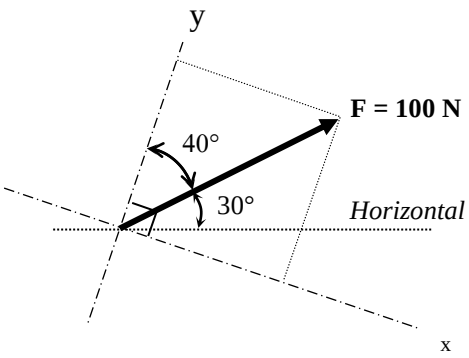
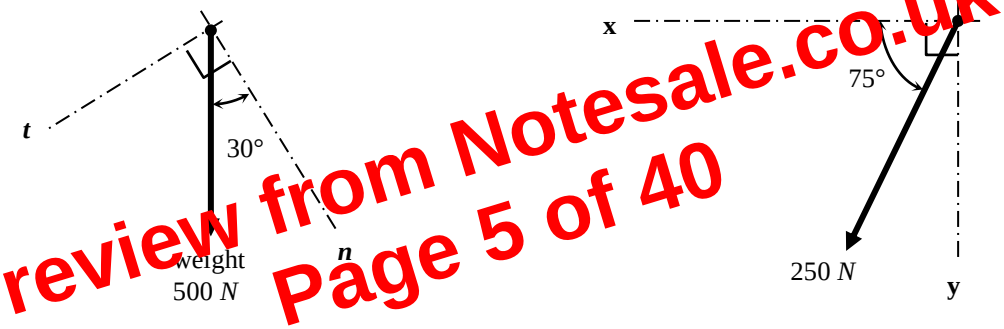
Example 2.2

Resolve the 100 *N* force along the x- and y- axes. *Follow the steps as in Example 2.1*



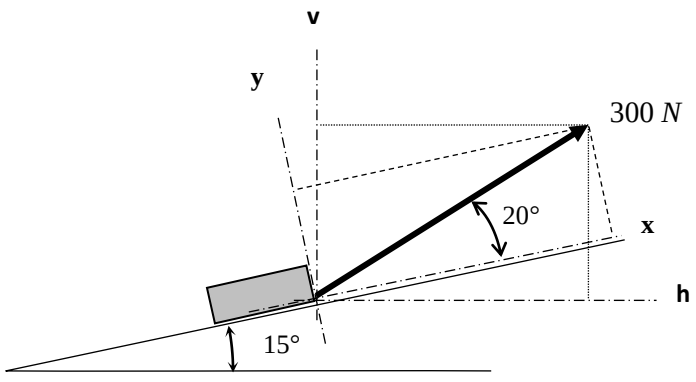
TUTORIAL

2.1 Resolve the given forces into the specified directions. *(Follow the steps as in Example 2.1)*



(a) (b)

2.2 Resolve the 300 *N* pulling force (tension) into rectangular components in
(a) the **x** and **y** directions.
(b) the **vertical** and **horizontal** directions



Answers :

2.1 (a) $F_n = 433\ N$
$F_t = 250\ N$

2.1 (b) $F_x = 64.71\ N$
$F_y = 241.5\ N$

2.2 (a) $F_x = 281.9\ N$
$F_y = 102.6\ N$

2.2 (b) $F_v = 172.1\ N \uparrow$
$F_h = 245.7\ N \rightarrow$

2.5 Addition of Moments

If more than one force or its components act on a body, the **resultant moment (ΣM)**, is the algebraic sum of all the moments acting about the same point. If clockwise moment is taken as ***positive*** then anticlockwise will be ***negative***, or vice versa.

Example 2.8

Determine the resultant moment ΣM about various points, neglecting the weight of the structure. *(Resolve the force where necessary).*

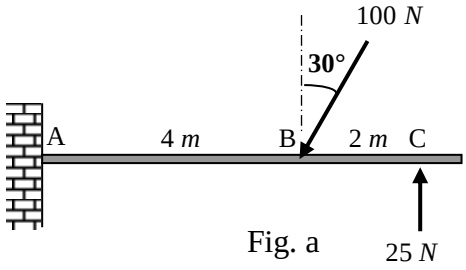


Fig. a

M_A *(for 100N force)* = _____

M_A *(for 25N force)* = _____

ΣM_A = _____

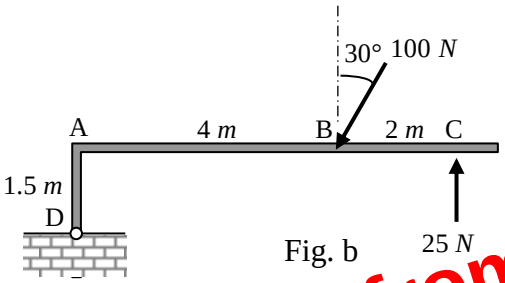


Fig. b

M_D *(for 100N force)* = _____

M_D *(for 25N force)* = _____

ΣM_D = _____

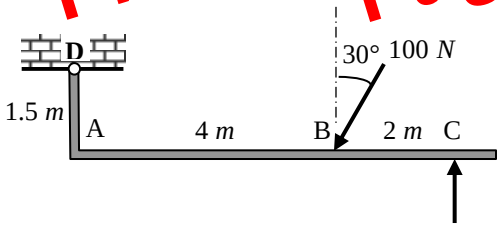


Fig. c

M_D *(for 100N force)* = _____

M_D *(for 25N force)* = _____

ΣM_D = _____

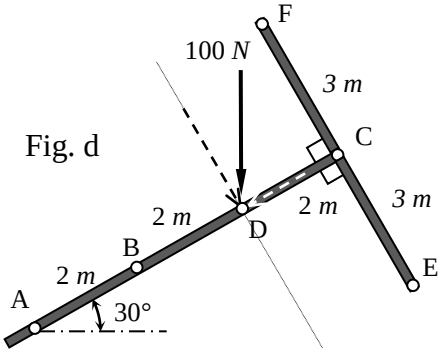


Fig. d

ΣM_A = _____

ΣM_C = _____

ΣM_E = _____

ΣM_F = _____

2.7 Calculate the moment of the given force about point A in the following cases. Indicate the resolved components. (*Ans : 58.99 Nm* ↺ *, 953.5 Nm* ↻)

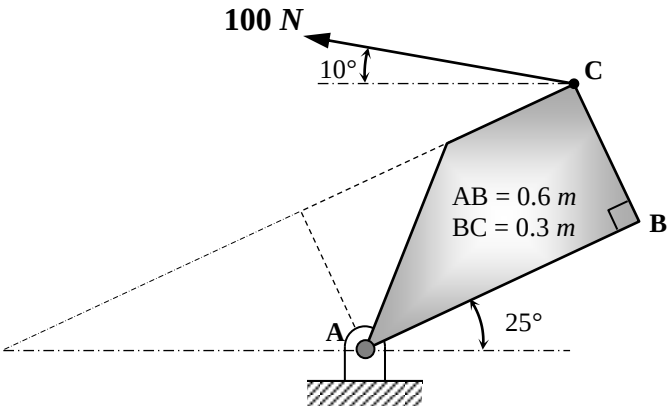


Fig. a

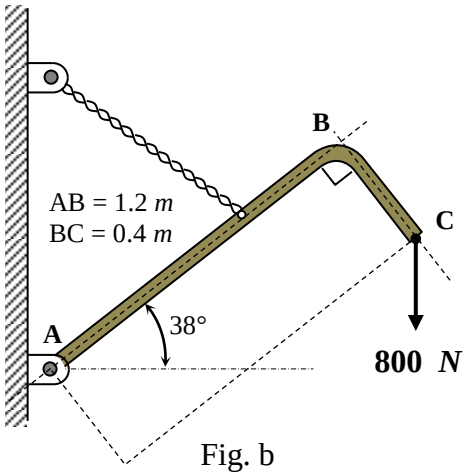


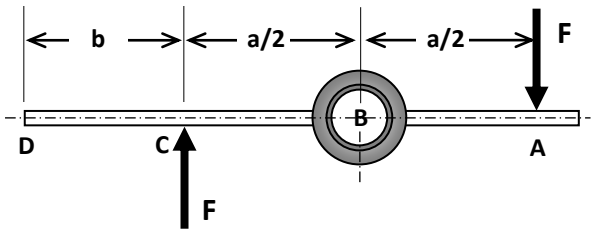
Fig. b

2.6 Couples

Couples are commonly encountered in engineering. A couple consists of two equal and opposite forces having separate lines of action. We often represent a couple with a curved arrow, i.e. (↻) or (↺)

A couple has the following characteristics:

1. *The resultant force of a couple is zero.*
2. *The moment of a couple is the product of one of the forces and the perpendicular distance between their lines of action.*
3. *The moment of a couple is the same for all points in the plane of the couple.*



For the die-holder shown, calculate the moment of the couple about points A, B, C & D.

