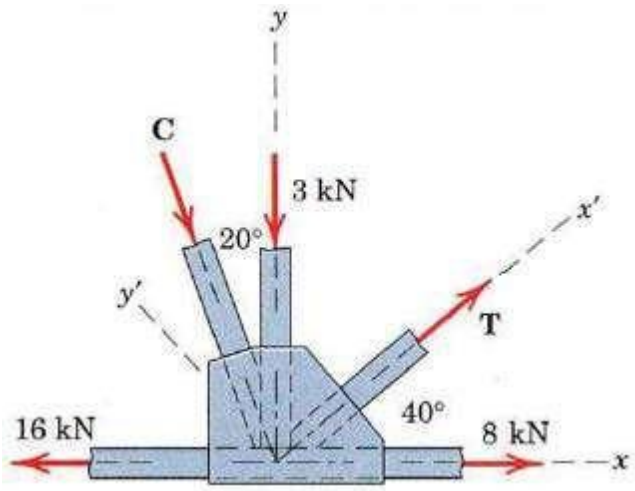
Al-Mustaqbal University / College of Engineering & Technology
Mechanical Power Techniques Department Class (1st)
Subject (Engineering Mechanics) / Code (UOMU021028)
Lecturer (Assist.lec.Teeb Basim Abbas)
1st term – Lecture No.7

Free-body diagram

Is a sketch of a body, a portion of a body, or two or more bodies completely isolated or free from all other bodies, showing the forces exerted by all other bodies on the one being considered .\

Example 1

Determine the magnitudes of the forces C and T, which, along with the other three forces shown, act on the bridge truss joint.



Solution

[ΣFx = 0] 8 + T cos 40 + C sin 20 - 16 = 0

0.766T + 0.342C = 8 ----------(1)

[ΣFy = 0] T sin 40 - C cos 20 - 3 = 0

0.643T - 0.940C = 3 ---------- (2)

Simultaneous solution of Equations (1) and (2) produces

T = 9.09 kN **C = 3.03 kN**

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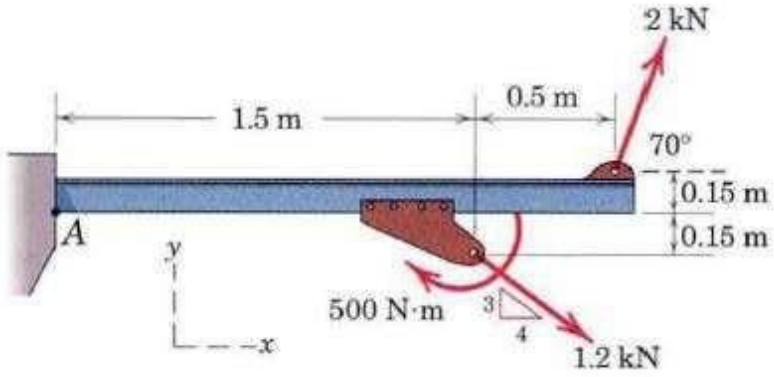
Example 2

The flanged steel cantilever beam with riveted bracket is subjected to the couple and two forces shown, and their effect on the design of the attachment at A must be determined. Replace the two forces and couple by an equivalent couple .M and resultant force Rat A.



Solution

$$R_x = F_x = 2\cos 70^o + 1.2\,\frac{4}{5} = 1.644\ KN$$

$$R_y = F_y = 2\sin 70^o + 1.2\,\frac{3}{5} = 1.159 KN$$

$$M_A = -2\cos 70^o \times 0.15 + 2\sin 70^o \times (1.5+0.5) + 1.2\,\frac{4}{5} \times 0.15 - 1.2\,\frac{3}{5} \times (1.5) - 0.5$$

