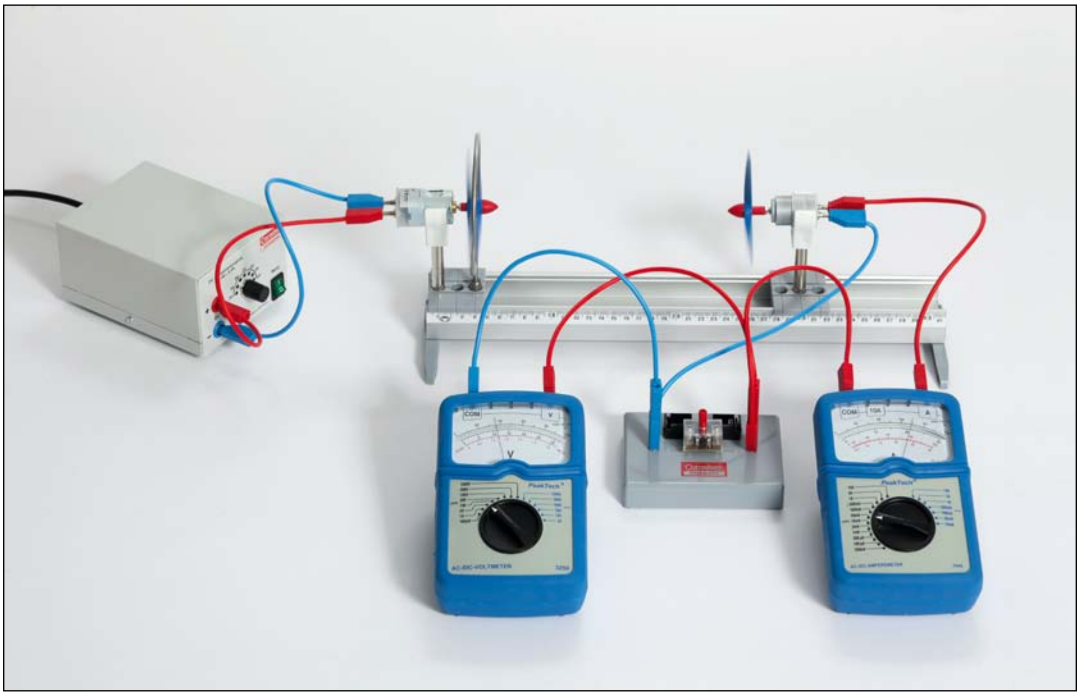
Experiment description/Manual

Demonstration kit

Wind energy



Cornelsen EXPERIMENTA

Demonstration kit

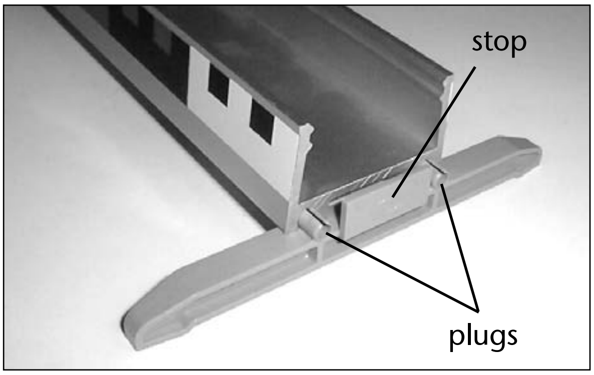
Wind energy

Order number 54620

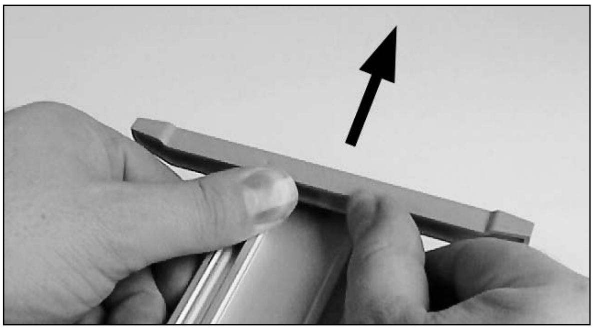
Contents

Cornelsen Experimenta products are designed for **educational** use only and are not intended for use in
industrial, medical or commercial applications.
We assume no liability for damages which are caused by inappropriate usage of the equipment.

