

Linkages

ANSWERS

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

Each picture asks its own question. A lever turns about its pivot: its two ends move opposite ways with the pivot between them and the same way with it at one side, each in proportion to its arm. A crank pin turns a piston to and fro: the stroke is twice the pin's distance from the centre.

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1

Band 1

Answer: B

Rod I moves up. Which way does rod X move?

Rod I is on the arm to the right and moves up, so the crank turns anticlockwise
The arm pointing down then swings right
Rod X moves right

A

Left

The other way along the same line: look at which side of the pivot each arm is on

B

Right

The answer

C

Up

The direction the first rod moves: a bell crank turns the movement through a right angle

D

Down

A bell crank turns the movement through a right angle: not along the same line as the first rod

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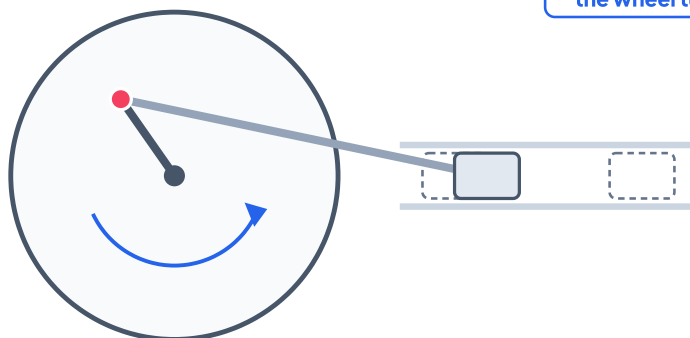
2

Band 1

Answer: D

The wheel turns 5 times. How many strokes does the piston make?

the wheel turns 5 times



A stroke is one way along the guide: two strokes a turn
 $2 \times 5 = 10$

A

5

One stroke to a turn:
there are two, out
and back

B

7

The turns and a
number added, not
doubled

C

8

Not what the linkage
gives

D

10

The answer

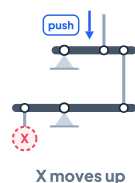
3

Band 2

Answer: B

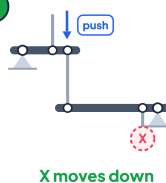
The handle is pushed down in each. In which does X move down?

A



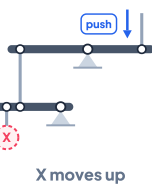
X moves up

B



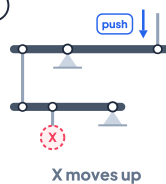
X moves down

C



X moves up

D



X moves up

A lever with its pivot between the ends turns the movement round;
with the pivot at one side it does not

A

A

Not this one: X moves
up

B

B

The answer: X
moves down

C

C

Not this one: X moves
up

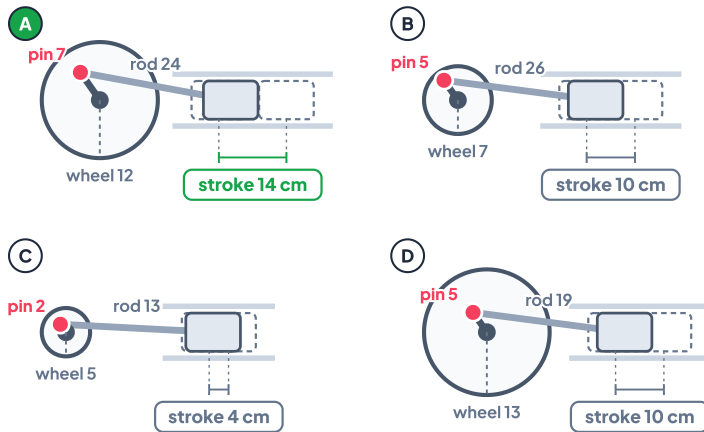
D

D

Not this one: X moves
up

Which piston has the longest stroke?

radii, pin distances and rods in cm; rods not to scale



Only the pin's distance from the centre sets the stroke: $2 \times$ the pin's distance