$$= 2.22\ KN.m$$

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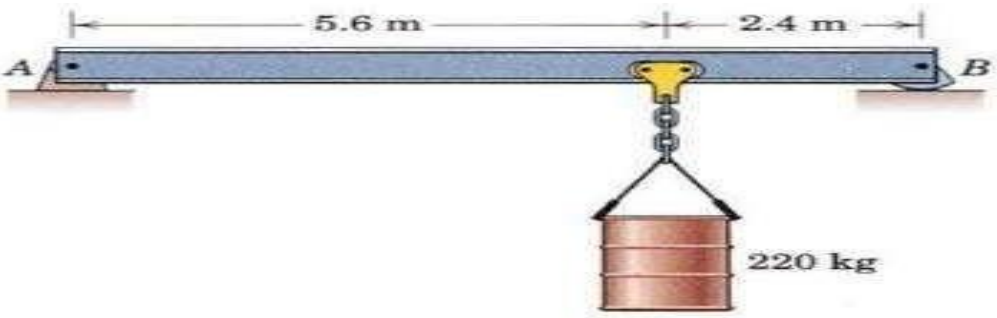
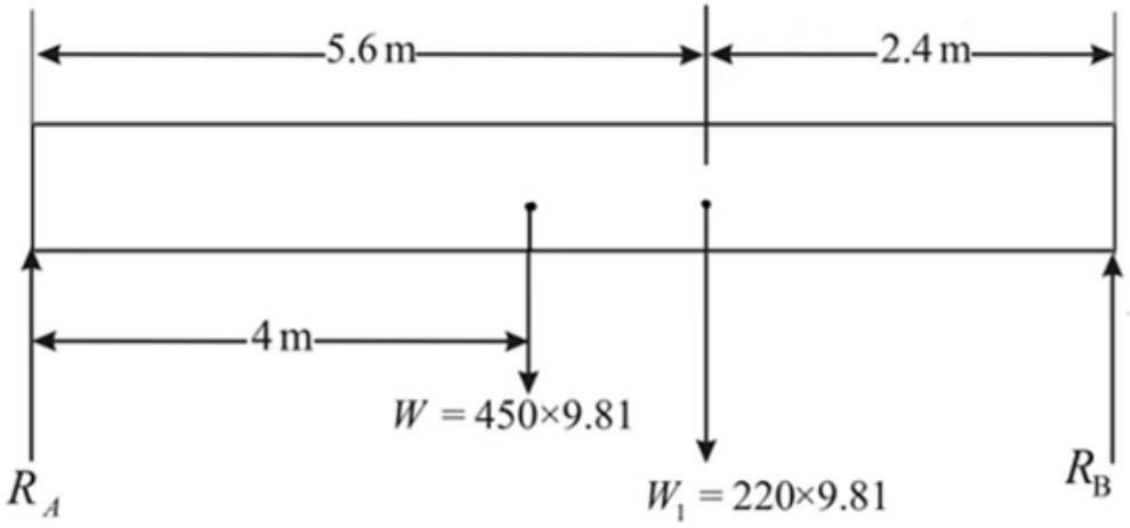
Example 3

The 450-kg uniform I-beam supports the load shown. Determine the reactions at the supports



Solution



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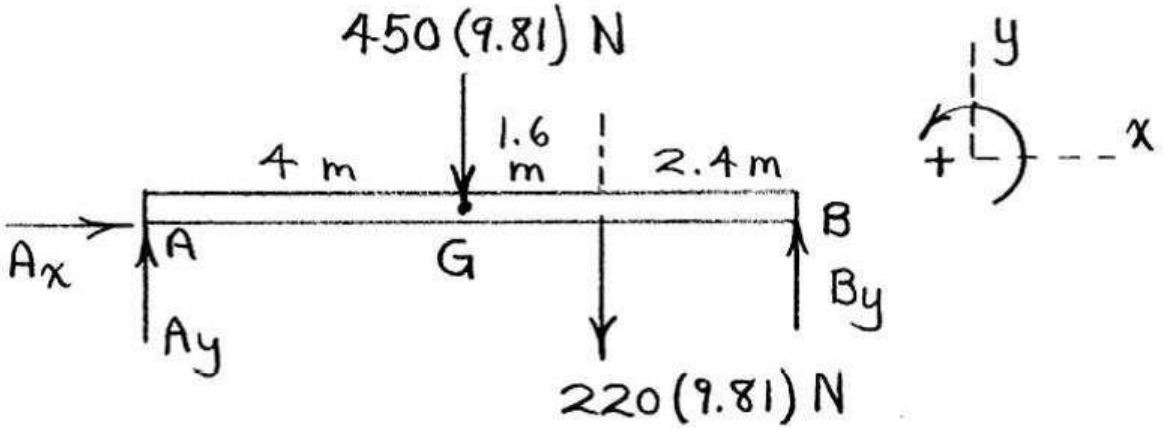

