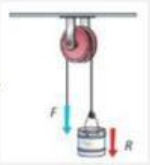
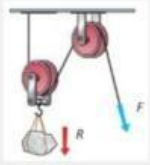
Technology	UD: MECHANISMS (Pulleys and gears worksheet) 2º ESO
	Group:_____Name:_____

- **PULLEYS AND COMPOUND PULLEYS**



Fixed pulley: it is ballanced when F=R

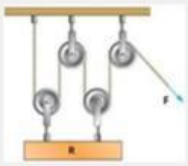
Does it have mechanical advantage?



Moveable pulley: made by two pulleys, one fixed and one moveable. F= R/2

Does it have mechanical advantage?

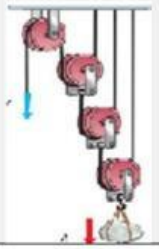
Compound pulleys (block and tackle)



F = R/2.n

n= number of moveable pulleys

Does it have mechanical advantage?

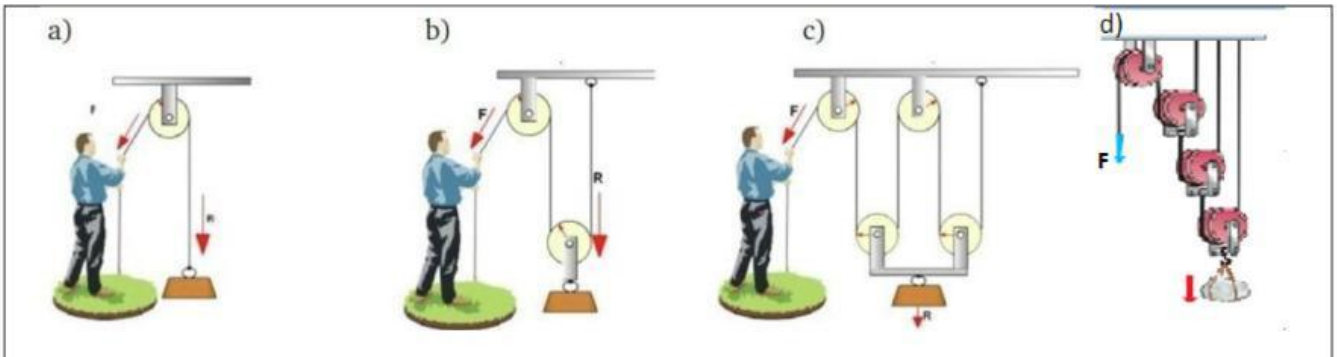


F = R/2^n (exponential system)

n= number of moveable pulleys

Does it have mechanical advantage?

1. Calculate the force needed to lift the load in each case. The load weights 100 **N**. Determine if there is mechanical advantage in each case and how much is it.



Name:	Name:	Name:	Name:
F	F	F	F
Mech. advantage?	Mech. advantage?	Mech. advantage?	Mech. advantage?

NOTE: Remember that the kg is a unit to express **mass** not **force**. To caculate the force (weight) you have to multiply by 9,8 m/s^2 that is the gravity aceleration. It is also possible to use the concept of kg-force that is expressed in kg, therefore, you can do the exercise using kg to express the weight.

- **ROTARY TRANSMISION (PULLEYS AND GEARS)**

The rotary motion mechanisms make it possible: • To connect two mechanisms transmitting the motion from one of them to the other. • To modify the rotary speed of the driven element increasing or decreasing its velocity.			
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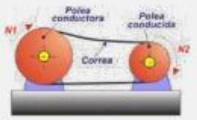
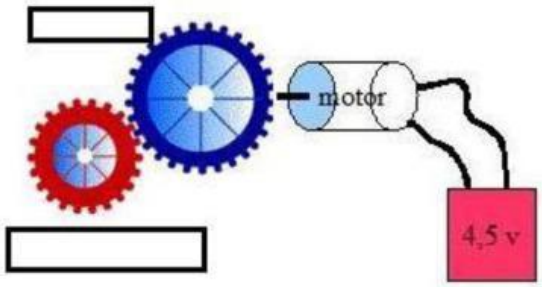
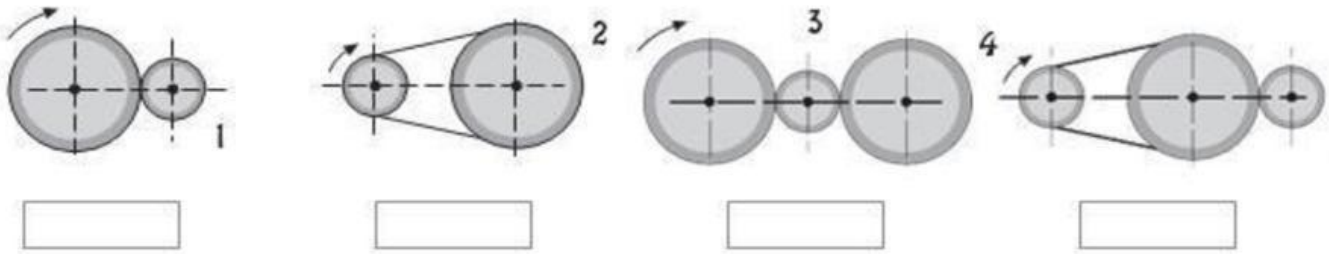
			



