Hydraulic Press

The one example

is the hydraulic press. Mechanics use this equipment when they need to raise a car to look underneath it or at the tyres. When you transmitted water from a smaller syringe to a larger syringe, you were creating a hydraulic press.

1 The hydraulic press

You can create a hydraulic press by applying a force to a piston with a small volume and transmitting it through liquid to another piston with a larger volume.

Let's investigate how a hydraulic press works. After this activity you will be able to do simple calculations to work out the mechanical advantage between two unequal cylinders.

FIGURE 5 shows two cylinders of different sizes. The smaller cylinder is the input cylinder. The piston on the smaller cylinder is marked F1. This indicates force 1 on which a force of 25 N is exerted. The piston area of F1 is marked A1. We will work with the diameter of each piston. You can see in the picture that the diameter of A1 is 50 mm.

The piston on the output cylinder is marked F2. The piston area of the larger cylinder is 150 mm, and is marked A2. In the picture, F1 and A1 are known. On the output cylinder, A2 is known but F2 is unknown. Calculate the output force at F2.

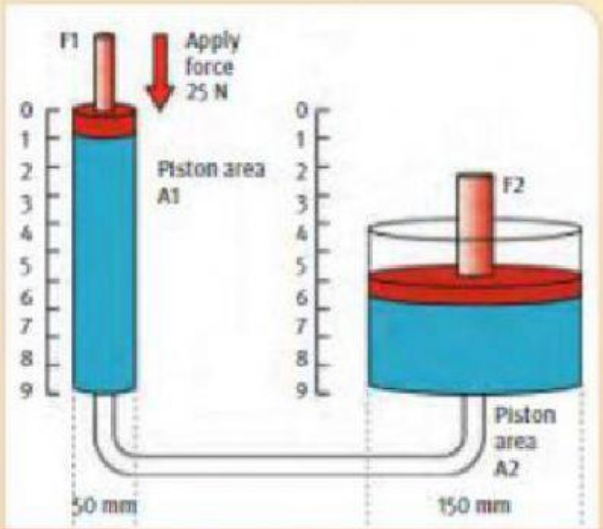

FIGURE 5 Hydraulic multiplication

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This will determine the mechanical advantage of this hydraulic system. Copy this table into your workbook. Look at **FIGURE 5** and fill in the known information at points (a), (b) and (c).

Input cylinder		Output cylinder	
Pressure exerted on F1 =	(a)	Pressure exerted on F2 =	Unknown
Area of cylinder A1 =	(b)	Area of cylinder A2 =	(c)

1 Write down the force exerted on F1 in (a).
2 Write down the diameter of A1 in (b).
3 What is the diameter of A2? Write your answer in the (c) column.
4 Notice that the output force F2 is unknown.
5 If you compare the input cylinder to the output cylinder, you will notice that the output cylinder is larger than the input cylinder.

a Calculate how much larger A1 is than A2. You will have to divide A2 by A1. Do this in your workbook.

> A2 – 150 mm
>
> A1 – 50 mm
>
> Answer: _____. This tells us that the diameter of the output piston is _____ times larger than the diameter of the input piston.
>
> Did you notice it? Yes _____ No _____
>
> If not, ask your teacher to explain it to you.

Write the sentences above in your workbook and fill in the answers.

b Notice that there is hydraulic liquid between the two cylinders. Pascal's principle states that:
Pressure applied anywhere on a confined fluid is transmitted in _____ direction. The force exerted by the confined fluid is applied to _____ portion of the surface of the container and is _____ to equal areas.

c Your calculation will tell you that the surface area of your output piston is three times larger than the surface area of the input piston. Therefore, the force output (F2) will be three times larger. Now calculate the force output A2 in your workbook.
F2 = F1 × 3 (25 N × 3 = 75 N)
What does this mean? The hydraulic press has a mechanical advantage _____ times larger than the input force.

d Calculate the distance moved at the output piston if the input piston was pressed down from 0 ml to 9 ml.

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