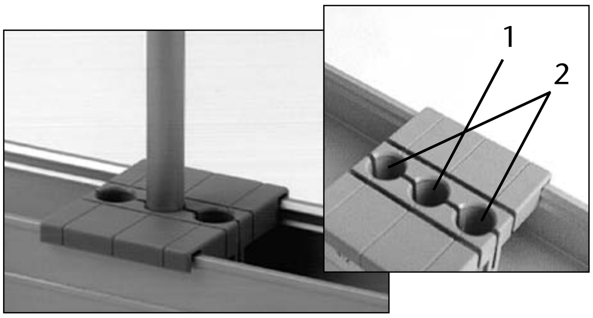
General notes



The experiments are set up on a rail.
The plastic feet can be plugged into the grooves of the rail. Please take care that the feet are inserted as far as the stop and that they are straight.
Mounting of the feet can be eased by the application of a little silicone grease inside the grooves.



Keep the feet straight when pushing them off. The best way to remove the feet is to turn the rail upside down and use your thumbs to press the feet out of the rail (see the picture).



The clamp sliders can be attached to any position on the rail. They serve for insertion and fixing of the rods.
Therefore the middle aperture of the clamp slider (1) shall be used, the slider is then fixed on the rail. To keep slider and rod relocatable on the rail, use the outer apertures (2).

Safety notice:

Please observe this for all experiments:
Do not touch moving rotor blades!

Wind energy

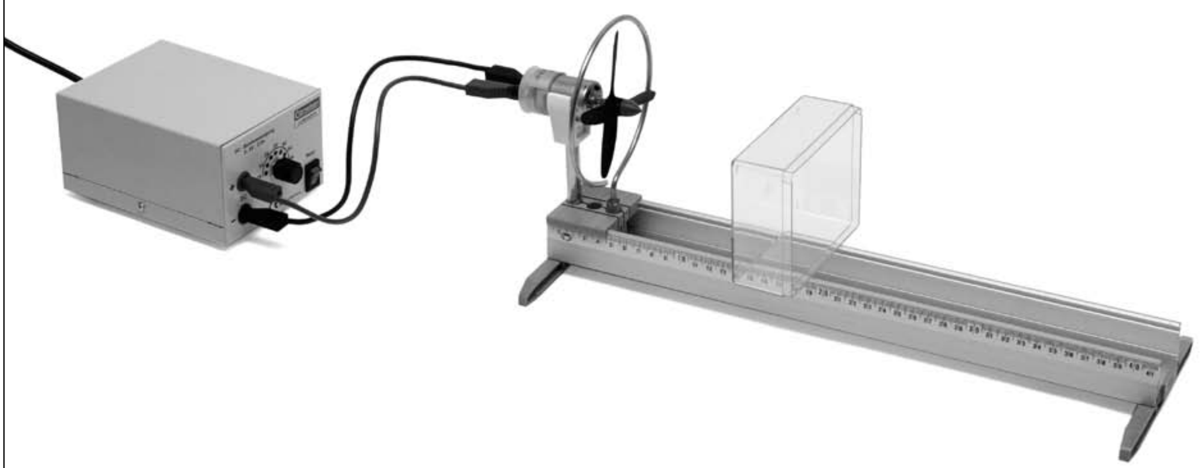
List of components

Illustr. no.	Qty.	Description	Order no.
1	1	Rail, 420 mm	408101
2	1	Pair of feet for rail	40861
3	2	Clamp sliders	40820
4	1	Motor on rod with 4-mm axle	54587
5	1	Generator on rod with 4-mm axle	54588
6	1	Rotor with 2 blades and 4-mm bushing	44571
7	1	Rotor with 3 blades and 4-mm bushing	44572
8	2	Rotors with 4 blades and 4-mm bushing	44573
9	4	Experiment leads, 250 mm, red	51613
10	4	Experiment leads, 250 mm, blue	51620
11	1	Mignon NiMH accumulator battery, 1.2 V	51920
12	1	Socket for plug-in components and holder for accumulator battery	51945
13	1	LED, red, on plug-in element	62714
14	1	Silicon diode, on plug-in element	62988
15	1	Lamp holder, E10, on plug-in element	52188
16	2	Bulbs, 1.5 V/0.15 A	53131
17	1	Variable resistor, 100 Ω, on plug-in element	62730
18	1	Power supply, 1 – 6 V/2.5 A DC	55225
19	1	Water basin, transparent	54605
20	1	Pump with motor and hose	54610
21	1	Ring on rod, 110 mm diam.	77057
22	1	Storage plan „Wind Energy“	546203
–	1	Silicone grease	408619

