Advanced moments: sharing a beam’s load

Student activity • observation and reasoning

YEAR 10 / LESSON 12 / PHYSICS ONLY

The question

How does moving a load change the forces at the two ends of a beam?

Model a light beam with two supports and test its predicted reactions using clearly labelled practice data.

Equipment

- Booklet, ruler, calculator and graph paper
- Beam-and-load diagram cards

Paper modelling only. Do not stand on rulers, benches or improvised beams to test the model.

Course coverage: Physics only: 1.32P, 1.33P. Support forces and moments.

Plan, model or apparatus sketch

Draw a labelled setup or force diagram; include the measured quantities.

Method and reasoning

Read the whole sequence before starting

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1. Draw a horizontal light beam 1.0 m long, supported at both ends. Mark upward forces A and B and a downward 20 N load at distance x from the left end.

2. Use vertical equilibrium to write A + B = 20 N. Take moments about the left support to obtain B × 1.0 m = 20 N × x.

3. Calculate A and B for x = 0.20, 0.40, 0.50, 0.60 and 0.80 m. Keep the total load and support separation fixed.

4. Plot each support force against x and compare the two trends. Check that the reactions add to 20 N at every position.

5. Add a hypothetical uniform beam weight of 4 N at its centre. Recalculate one case, explaining why each end now supports an extra 2 N.

6. Discuss why this model assumes a stationary rigid beam, vertical forces and a load between the supports. It is not a test of a real bridge or a prediction of structural safety.

Cleanup

- Return cards and keep corrected diagrams and calculations.

Record your evidence

Blank spaces are for your own work

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Reference and task data

These are idealised practice calculations, not measurements. A light beam means its weight is neglected. For a real uniform beam, its weight acts at the midpoint and must be included. The support nearer the movable load generally carries more of that load. Do not mix metres and centimetres in one moment calculation.

x / m	A / N	B / N	A + B / N
0.2			
0.4			
0.5			
0.6			
0.8			

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Find B when x = 0.20 m.

2. Find A for that position.

3. What happens at the midpoint?

4. What remains constant as the load moves?

5. Why does a 4 N uniform beam add 2 N at each support?

6. Can this calculation certify a real bridge as safe?