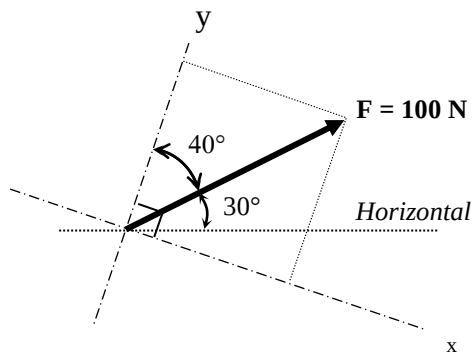
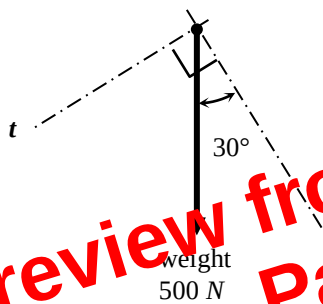


Example 2.2

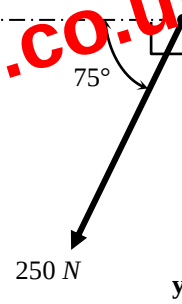
Resolve the 100 N force along the x- and y- axes. *Follow the steps as in Example 2.1*

**TUTORIAL**

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

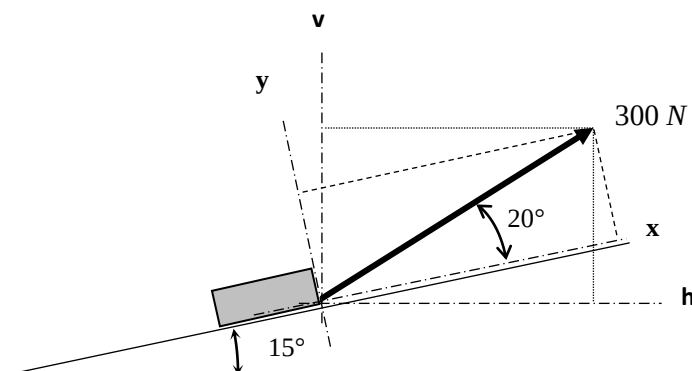


(a)



(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) $F_n = 433 \text{ N}$
 $F_t = 250 \text{ N}$

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

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

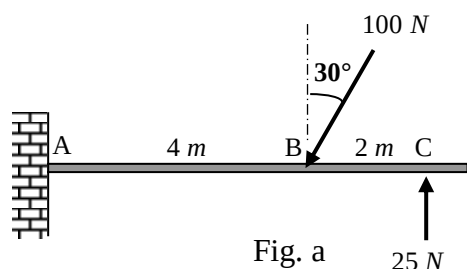
2.2 (b) $F_v = 172.1 \text{ N} \uparrow$
 $F_h = 245.7 \text{ N} \rightarrow$

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

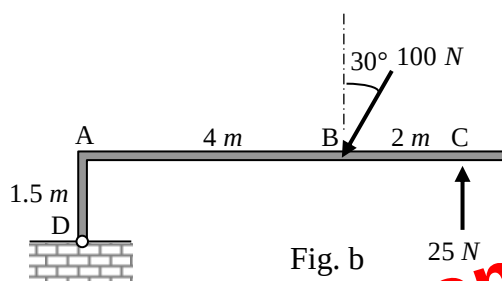
Determine the resultant moment ΣM about various points, neglecting the weight of the structure. (*Resolve the force where necessary*).