Storage plan

Wind energy

1 Energy from an air current



Material

Rail	1
Pair of feet for rail	2
Clamp slider	3
Motor on rod	4
Rotor with 4 blades	8
Experiment lead, red	9
Experiment lead, blue	10
Power supply	18
Ring on rod	21

Experiment set-up

Attach feet to both ends of the rail and place a clamp slider at one end. Attach the motor to the left-hand clamp of the slider with the pin preventing it from turning to the side. Then attach the ring on a rod to the right-hand side of the slider and align it at right angles to the rail. Next push a 4-blade rotor onto the shaft of the motor.
Connect the motor to the power supply using experiment leads. Make sure the supply is switched off when you do this. Set the knob on the supply to “0 V”.

Keep ready the bottom of the plastic box in which the rotor blades are stored.

Experiment

First turn on the power supply and set the knob to “1 V”, and then hold your hand out with the open palm held vertical above the rail about 20 cm from the rotor (be careful not to touch the rotor blades). If you cannot feel a breeze, then the polarity of the motor needs to be reversed. Now turn the knob on the supply briefly up to “2 V” and then up to “3 V” and check what happens with your hand.
Next turn the knob back to “0 V” and place the plastic box on the rail about 10 cm from the rotor, resting on one of its long sides so that the bottom is pointing towards the rotor. Turn the supply knob to “1 V”, “2 V” and “3 V” in sequence and see what happens to the plastic box.
Finally turn the knob back to “0 V” and turn off the power supply.

