Moments, levers and gears

Name _____ Class _____ Date _____

A force can make an object turn. The turning effect of a force is called a **moment**.

KEY EQUATION

$$M = F\,d$$

M = moment (N m)
F = force (N)
d = perpendicular distance from the pivot to the line of action of the force (m)

WORKED EXAMPLE

A 20 N force acts 0.3 m from a pivot.
M = 20 × 0.3 = **6 N m**

Section A · Recall and calculate

Grade 4–5

1 Calculate the moment when a 50 N force acts 0.4 m from the pivot. [2]

M = 50 × 0.4 = 20 N m

2 State the principle of moments. [2]

If an object is balanced, the total clockwise moment about a pivot

equals the total anticlockwise moment about that pivot.

3 Why is it easier to open a door by pushing far from the hinge? [2]

The distance from the pivot is larger,

so a smaller force gives the same moment.

Section B · Balance

Grade 5–6

4 A seesaw is balanced. A 300 N child sits 2.0 m to the left of the pivot. Where must a 400 N child sit on the right? [3]

Anticlockwise moment = 300 × 2.0 = 600 N m

Clockwise moment = 400 × d = 600

d = 1.5 m

5 A uniform 2 m plank is pivoted at its centre. A 60 N weight is placed 0.5 m to the left of the pivot. Calculate the weight needed 0.8 m to the right to balance it. [3]

Anticlockwise = 60 × 0.5 = 30 N m

W × 0.8 = 30

W = 37.5 N

Section C · Levers and gears

Grade 6–7+

6 Explain how a lever, such as a crowbar, acts as a force multiplier. [3]

A small force is applied far from the pivot,

creating a large moment.

The load is close to the pivot, so the same moment produces a large force on it.

7 A small gear with 10 teeth drives a large gear with 30 teeth. Describe how the speed and the moment of the large gear compare with the small gear. [2]

The large gear turns more slowly (one third of the speed)

but with a larger moment (three times bigger).

Exam-style question

AQA style

8 A wheelbarrow carries a load. The wheel acts as the pivot.

a The load weighs 600 N and acts 0.4 m from the pivot. The handles are 1.2 m from the pivot. Calculate the upward force needed on the handles to lift the load. [3]

Clockwise moment of load = 600 × 0.4 = 240 N m

F × 1.2 = 240

F = 200 N

b Explain why the load should be placed close to the wheel. [2]

A smaller distance from the pivot means a smaller moment from the load,

so a smaller force is needed at the handles.

Total: _____ / 22

How confident am I?

	Not yet	Nearly	Got it
I can calculate moments using M = Fd	☐	☐	☐
I can use the principle of moments	☐	☐	☐
I can explain how levers and gears work	☐	☐	☐