A

A

The answer (stroke 14 cm)

B

B

The longest rod, but the rod does not change the stroke (stroke 10 cm)

C

C

A shorter stroke (stroke 4 cm)

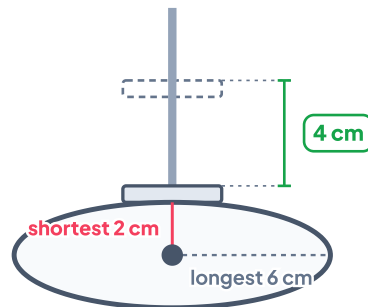
D

D

The biggest wheel, but the pin's distance sets the stroke (stroke 10 cm)

How far does the follower rise as the cam turns, from its lowest to its highest?

not to scale



The follower is lowest on the shortest radius and highest on the longest
 $6 - 2 = 4 \text{ cm}$

A

4 cm

The answer

B

6 cm

The furthest the cam reaches, not how far the follower rises

C

8 cm

The two distances added, not taken away

D

12 cm

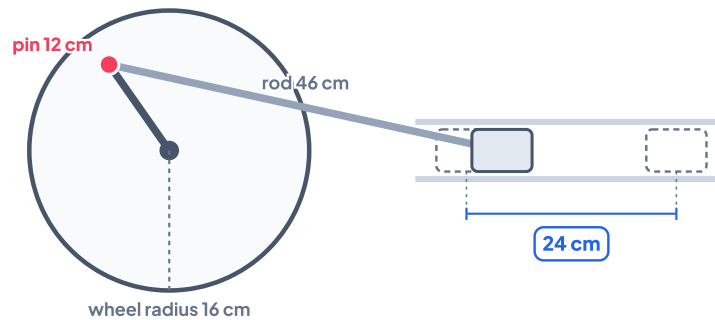
Not what the linkage gives

6

Band 3

Answer: B

The piston's stroke is 24 cm. How far is the pin from the centre of the wheel?



The stroke is twice the pin's distance, so the pin is half the stroke from the centre
 $24 \div 2 = 12 \text{ cm}$

A

6 cm

Not what the linkage gives

B

12 cm

The answer

C

24 cm

The whole stroke: the pin is half of it from the centre

D

48 cm

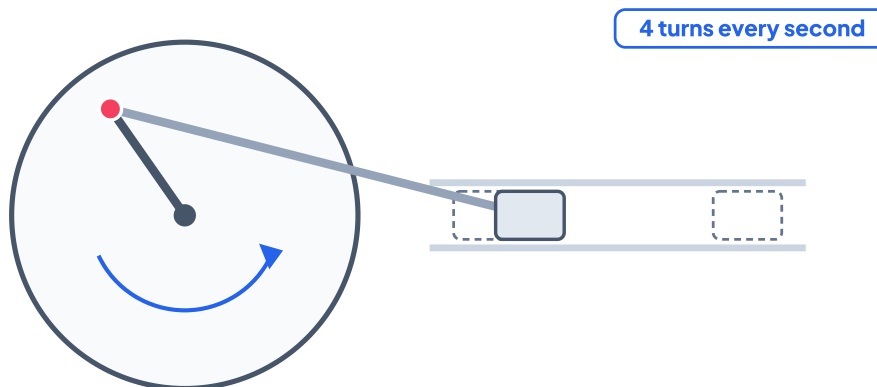
Twice the stroke, the wrong way round

7

Band 4

Answer: C

The wheel turns 4 times a second. How many strokes does the piston make in 2 seconds?