Fx = 0

Fy = 0

Ax =0

M_A= 0

0 = -450 × 9.81 × 4 -220 × 9.81 ×5.6 + By ×8

By = 3720 N

Fy = 0

Fy = Ay -450 × 9.81 -220 × 9.81 + By

0 = Ay -450 × 9.81 -220 × 9.81 + 3720

Ay = 2850N

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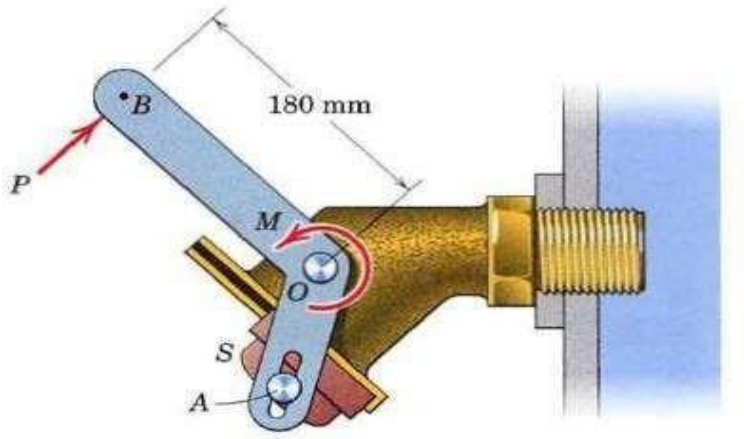
Example 4

The elements of a heavy-duty fluid valve are shown in the figure. When the member DB rotates clockwise about the fixed pivot O under the action of the force P the element S slides freely upward in its slot, releasing the flow. If an internal torsional spring exerts a moment M = 20 N·m as shown, determine the force P required to open the valve. Neglect all friction



Solution

$M = F \times d$

$20 = P \times 0.180$

$P = \frac{20}{0.180}$

$= 111.1\ N$

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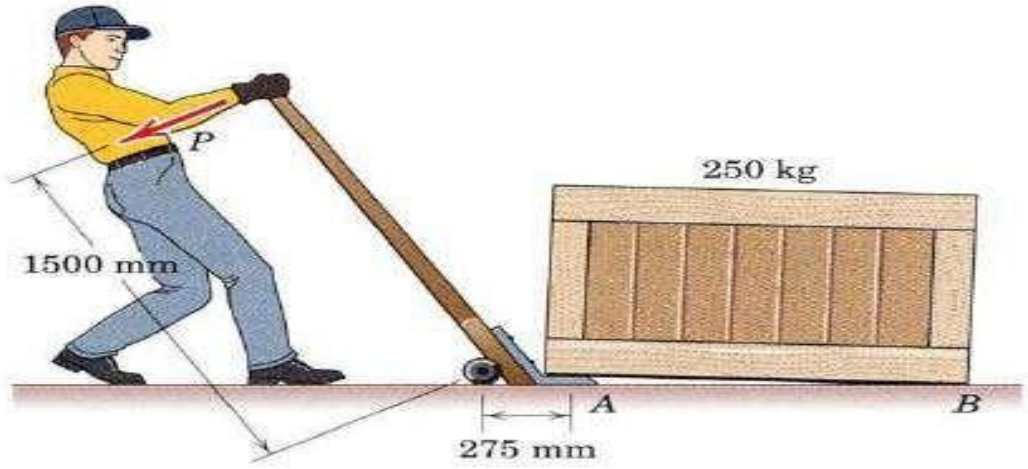
H.W

Determine the force magnitude P required to lift one end of the 250 kg crate with the lever dolly as shown. State any assumptions.



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