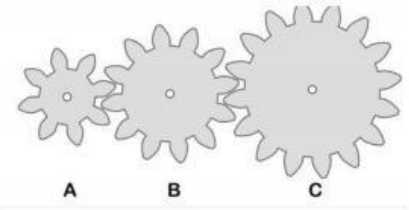
We can vary the output velocity of the driven element with the proper combination of elements:

Multiply velocity	**Reduce velocity**	**Formula:**
When the drive pulley/gear is larger than the driven pulley/gear. $D_1 > D_2$ or $Z_1 > Z_2$ $N_1 < N_2$ 1:drive 2:driven **D:** diameter **N:** velocity (rpm) **Z:** nº of teeth	When	$D_1 x N_1 = D_2 x N_2$ $Z_1 x N_1 = Z_2 x N_2$ speed ratio $i = D_1 / D_2$ $i = Z_1 / Z_2$

2. Indicate wether the following systems reduce, multiply or mantain the velocity.



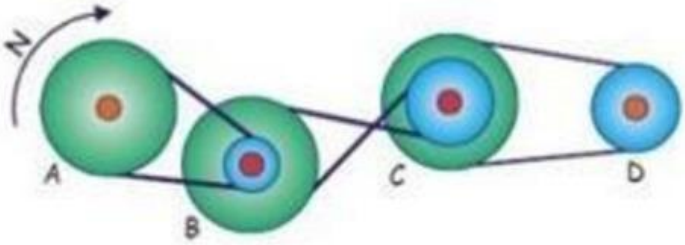
4. Answer the questions:



Which gear is the fastest?

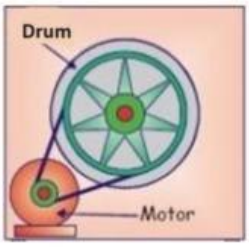
Which one is the slowest?

5. Indicate the direction of rotation:

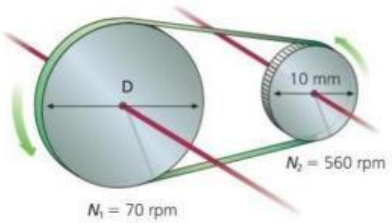


A	Clockwise
B	
C	
D	

3. The washing machine motor rotates at 1500 rpm. The drive pulley transmits the motion to the drum (*tambor de la lavadora*). Calculate the velocity of the drum.
   Data: D1 =7 cm D2= 35 cm



6. Calculate:



a) The diameter of the drive pulley.

b) The speed ratio (i).

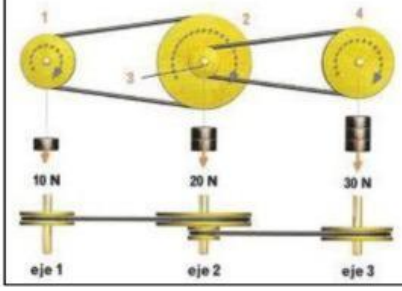
c) Does this system reduce or multiply the velocity?

d) How many times?

7. Calculate the velocity of the pinion (small gear) if the drive gear (the big one) rotates at 30 rpm. How much is the speed ratio (i)? Data: The pinion has15 teeth and gear double number of teeth.

8. Calculate the velocity of the gear if the screw rotates at 1800 rpm. How much is the speed ratio (i)? Data: The screw has 1 groove.

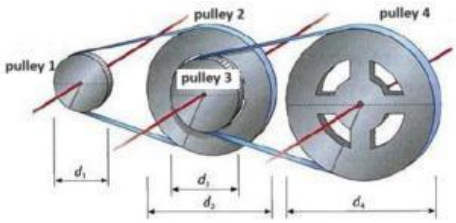
- **PULLEY TRAINS**



This consists of two pairs of pulleys with belts working together.

As shown in the picture, the central shaft is made up with two pulleys built together. To study this mechanism we have to divide it in parts. First of all we analyze the first two pulleys and then the other two, considering the same speed for both central pulleys.

9. Calculate the speed ratio of these pulley train (i) and calculate the speed of each pulley if the drive wheel rotates at 100 rpm.

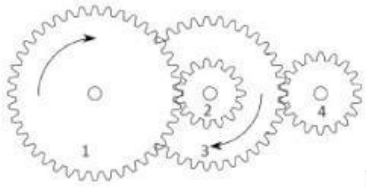


$D_1 = 5$ cm $D_2 = 20$ cm $D_3 = 15$ cm $D_4 = 30$ cm

- **GEAR TRAINS**

This consists of two pairs of gears working together. It is used when we need large changes in speed of rotation. This mechanism must be calculated the same as we saw in the belts and pulleys train.

10. Complete the table with the data that you have to calculate. The drive gear is rotating at 1500 rpm.



$Z_1 = 80$ cm $Z_2 = 16$ cm $Z_3 = 60$ cm $Z_4 = 20$ cm

Gear ratio$_{1-2}$	Gear ratio$_{3-4}$	Total gear ratio	N_2	N_3	N_4