Solution sheet

# Pneumatic platform lift

## Example solution for topic task

**Topic task 3. a):** The forces of the two cylinders are added together; the total force is exactly double that for one cylinder. The pressure is defined as force per area:

$$p=\frac{F}{A}$$

F is the force and A is the effective area of the cylinder disc. The force, therefore, is the product of pressure and area:

$$F=p∙A$$

If we double the area by connecting the second cylinder in parallel while keeping the same pressure, then the force will double as well:

$$p∙2A=2∙F$$

a) The stroke remains unchanged, since the distance travelled by the cylinder is the same as with one cylinder.

**Topic task 4. a):** The force is now unchanged, since the effective area of the cylinder has not changed. The arrangement has the same effect as using a longer cylinder.

b) The path of travel is twice as long. The stroke is greater, but less than double.

c) In the lower position of the platform lift, a short travel distance causes a large change in the stroke. In the upper position, however, the same travel distance causes only a small change in stroke (but a greater stroke force).

**Topic task 5:** The platform lift as we have built it stops moving abruptly when the cylinder reaches its stop. If materials or people were on the platform lift, they could slip or fall down (therefore, railings would be a good idea on the lifting surface). The throttling results in a lower speed while maintaining the same force the platform lift can apply.

Another development would be *end position damping*. This is damping that goes into effect shortly before the cylinder reaches the stop. This allows high speeds to be combined with a softer end to the movement. See the references to further information [2].

## Evaluating the experimental task

The correlation between path of travel and stroke can be calculated as follows:

L

s

h

V

·

L is the length of the bar, the lower end of which is away from the cylinder. s is the length of the projection of L on the plane. h is the stroke (here measured from the plane). L, s and h form a right-angled triangle.

V is the path of travel of the cylinder, starting from the zero point position (which is not actually reachable due to mechanical restrictions) where the bar is flat against the plane. Therefore, the equation is:

$$s=L-V$$

$$L^{2}=s^{2}+h^{2}$$

$$h=\sqrt{L^{2}-s^{2}}=\sqrt{L^{2}-\left(L-V\right)^{2}}=\sqrt{L^{2}-\left(L^{2}-2LV+V^{2}\right)}=\sqrt{2LV-V^{2}}$$

This results in the following curve:

