# 6.3 Shear and bending

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

**KEY WORDS** shear force • bending moment

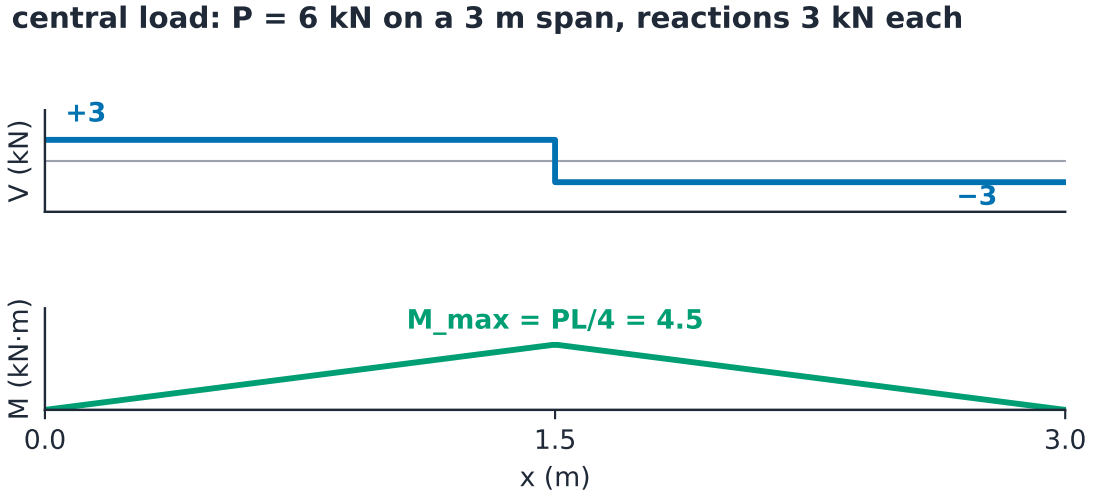
## Objective

Construct shear-force and bending-moment diagrams by sections, keep the sign convention, and use the differential relations to check the shapes.

## 1 Key knowledge and worked examples

### ■ The differential chain

$dV/dx = -w(x)$ and $dM/dx = V$; sagging positive. Central load: $M_{max} = PL/4$; uniform load: $M_{max} = wL^2/8$.




*The shear steps, the moment peaks

### ■ Worked example. The 3 m arm

Central $P = 6$ kN: reactions 3 kN, $V$ steps $\pm 3$ kN, $M_{max} = PL/4 = 4.5$ kN · m; as a uniform $w = 2$ kN/m instead: $M_{max} = wL^2/8 = 2.25$ kN · m.



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## 2 Practice

**2.1** A simply supported span of $L = 5$ m carries a central point load $P = 10$ kN: the support reactions and the maximum bending moment (one decimal, kN · m). [3]

**2.2** A simply supported span of $L = 4$ m carries a uniform load $w = 3$ kN/m over the whole span: the support reactions, the maximum shear force and the maximum bending moment (one decimal, kN · m). [4]

**2.3** For the beam of 2.2: where does the bending moment peak, and what are the two differential relations that connect load, shear and moment? [4]

**2.4** One sentence each: what does a hinge do to the bending moment diagram, and why does a kink in the moment diagram mean a point load acts there? [3]



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