$$M_A \text{ (for 100N force)} = \underline{\hspace{2cm}}$$

$$M_A \text{ (for 25N force)} = \underline{\hspace{2cm}}$$

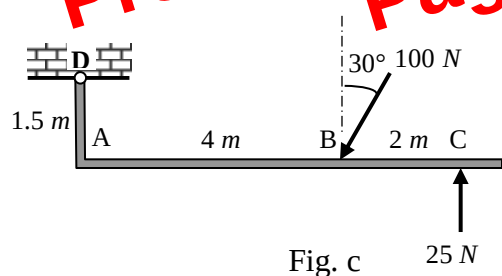
$$\Sigma M_A = \underline{\hspace{2cm}}$$



$$M_D \text{ (for 100N force)} = \underline{\hspace{2cm}}$$

$$M_D \text{ (for 25N force)} = \underline{\hspace{2cm}}$$

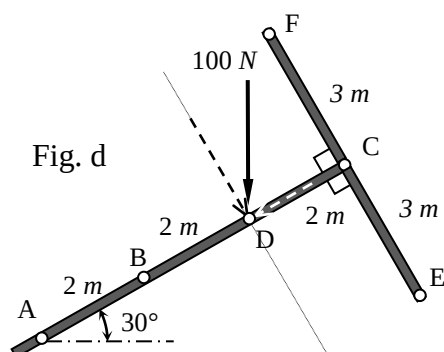
$$\Sigma M_D = \underline{\hspace{2cm}}$$



$$M_D \text{ (for 100N force)} = \underline{\hspace{2cm}}$$

$$M_D \text{ (for 25N force)} = \underline{\hspace{2cm}}$$

$$\Sigma M_D = \underline{\hspace{2cm}}$$



$$\Sigma M_A = \underline{\hspace{2cm}}$$

$$\Sigma M_C = \underline{\hspace{2cm}}$$

$$\Sigma M_E = \underline{\hspace{2cm}}$$

$$\Sigma M_F = \underline{\hspace{2cm}}$$

- 2.7 Calculate the moment of the given force about point A in the following cases. Indicate the resolved components. (Ans : $58.99 \text{ Nm } \curvearrowright$, $953.5 \text{ Nm } \curvearrowright$)

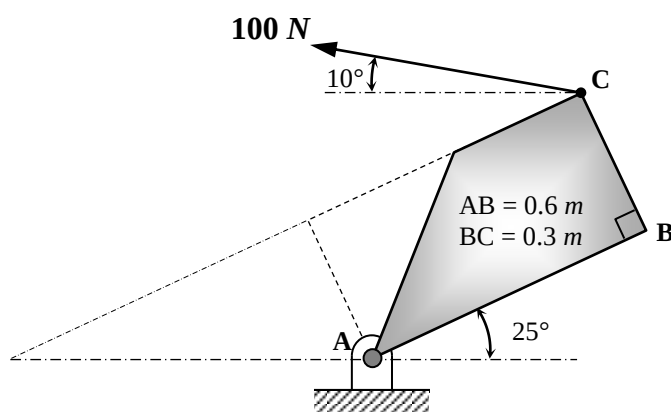


Fig. a

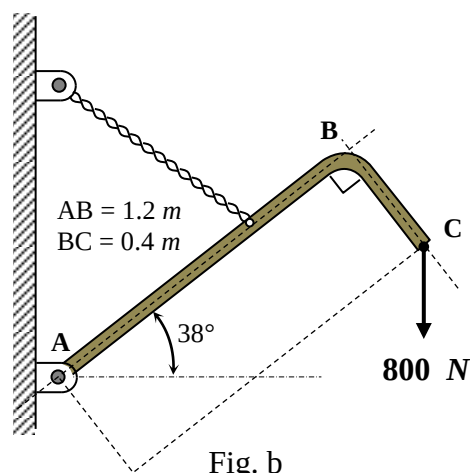


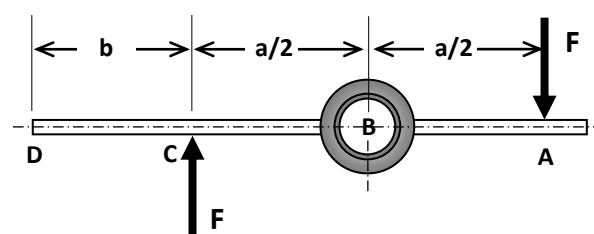
Fig. b

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. ($\curvearrowright$) or ($\curvearrowleft$)

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.