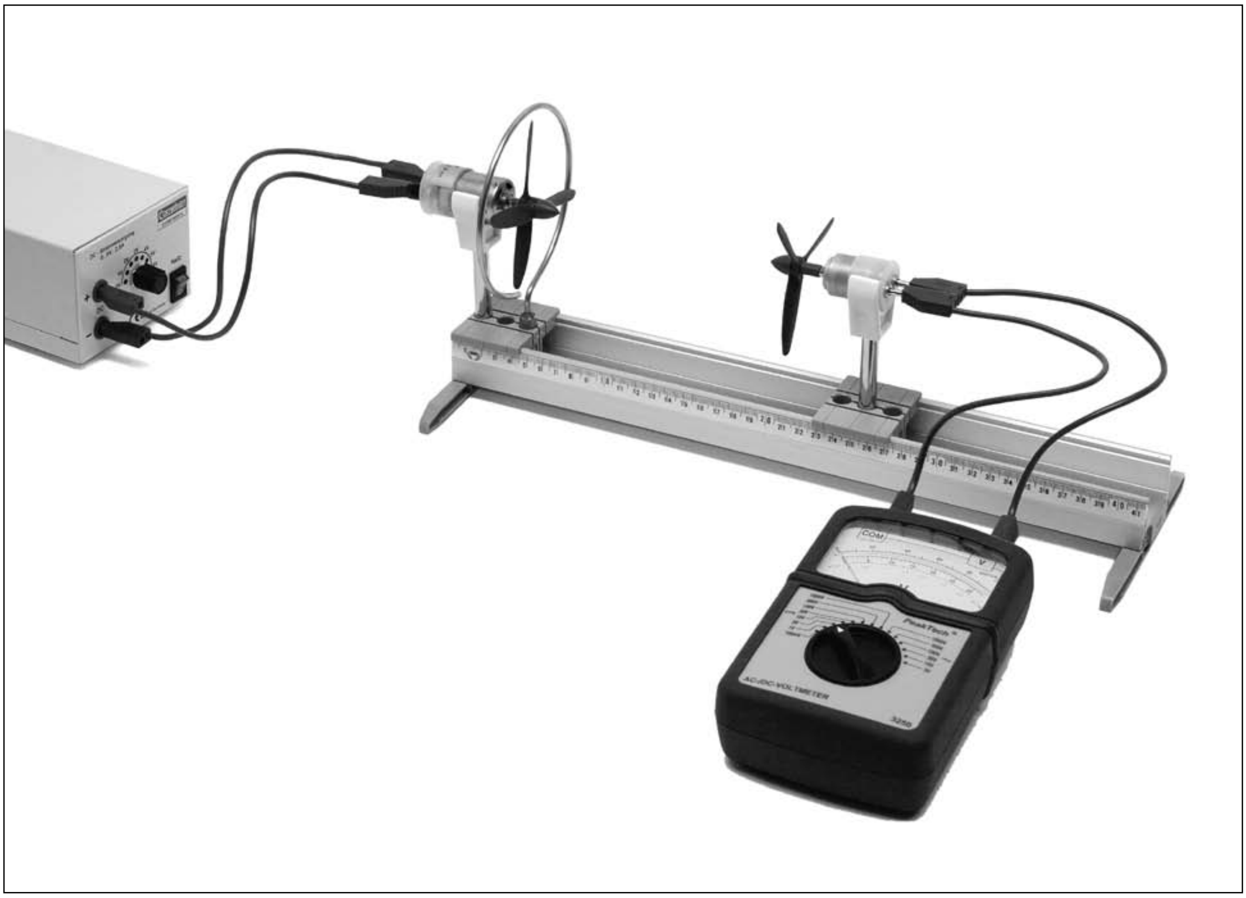
Results

When a large number of air molecules all move in the same direction at once, it can be called a flow of air, an air current or a breeze.
If an increase in the energy they are receiving should cause the speed of the molecules to increase then the air current gets stronger. The energy in the breeze itself has increased.
The energy in an air current can be transferred to other locations and converted into other mechanical forms of energy. This is clear from the fact that the plastic box is pushed away or tipped over.

For centuries now, people have been using the energy from such air currents to propel sailing ships, windmills and wind pumps. More recently, of course, they are also using it for wind turbine power plants.
It is obvious how much energy can be contained in winds by looking at the destructive effects of storms.

Wind energy

2 Energy conversion



Material

Rail	1
Pair of feet for rail	2
Clamp sliders (2x)	3
Motor on rod	4
Generator on rod	5
Rotor with 3 blades	7
Rotor with 4 blades	8
Experiment leads, red (2x)	9
Experiment leads, blue (2x)	10
Power supply	18
Ring on rod	21

Additionally required:
Meter with a DC voltage measuring range of 5 V

Experiment set-up

Attach feet to both ends of the rail and place the clamp sliders at the position as illustrated .
Attach the motor to the left-hand part of the left-hand slider with the pin preventing it from turning to the side. Then attach the ring on a rod to the right-hand side of the slider and align it at right angles to the rail. Next push a 4-blade rotor onto the shaft of the motor.
Connect the motor to the power supply using experiment leads. Make sure the supply is switched off when you do this. Set the knob on the supply to “0 V”.
Plug the generator into the centre plug of the right-hand slider. Attach a 3-blade rotor to its shaft. To begin with, do not connect the outputs from the generator.

