated معزول view مسقط of body is called a free body diagram (F . B . D)

Type of body removed نوع الجسم المحذوف	Sketch of reacting bodies رسم الاجسام المتصلة	Acting of a body removed up on free body تأثير الجسم المحذوف على الجسم المعزول
Earth الارض		
Cord وتر Rope حبل Cable حبل معدني (weight is neglected) وزنه محذوف		
Smooth surface سطح ناعم		
Roller رولة أو اسطوانة		
Smooth pin orhing بيم		

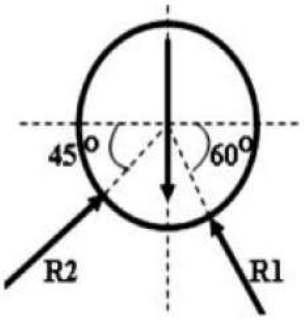


Ex (1) :

Draw Free – body diagram for the **50 N** sphare shown in fig.

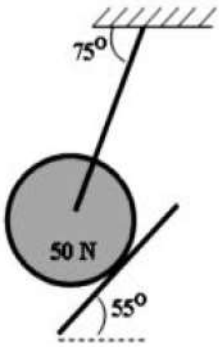


Solution

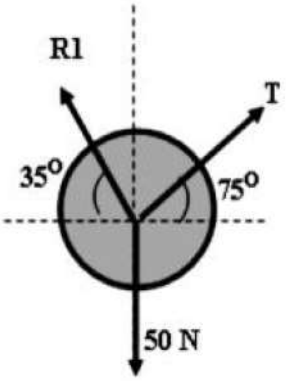


Ex (2) :

Draw Free – body diagram for the **50 N** sphare shown in fig.

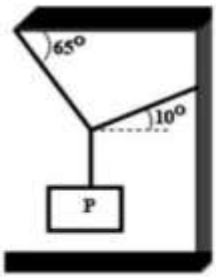


Solution

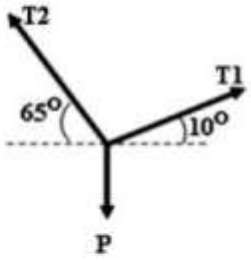


Ex (3) :

Draw Free – body diagram for the ropes system shown in fig.

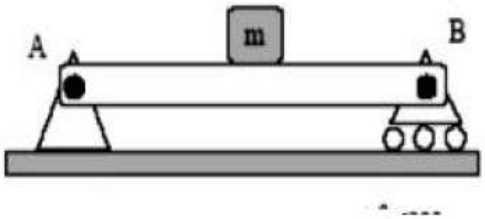


Solution

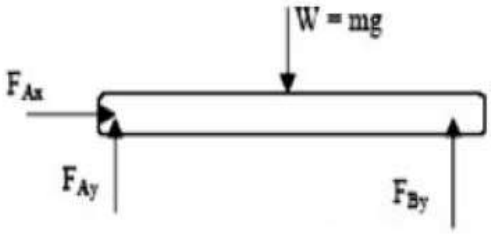


Examples

Mass at mid-point on beam (length L)



Free body diagram



Q// If th concurrent forces shown in Fig are in equilibrium find (F) And(θ) .

بما ان القوى الملتقية في حالة اتزان لذا فأن (R = 0)