M_A = _____

M_B = _____

M_C = _____

M_D = _____

Example 2.11

Calculate the moment of the couple applied to the steering wheel shown. Diameter of the steering wheel is 45 *cm*.

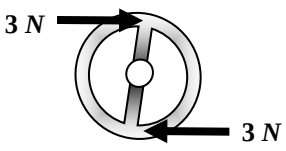
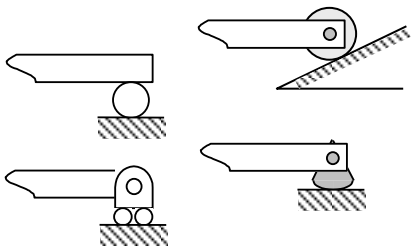
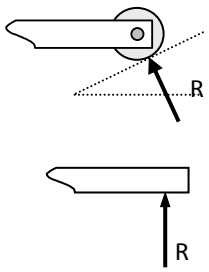
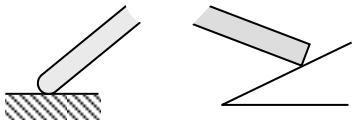
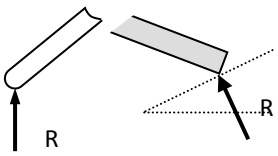
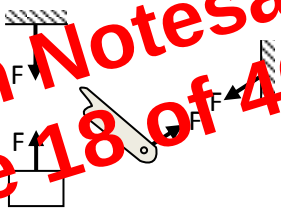
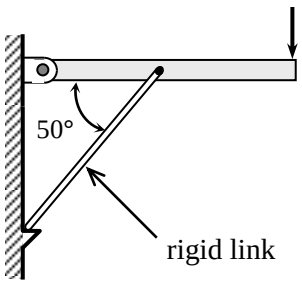
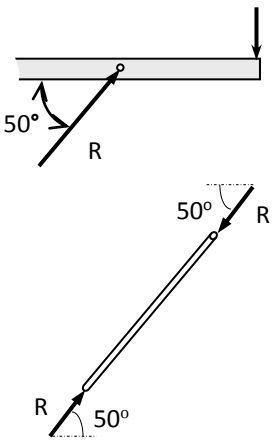


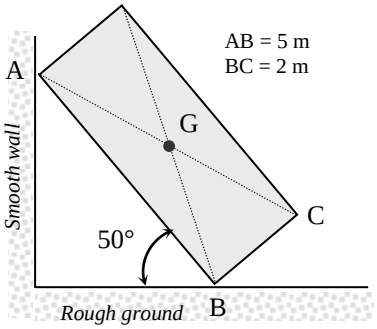
Table Showing Reactions for Various Support Types

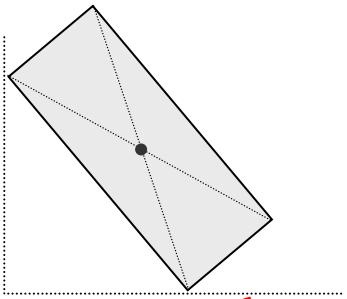
Type of Support	Direction of reaction	No. of unknowns
1. Rollers 		**1** unknown reaction. Direction is **normal** to the supporting surface.
2. Smooth surfaces 		
3. Cables/chain 		**1** unknown tension F pulling **away** from the body.
4. Rigid links *or* bars 		**1** unknown reaction. Direction **along** the link, either in compression or tension.

2.21 A 4 kN crate with its mass centre at G rests against a smooth wall as shown. Determine with the aid of a free body diagram,

a) the reaction at point A of the crate.
b) magnitude and direction of the ground reaction at B.

