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Wheel and axle (Item No.: P1254100)

Curricular Relevance Subtopic: Area of Expertise: **Education Level:** Topic: Experiment: Kräfte, einfache Physik Klasse 7-10 Mechanik Wellrad Maschinen Difficulty **Preparation Time Execution Time Recommended Group Size** <u>88888</u> 00000 $\Theta \Theta \Theta \Theta \Theta$ -----10 Minutes 20 Minutes 1 Student Intermediate **Additional Requirements: Experiment Variations: Keywords:**

Principle and Equipment

Principle

Investigate the conditions under which equilibrium exists on a wheel and axle.

In addition, investigate the correlation between the forces , the distances and the radii on the wheel and axle.

Equipment

Position No.	Material	Order No.	Quantity
1	Demo Physics board with stand	02150-00	1
2	Axle on fixing magnet	02151-04	1
3	Torsion dynamometer	03069-03	1
4	Scale for demonstration board	02153-00	1
5	Pointers f. Demonst.Board, 4 pcs	02154-01	1
6	Weight holder for slotted weights	02204-00	1
7	Slotted weight, black, 50 g	02206-01	1
8	Slotted weight, silver bronze, 50 g	02206-02	2
9	Wheel and axle	02360-00	1
10	Fish line, l. 100m	02090-00	1
11	Marker, black	46402-01	1

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Demo

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Set-up and procedure

Set-up

- Provide each of two pieces of cord (fish line), which are approximately 50 cm and 40 cm long, with a loop and thread them onto the circumference of the large and small wheels (pulleys), respectively, of the wheel and axle (step pulley).
- Place the axle on fixing magnet onto the upper part of the demonstration board.
- Screw the axle out of the threaded hole, place the two belt pulleys onto it and screw the shaft tight again. Using the crank, subsequently connect the two belt pulleys to form a rigid wheel and axle.
- Load the weight holder with three 50-g slotted weights.



Procedure

- Place the dynamometer onto the demonstration board and measure the weight $F_G = F_2$ for the loaded weight holder. Record F₂ under (1).
- Setup the experiment according to Fig. 1. Hang the weight holder on the line which is wrapped around the sm all wheel (pulley).
- Measure force F_1 , which is required to maintain the equilibrium of the wheel and axle. Record F_1 and F_2 under (2).
- Measure (or give the students the values for)the power arms r_1 and r_2 for F_1 and F_2 . Also record them.
- Mark the position of the weight holder and of the hook on the dynamometer's traction cord with different coloured arrows.
- Move the dynamometer slowly and uniformly diagonally downward (e.g. a distance of 45 cm). While doing so, observe the deflection of the dynamometer and record the required tractive force F_1 as well as $F_G = F_2$ under (3).
- Mark the current position of the weight holder and of the hook with arrows of colours corresponding to their previous use.
- Draw in and measure the distance s₂ (lifting height) of the load as well as the power distance s₁ on the demonstration board. Note the measured values.
- Record the measured values under (3).



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Observations and evaluation

Observations

1.
$$F_G = F_1 = 1.54N$$

- 2. Table 1
- 3. Table 2

$$\begin{array}{cccc} \mbox{Table 1} & & \mbox{Large wheel} & r_1 = 7.0\,cm \\ F_2 = 3.5\,cm & F_1 = 0.77N \\ F_2 * r_2 = 5.4Ncm & F_1 = 0.77N \\ F_1 * r_1 = 5.4Ncm & \mbox{Table 2} & \mbox{Table 2} \\ \mbox{Small wheel} & r_1 = 7.0\,cm \\ F_2 = 1.54N & F_1 = 0.80N \\ r_2 = 15.0\,cm & s_1 = 30.5\,cm \\ F_2 * s_2 = 23Ncm & F_1 * s_1 = 24Ncm \end{array}$$

Evaluation