$2 \text{ strokes a turn} \times 4 \text{ turns a second} \times 2 \text{ seconds} = 16$

A

6

The turns and a number added, not doubled

B

8

One stroke to a turn: there are two, out and back

C

16

The answer

D

32

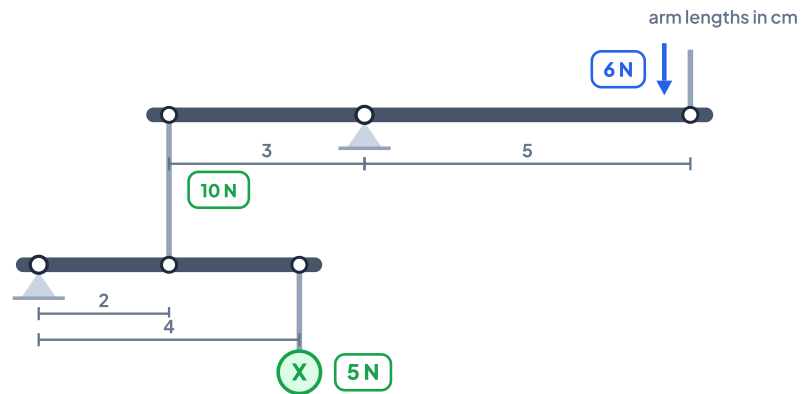
Four strokes to a turn: out and back is two

8

Band 4

Answer: A

The handle is pushed with 6 N. With what force does X push?



$$\text{Lever 1: } 6 \text{ N} \times (5 \div 3) = 10 \text{ N}$$

$$\text{Lever 2: } 10 \text{ N} \times (2 \div 4) = 5 \text{ N}$$

A

5 N

The answer

B

6 N

The force unchanged: a lever trades force for distance

C

10 N

Only the first lever counted

D

20 N

The last lever's ratio upside down

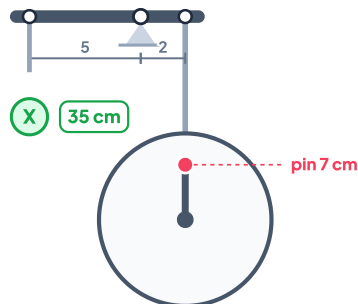
9

Band 5

Answer: B

How far does the end X of the lever move, from its lowest to its highest?

not to scale; the pin is drawn at its highest



The pin moves the end of the lever 14 cm, from lowest to highest: 2×7

The other arm is $5/2$ times as long: $14 \times (5 \div 2) = 35 \text{ cm}$

A

14 cm

The whole stroke: the pin is half of it from the centre

B

35 cm

The answer

C

70 cm

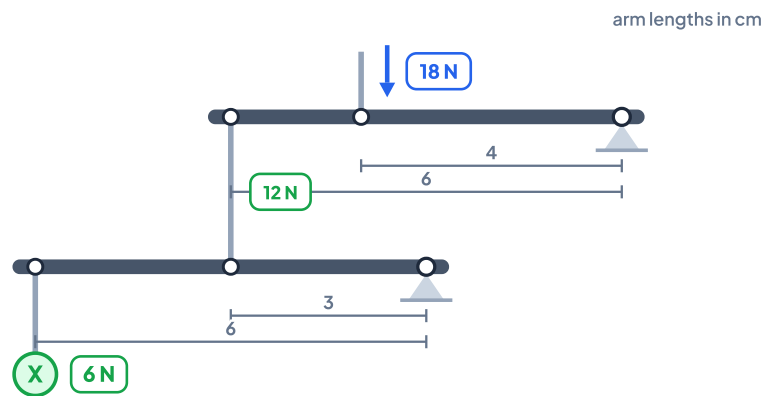
Not what the linkage gives

D

105 cm

Not what the linkage gives

The handle is pushed with 18 N. With what force does X push?



$$\text{Lever 1: } 18 \text{ N} \times (4 \div 6) = 12 \text{ N}$$

$$\text{Lever 2: } 12 \text{ N} \times (3 \div 6) = 6 \text{ N}$$

A

2 N

Not what the linkage gives

B

3 N

Not what the linkage gives

C

6 N

The answer

D

18 N

The force unchanged: a lever trades force for distance

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