(0.8782 *kN* ; 4.095 *kN* ; 77.62° ⦡)

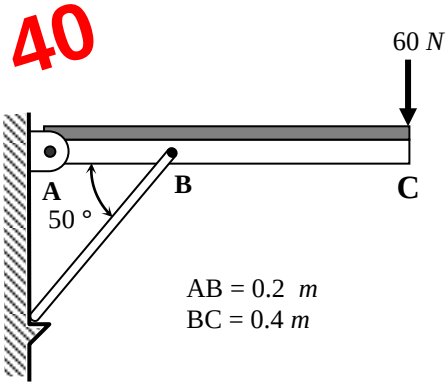


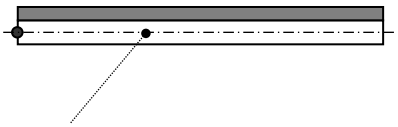


2.22 The flip-up table-top ABC weighs **20** *N* and its CG is at the middle of AC. It is supported by a hinge at A and a pin-ended bar at B which is anchored at the wall.

Calculate the reactions at A and B of the table-top.

(219 *N*, 36.4° ⦢, 274.1 *N* , ⦣ 50°)



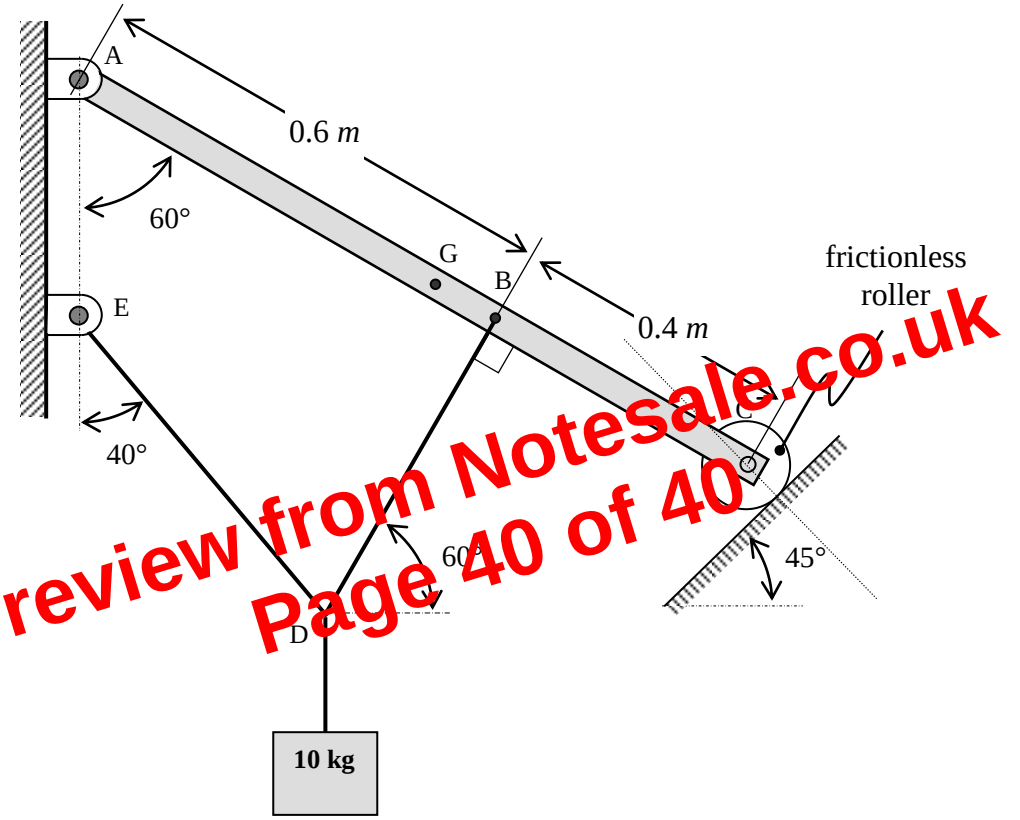


*2.29 A mass of 10 *kg* is supported by two cables DB and DE as shown in the figure. The beam ABC has a mass of 3 *kg* and is held in equilibrium by a pin at A and a frictionless roller at C.

a) Sketch a free body diagram of the point **D** and show that the tensions in the cables DB and DE are 67.1 *N* and 52.2 *N* respectively.

b) Sketch a free body diagram of the uniform beam ABC and determine:
   i) the reaction at **C**;
   ii) the reaction at **A**.

((i) R_c = 204.8 *N*, 45° ⬎ (ii) 187.4 *N*, ⬎ 17.8°)



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