

Name _____

Class _____

Date _____

By the end of this worksheet I can...

- ☐ calculate force, pressure and area using $F = P \times A$
- ☐ calculate the area of a piston from its diameter
- ☐ calculate the instroke force of a double-acting cylinder
- ☐ convert between bar and N/mm^2

I DO**Key ideas and worked example** Read this first **$F = P \times A$** Force = pressure $\times$ area. Rearranged: $P = F \div A$ and $A = F \div P$

- Force F in newtons (N)
- Pressure P in N/mm^2 (1 bar = 0.1 N/mm^2)
- Area A in mm^2

- Piston area: **$A = \pi r^2$** (or $\pi d^2 \div 4$). Halve the diameter to get the radius.
- Instroke of a double-acting cylinder: **effective area = piston area – rod area.**
- From an area to a diameter: $d = \sqrt{(4A \div \pi)}$.

RememberNever put the diameter straight into $F = P \times A$: work out the area first.*A 40 mm diameter cylinder is supplied with air at 3 bar.***Example Calculate the outstroke force.****Worked answer** set out every step like this

$$P = 3 \text{ bar} = 0.3 \text{ N/mm}^2$$

$$A = \pi r^2 = \pi \times 20^2 = 1257 \text{ mm}^2$$

$$F = P \times A = 0.3 \times 1257$$

$F = 377 \text{ N}$

Why marks are not awarded

- ✗ Using the diameter (40) instead of the radius (20)
- ✗ Not converting bar to N/mm^2

WE DO**Guided practice** Follow the steps to help you*A double-acting cylinder has a 25 mm piston and a 10 mm rod. The pressure is 0.4 N/mm^2 .***1 Calculate the instroke force.** (3 marks)**Steps**

1. Piston area = $\pi \times 12.5^2 = \dots$
2. Rod area = $\pi \times 5^2 = \dots$
3. Effective area = piston – rod, then $F = P \times A$

YOU DO

On your own Show your working. Check your answers afterwards.

Force

2 Write down the formula used to calculate the outstroke force of a single-acting cylinder.

3 A stamping machine does not imprint its logo properly. Suggest two ways of increasing the force from its cylinder.

4 What controls the instroke of a single-acting cylinder?

5 A single-acting cylinder must press two sheets of acrylic together with a force of 300 N. The piston diameter is 20 mm and the pressure is 0.3 N/mm². Will this work? Show your working.

6 What force does a 20 mm diameter cylinder produce on the outstroke at 0.8 N/mm²?

7 A double-acting cylinder has a 60 mm piston and a 10 mm rod. The supply is 12 bar. Calculate the instroke force.

Pressure

8 Write down the formula used to find the pressure when the force and cylinder size are known.

9 A stamping machine exerts 454 N with a 34 mm diameter piston. Calculate the air pressure needed, in N/mm² and in bar.

10 A bottle-capping machine needs 650 N from a 56 mm diameter single-acting cylinder. Calculate the air pressure needed.

11 A 60 mm diameter cylinder must push a packing case off a conveyor with a force of 540 N. Calculate the pressure needed.

12 A drawer-testing rig needs 16 N from a 10 mm diameter cylinder. Calculate the pressure needed.

Area and diameter

13 Write down the formula used to find the piston area when the force and pressure are known.

14 A cylinder lifting parcels needs 180 N at 6 bar. Calculate the piston area needed.

15 A sliding door needs 400 N to open. The single-acting cylinder is supplied at 5 bar. Calculate the piston diameter needed.

16 A furnace door weighs 100 N and is lifted by a single-acting cylinder at 4 bar. Calculate the piston diameter needed.

Check and reflect

Mark your answers with the answer sheet. Which “I can” statement above still needs work? Look back at the notes for that topic on the site.