Experiment

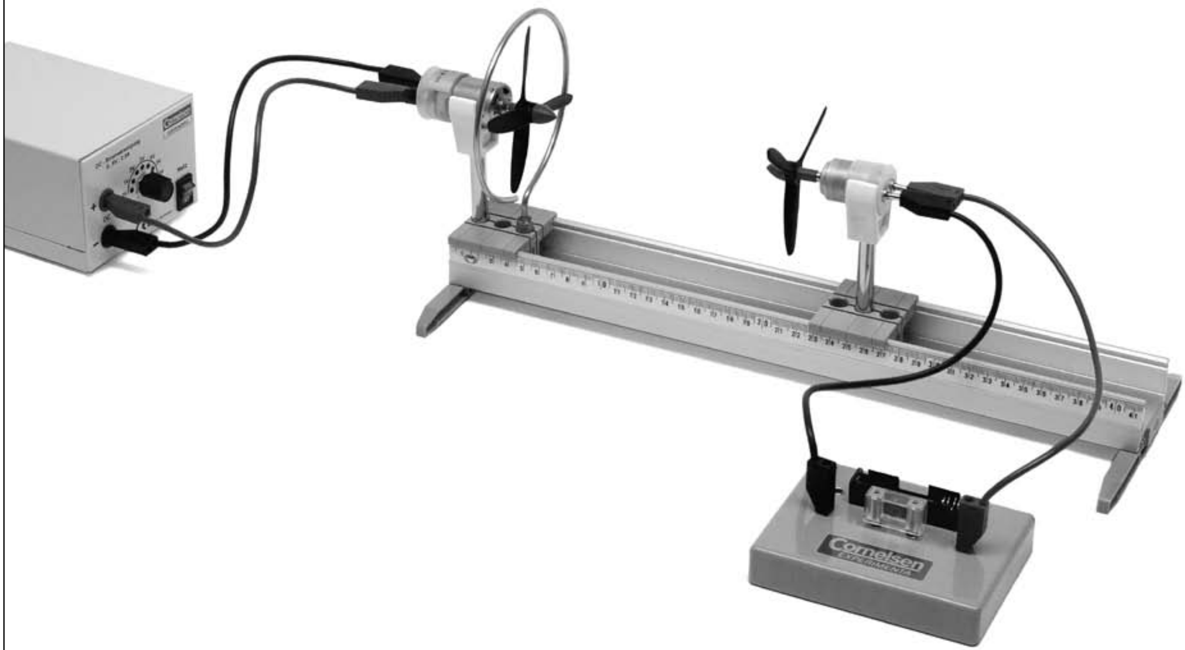
Set the knob on the supply to “3 V”, turn it on and observe what happens to the rotor. Turn the supply off again afterwards.
Now connect the output sockets of the generator to a meter, which has been set to a DC measuring range of 5 V.
Turn the supply back on and observe the display on the meter.
Next, the knob on the supply should briefly be set to “4 V”, “5 V” and then “6 V” and you should observe the meter display at each of those settings.
Finally turn the knob back to “0 V” and turn off the power supply

Results

The flow of air from the wind generator acts on the blades of the generator’s rotor causing them to turn. The rotary motion arises both because of the air current being deflected sideways at the surface of the blades and because of the air flowing around the rotor blades. The motion of the rotor blades drives the generator, which produces an electric voltage due to inductive effects.
The energy of the air current is initially converted to rotary motion of the rotor blades, which in turn is converted into electrical energy by the generator.

The greater the energy of the air current, the higher the voltage generated by induction in the generator will be, meaning that the amount of useful electrical energy will be also be greater.

3 Polarity of the voltage at the generator



Material

Rail	1
Pair of feet for rail	2
Clamp sliders (2x)	3
Motor on rod	4
Generator on rod	5
Rotor with 3 blades	7
Rotor with 4 blades	8
Experiment leads, red (2x)	9
Experiment leads, blue (2x)	10
Socket for plug-in components	12
LED, red	13
Power supply	18
Ring on rod	21

Experiment set-up

Attach feet to both ends of the rail and place the clamp sliders at the position illustrated.
Attach the motor to the left-hand part of the left-hand slider with the pin preventing it from turning to the side. Then attach the ring on a rod to the right-hand side of the slider and align it at right angles to the rail. Next push a 4-blade rotor onto the shaft of the motor.
Connect the motor to the power supply using experiment leads. Make sure the supply is switched off when you do this. Set the knob on the supply to "0 V".
Plug the generator into the centre plug of the right-hand slider. Attach a 3-blade rotor to its shaft.
Connect the outputs from the generator to the socket for plug-in components via experiment leads, having first removed the jumpers. Insert the plug with an LED into the socket.

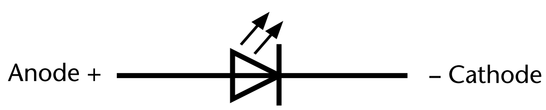
Experiment

Set the knob on the supply to "4 V", turn it on and observe what happens to the LED. Turn the supply off again afterwards.
Now take out the plug-in component with the LED and plug it back in to the socket having turned it round by 180°.
Turn on the supply again and observe the LED once again.
Finally turn the knob back to "0 V" and turn off the power supply.

