

Stability

ANSWERS

Bands 1, 2, 3, 4, 5 · 10 questions · Free sample

Each picture asks its own question. A body tips when the line down from its centre of gravity leaves its base: a uniform box tips at width over height. The centre of gravity of blocks or of a flat plate is the average of the parts' centres, each counted by its weight or area.

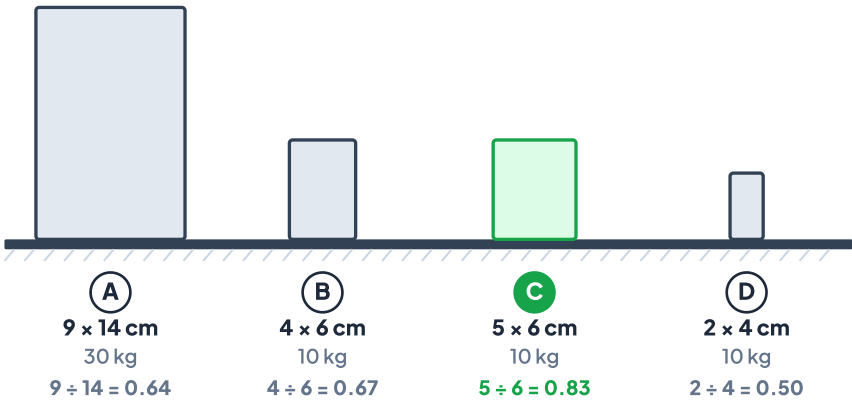
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1 Band 1

Answer: C

Which box is the hardest to tip over?

uniform boxes, drawn to scale



width ÷ height: the biggest ratio is the hardest to tip

- A

A

The widest box, but a taller one is not stable (9 ÷ 14 = 0.64)
- B

B

Tips more easily (4 ÷ 6 = 0.67)
- C

C

The answer (5 ÷ 6 = 0.83)
- D

D

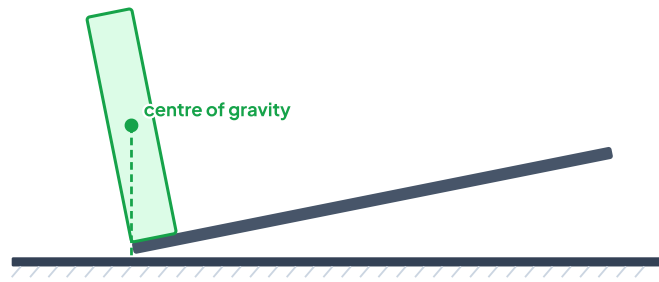
The shortest box, but a narrow base tips (2 ÷ 4 = 0.50)

2

Band 1

Answer: B

The board is tilted until the box tips. What gradient is that?



It tips when its centre of gravity is straight over the lower corner:

$$\text{gradient} = 3 \div 15 \times 10 = 2 \text{ in } 10$$

(A) 1 in 10

Half the gradient: the half width over the whole height

(B) 2 in 10

The answer

(C) 3 in 10

The width, not the width over the height

(D) 50 in 10

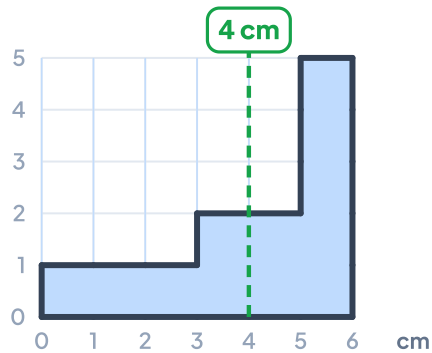
The ratio upside down

3

Band 2

Answer: A

How far is the centre of gravity from the left edge?



Parts (areas, cm²): 6, 3, 3; total 12
 $x = (6 \times 3 + 3 \times 4.5 + 3 \times 5.5) \div 12 = 4 \text{ cm}$

(A) 4 cm

The answer

(B) 5 cm

Not what the geometry gives

(C) 6 cm

Not what the geometry gives

(D) 7 cm

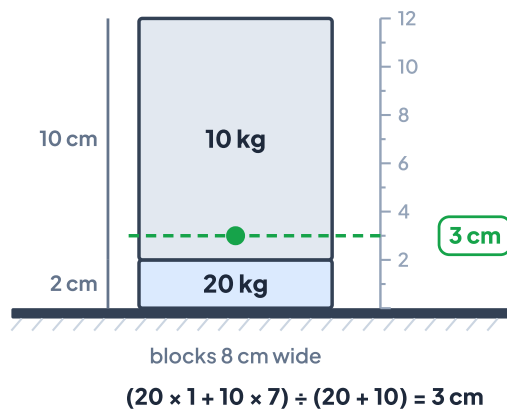
Not what the geometry gives

4

Band 2

Answer: C

How high above the table is the centre of gravity?



A

1 cm

The centre of the heavier block only

B

2 cm

Not what the geometry gives

C

3 cm

The answer

D

6 cm

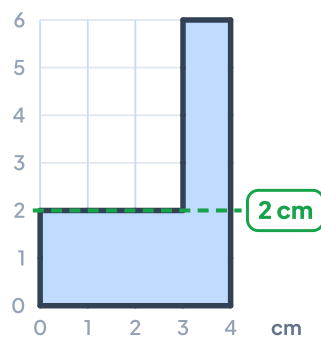
Half the total height: the middle, not the centre of gravity

5

Band 3

Answer: B

How far is the centre of gravity from the bottom edge?

