## *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

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.
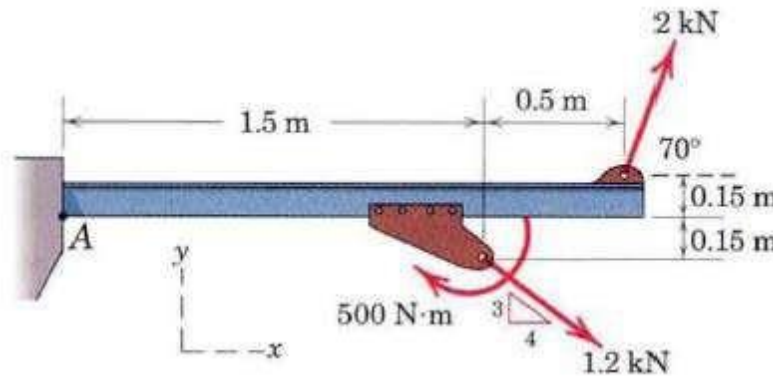
Solution

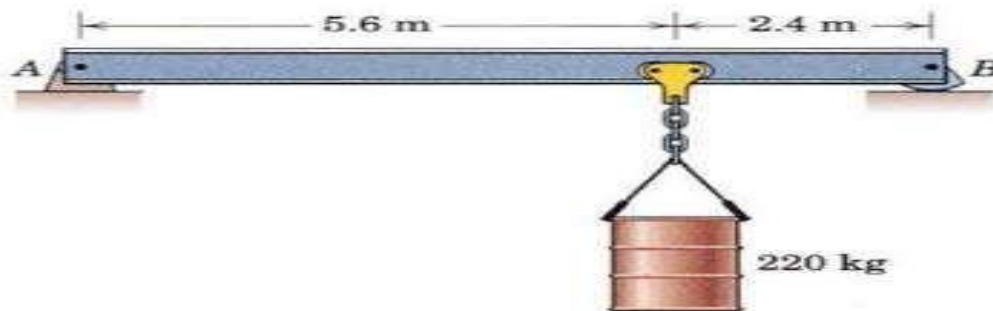$$Rx = Fx = 2\cos 70^\circ + 1.2 \frac{4}{5} = 1.644 \text{ KN}$$

$$Ry = Fy = 2\sin 70^\circ + 1.2 \frac{3}{5} = 1.159 \text{KN}$$

$$M_A = -2\cos 70^\circ \times 0.15 + 2\sin 70^\circ \times (1.5+0.5) + 1.2 \frac{4}{5} \times 0.15 - 1.2 \frac{3}{5} \times (1.5) - 0.5$$
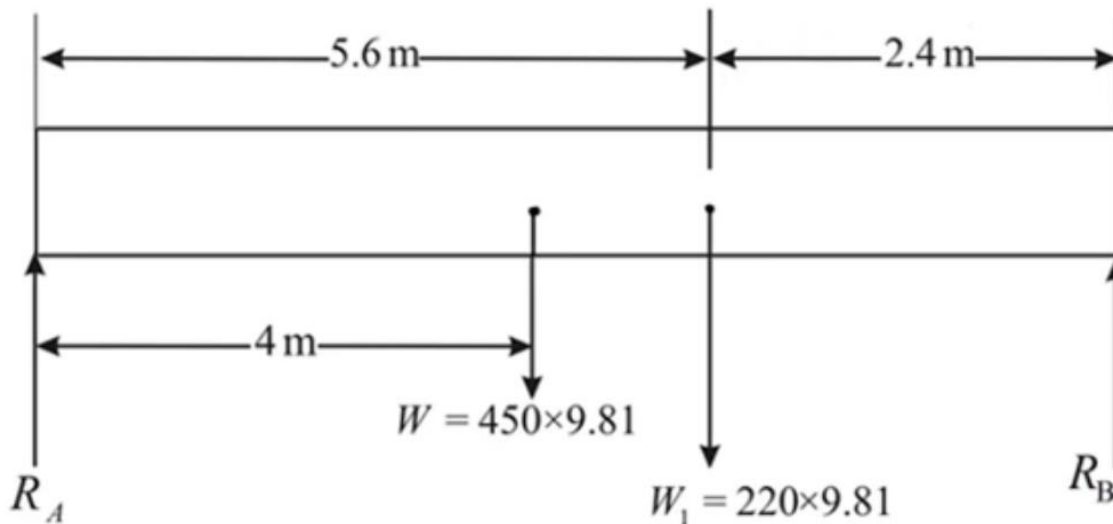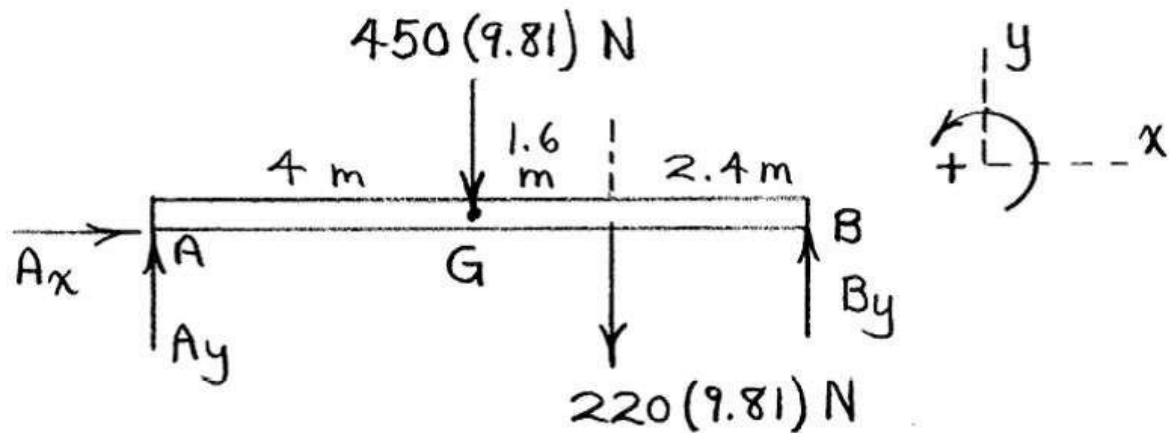
$$= 2.22 \text{ KN.m}$$

Example 2

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

Solution

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

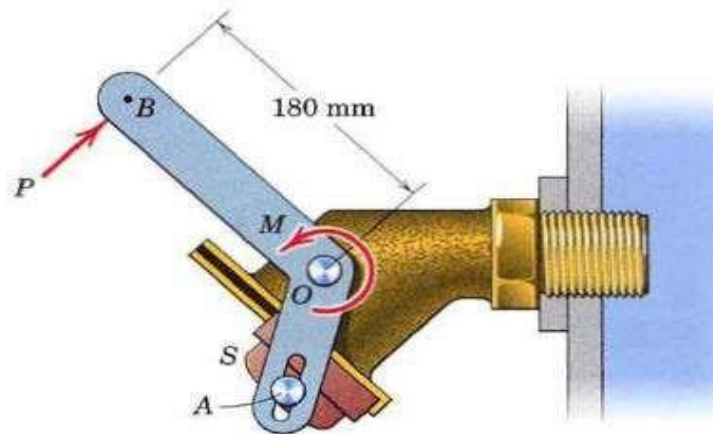 **0 = Ay -450 × 9.81 -220 × 9.81 + 3720**

Ay = 2850N

Example 3

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×d

20=P× 0.180

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

=111.1 N

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