USING THE LEVERS & FLUIDS RIG

1-1: Determine the internal cross-sectional area of the 20cc syringes in cm^2

Method A:

Measure the internal diameter of the barrel of the 20cc syringe once the plunger is removed.

Use the formula Area = πr^2 to determine area in cm^2

Method B:

Measure the distance between the 10cc mark and the 20cc mark – a volume of $10cm^3$

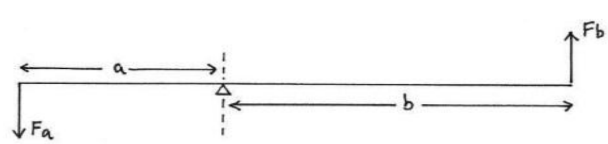
Use the formula for a cylinder: Volume = Area X height (distance)

Using method A our result was:

Using method B our result was:

1-2: Using the formulae Circumference = $2\pi r$ and diameter (d) = 2r, determine the internal circumference of the 20cc syringes:

2-1: First-class levers:

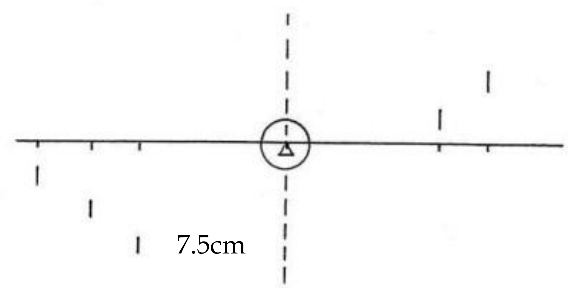


In the diagram above (Fa) x a = (Fb) x b

If Fa = 8N, a= 6 units and b= 8 units then what is the value of Fb?

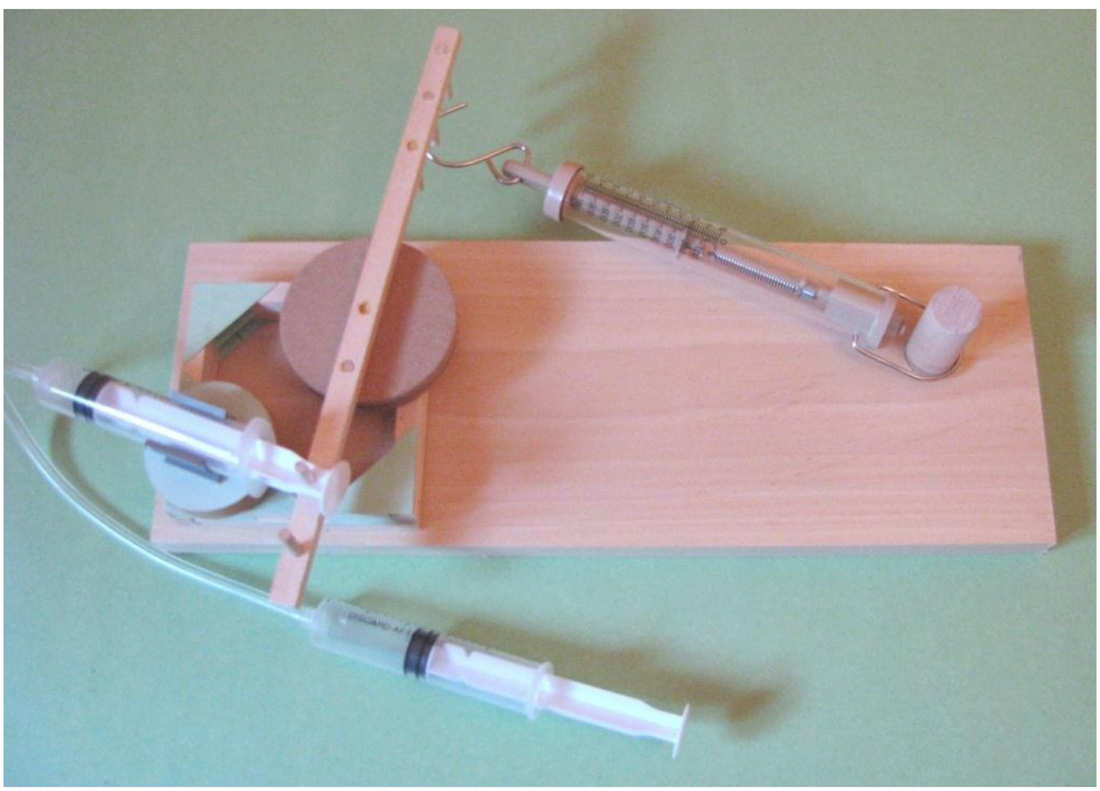
2-2: Measuring the Levers & Fluids Rig:

There are 5 pegs on the arm of the rig. Measure the distance of each peg from the fulcrum or the center of the wheel and mark on the diagram bvelow:



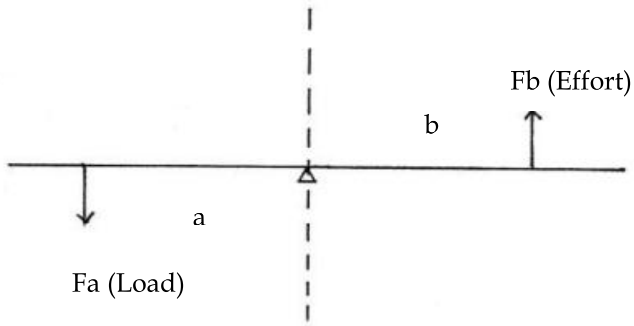
3-1: Setting up the Rig:

The diagram below shows the plunger with the hole in it attached to the position nearest the fulcrum (the center of the wheel). The spring scale is attached to the middle position on the other side of the class 1 lever



3-2: Using the Tubular Spring Scale:

Connect the hook of the tubular spring scale to the middle peg and the plunger of the driven syringe (the syringe in the syringe holder) to the peg farthest from the fulcrum



Close the driven syringe and attach the tubing. On the other end of the tubing attach the other syringe – the driving syringe. Make sure it is open - its plunger is fully extended

Push the plunger of the driving syringe in until it is quite hard to push any further and measure the load force exerted using the tubular spring scale.

Do the math and determine the effort force exerted by the driven syringe.

3-3: Recording the Results:

a	b	Load Fa (N)	Effort Fb (N)
7.5			
7.5			

There are six possible combinations of a & b with six different readings of Fb. Determine the remaining 5 values for Load Fa; and then calculate the remaining 5 values for the Effort Fb

4-1: Mechanical Advantage:

Mechanical Advantage (MA) = Load/Effort or, in the case of the rig, Fa/Fb

a	b	Load Fa (N)	Effort Fb (N)	MA = Fa/Fb

Do you notice anything about the values for MA?

5-1: Introducing Pressure:

Pressure = Force/Area

Unit of Pressure is Pascal (Pa) where Force is measured in N and Area in m^2.

1 Pascal (Pa) is a very small measure. In meteorology and weather reporting the term kilo-Pascal (KPa) = 1000 Pa, is used

In above investigation the Effort force exerted by the driven syringe when a=7.5cm and b=7.5cm was _______N

From section 1-1 the cross-section internal area of the 20cc syringe was ________cm² (*Area)*

Therefore the maximum Pressure inside the 20cc syringes is (*Force)*/((*Area)* X $(1/10^4)$)

=

Why $1/10^4$? Look again at the definition of a Pascal.

The maximum Pressure inside the 20cc syringes was _________Pa when a=7.5cm and b=7.5cm

Calculate the Pressure inside the driven syringe in the remaining 5 combinations of a & b

a	b	Effort Fb (N)	Pressure Pa

Is there a relationship between the Effort Force and the Pressure?

What does a graph of Pressure (Pa) v's Effort (N) look like?

5-2: Pascal's Principle: Pressure is evenly distributed throughout fluid

Air is a "spongy" fluid and takes time to adjust. Observe the fact that as load is applied to the driving syringes in the above investigation the plunger "sinks" slightly compressing the air in the syringe until it overcomes frictional forces that resist its movement. Once frictional forces resisting movement are overcome, the driven syringe moves.

What else have you observed about the behaviour of air inside the syringes?

6-1: Work Done (J) = Force (N) X Plunger stroke of driven syringe (m)

Work Done is measured in Joules (J) defined as work done in moving 1N a distance of 1m

a	b	Effort Fb (N)	Length of stroke (cm)	Length of stroke (m)	Work Done (J)

Measure the length of the stroke for three combinations of a & b and calculate the work done in Joules in each case