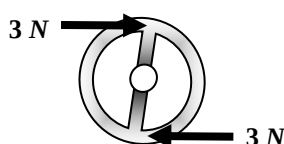
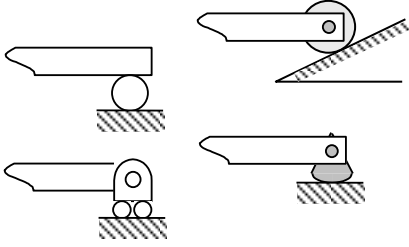
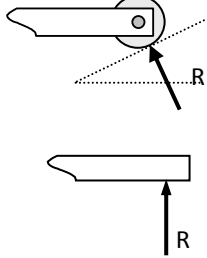
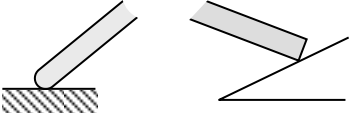
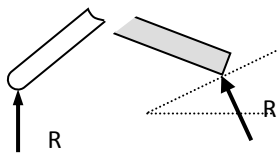
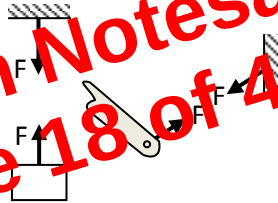
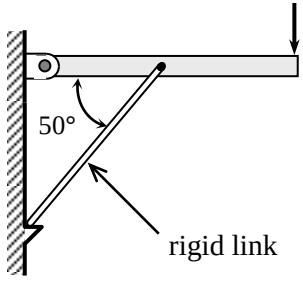
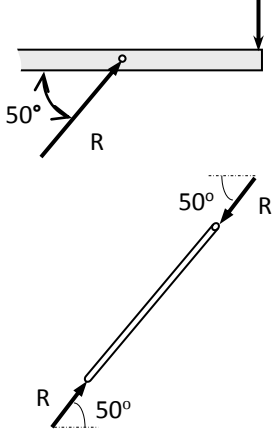


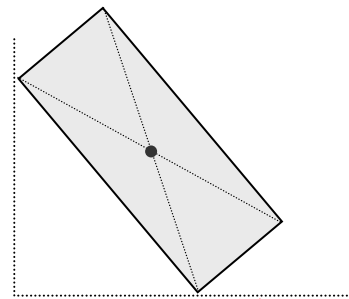
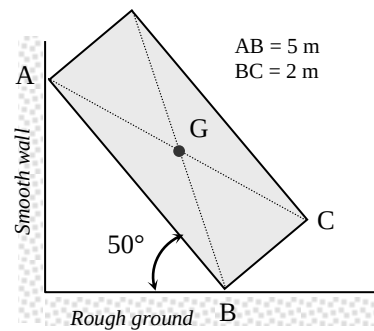
Table Showing Reactions for Various Support Types

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,

- the reaction at point A of the crate.
- magnitude and direction of the ground reaction at B.

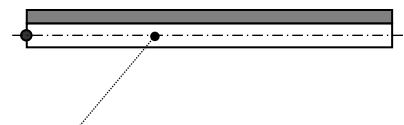
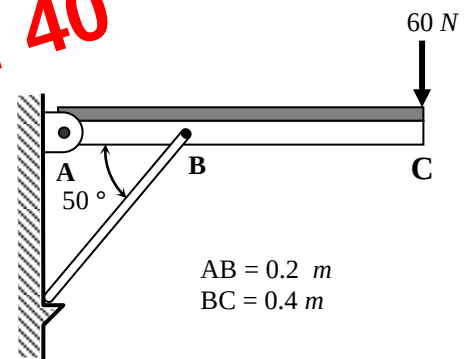
(0.8782 kN ; 4.095 kN ; $77.62^\circ \searrow$)



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 leg at B which is anchored at the wall.

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

(219 N, $36.4^\circ \nearrow$, 274.1 N, $\nearrow 50^\circ$)



*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.

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

((i) $R_c = 204.8 \text{ N}$, 45° $\searrow$ (ii) 187.4 N , $\swarrow 17.8^\circ$)