$R_X = 0$ $R_Y = 0$

$R_X = 0$

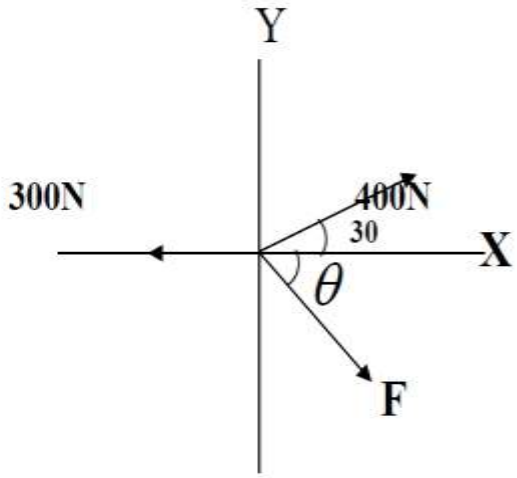
400cos 30 + Fcos θ - 300 =0

Fcos θ = 300-400 * 0.866

Fcos θ =300 – 346.4

$F_X = F\cos\theta = -46.4$ N

FX = 46.4 N ←



$R_Y = 0$

$400\sin 30 - F\sin\theta = 0$

$F\sin\theta = 400*0.5$

$F_Y = F\sin\theta = 200N$

F_Y = 200 N ↑

$$\tan\theta = \frac{F_Y}{F_X}$$

$$\tan\theta = \frac{200}{46.4}$$

$$\tan\theta = 4.31$$

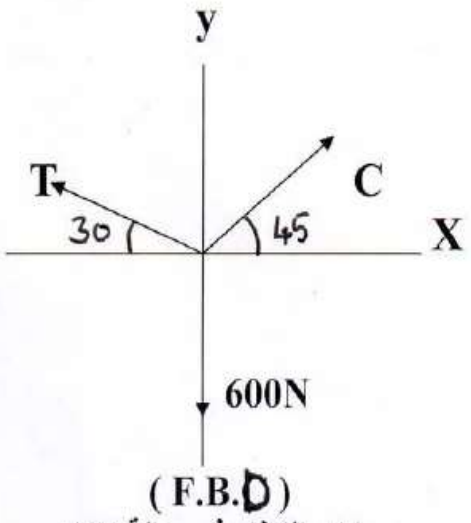
$$\theta = 76.9^0$$

$$F = \sqrt{F_X^2 + F_Y^2}$$

$$F = \sqrt{(46.4)^2 + (200)^2}$$

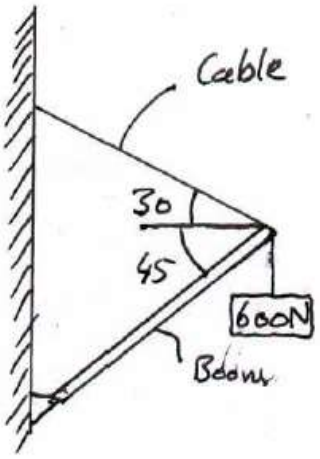
$$F = 205N$$

Q/ The cable حبل معدني and Boom ذراع الرافعة shown in Fig . Support a load of (600N) . ~~Detrains~~ أحسب determine the tensile force قوة الشد(T) in the cable and compressive force قوة الضغط (C) in the Boom ذراع الرافعة .when the system is in aquarium ?



(F.B.D)