Parts (areas, cm²): 6, 6; total 12

$$y = (6 \times 3 + 6 \times 1) \div 12 = 2 \text{ cm}$$

A

1 cm

Not what the geometry gives

B

2 cm

The answer

C

3 cm

The middle of the plate's outline, not its centre of gravity

D

4 cm

Not what the geometry gives

6

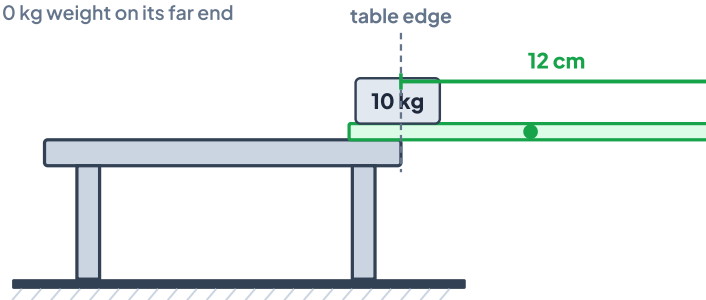
Band 3

Answer: A

How far out can the plank be pushed before it tips?

plank: 14 cm long, 4 kg (uniform)

a 10 kg weight on its far end



Turning about the edge: the plank's centre is 5 cm beyond it ($4 \times 5 = 20$),
the 10 kg load is 2 cm behind it ($10 \times 2 = 20$): equal, so it just balances

pushed out 12 cm

A

12 cm

The answer

B

18 cm

Not what the
geometry gives

C

24 cm

Not what the
geometry gives

D

36 cm

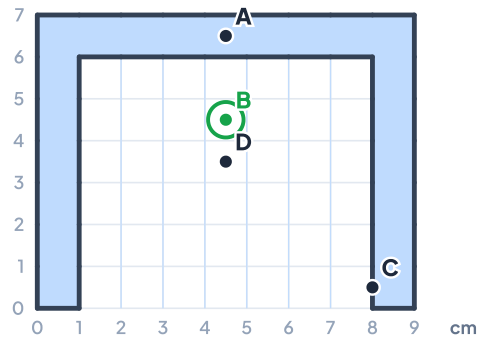
Not what the
geometry gives

7

Band 4

Answer: B

Which point is the centre of gravity of the plate?



Parts (areas, cm²): 9, 6, 6; total 21

$$x = (9 \times 4.5 + 6 \times 0.5 + 6 \times 8.5) \div 21 = 4.5 \text{ cm}$$

$$y = (9 \times 6.5 + 6 \times 3 + 6 \times 3) \div 21 = 4.5 \text{ cm}$$

A

A

The centre of the
biggest part only

B

B

The answer

C

C

Not what the
geometry gives

D

D

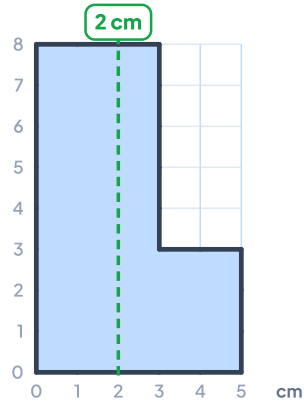
The middle of the
plate's outline, not its
centre of gravity

8

Band 4

Answer: B

How far is the centre of gravity from the left edge?



Parts (areas, cm²): 40, cut-out -10; total 30
 $x = (40 \times 2.5 - 10 \times 4) \div 30 = 2 \text{ cm}$

A

1 cm

Not what the geometry gives

B

2 cm

The answer

C

3 cm

The mirror image of the centre of gravity

D

4 cm

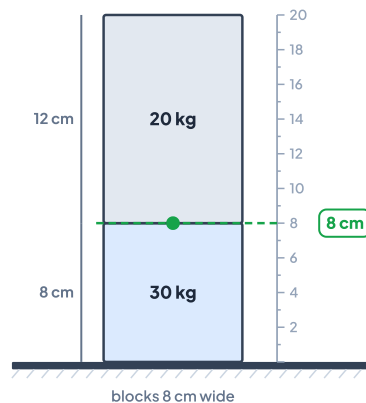
Not what the geometry gives

9

Band 5

Answer: D

The board is tilted until the pile tips. What gradient is that?



blocks 8 cm wide

centre of gravity 8 cm high, half the width 4 cm:
 $\text{gradient} = 4 \div 8 \times 10 = 5 \text{ in } 10$

A

2 in 10

Not what the geometry gives

B

3 in 10

Not what the geometry gives

C

4 in 10

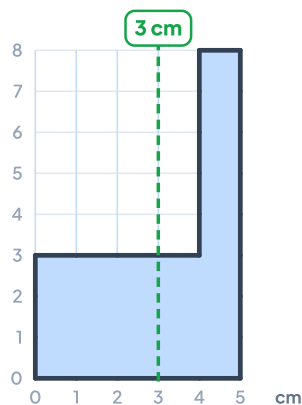
Half the total height: the middle, not the centre of gravity

D

5 in 10

The answer

How far is the centre of gravity from the left edge?



Parts (areas, cm²): 40, cut-out –20; total 20
 $x = (40 \times 2.5 - 20 \times 2) \div 20 = 3 \text{ cm}$

A

1 cm

Not what the
geometry gives

B

2 cm

The mirror image of
the centre of gravity

C

3 cm

The answer

D

4 cm

Not what the
geometry gives



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