بما ان النظام في حالة اتزان



$R = 0$

$R_X = 0$, $R_Y = 0$ لان القوى ملتقية

$R_X = 0$

$C \cos 45 - T \cos 30 = 0$

$C \cos 45 = T \cos 30$

$$C = \frac{T * 0.866}{0.707} \rightarrow (1)$$

$R_Y = 0$

$C \sin 45 + T \sin 30 - 600 = 0$

من ١

$$\frac{T * 0.866}{0.707} * 0.707 + 0.5T = 600$$

نعوض في ١

$0.866T + 0.5\,T = 600$

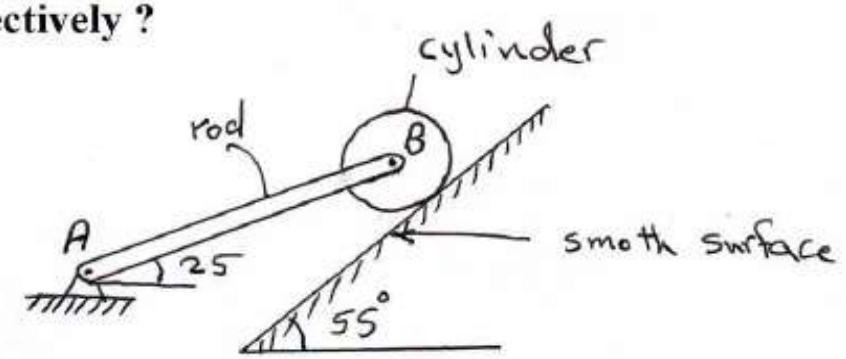
$1.366T = 600$

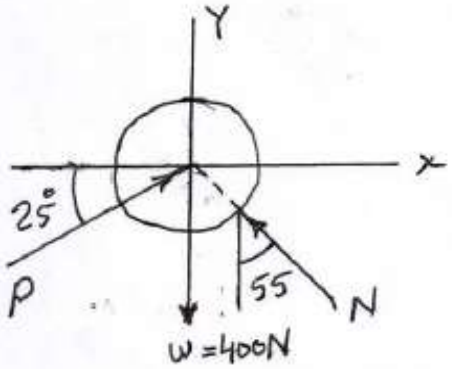
$$C = \frac{439 * 0.866}{0.707}$$

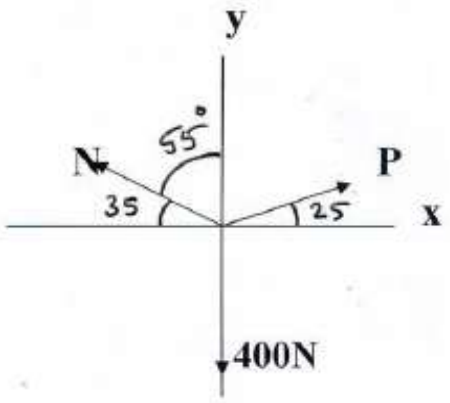
$C = 538\,N$

$T = 439$ N

Q/ A cylinder اسطوانة weighting وزنها (400N) is held مسندة against a smooth incline سطح مائل املس by means of the weight less rod (AB) as show in Fig . Determine احسب the force (P) and (N) exerted on the cylinder by the rod (AB) and the incline respectively ?







بما ان القوى ملتقية وفي حالة اتزان

$R = 0$

$R_X = 0$ $\qquad$ $R_Y = 0$

$R_X = 0$

$P\cos 25 - N\cos 35 = 0$

$0.906 = 0.819\ N$

$$P = \frac{0.819}{0.906} N$$

$P = 0.903\ N$ ——— (1)

$R_Y = 0$

$P\sin 25 + N\sin 35 - 400 = 0$

$0.903 * 0.423 + 0.574 = 400$

$0.954\ N = 400$

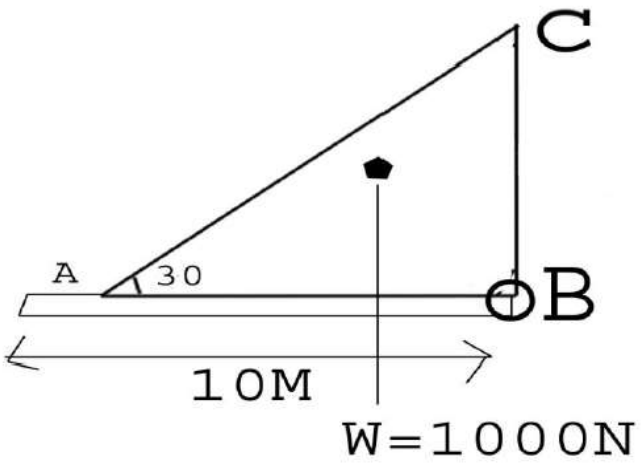
$$N = \frac{400}{0.954}$$

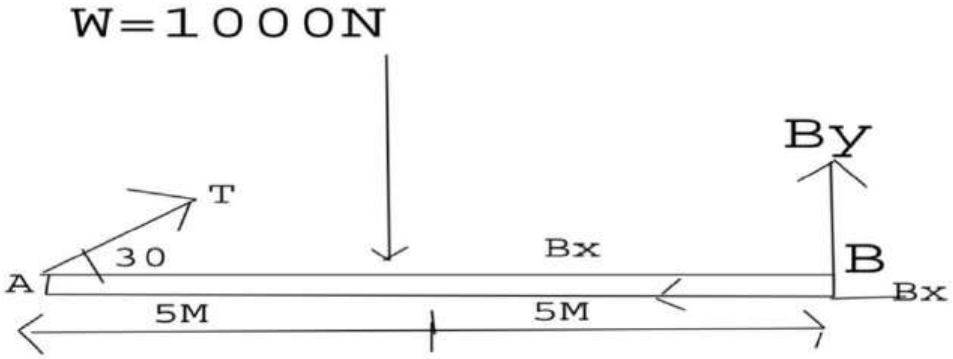
$N = 419\ N$

$P = 0.903 * 419$ من 1

$P = 378\ N$

The bar (AB) weight (1000)N and is supported by a cable (AC) and a pin c at (B). Determine the reaction at (B) and the tension in the cable?





$\Sigma MA=0 = -1000(5) + By(10)$

$By = 5000/10 = 500\ N.m$

$Ry = 0 = -1000 + By + T \sin 30^0$

$-1000 + 500 + T(0.5) = 0$

$T = 1000N$

$Rx = 0 = -Bx + T \cos 30^0$

$Bx = 1000(0.866)$

$Bx = 866\ N$