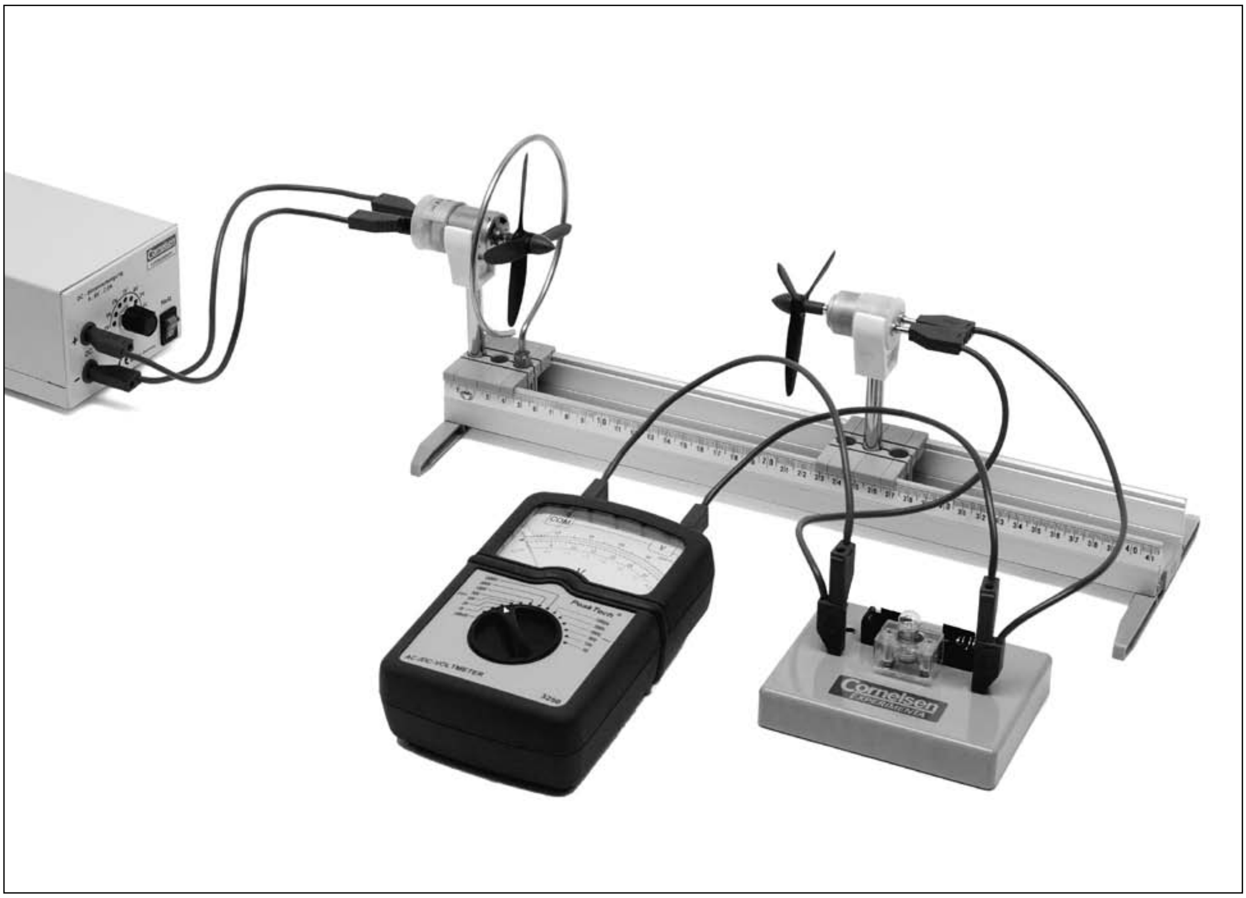
Results

The LED only lights up in one direction. Since the illumination of the LED is dependent on the polarity of the applied voltage, it can be deduced that the voltage produced by the generator is DC. The generator to be used must therefore be designed in such a way that the voltage created therein by induction always has the same polarity at the output sockets.

The LED lights up when its cathode is connected to the negative pole of the generator and its anode is connected to the positive pole.



4 Influence of wind speed



Material

Rail	1
Pair of feet for rail	2
Clamp sliders (2x)	3
Motor on rod	4
Generator on rod	5
Rotor with 3 blades	7
Rotor with 4 blades	8
Experiment leads, red (3x)	9
Experiments leads, blue (3x)	10
Socket for plug-in components	12
Lamp holder, E10	15
Bulb, 1.5 V/0.15 A	16
Power supply	18
Ring on rod	21

Additionally required:
Meter with a DC voltage measuring range of 5 V

Experiment set-up

Attach feet to both ends of the rail and place the clamp sliders at the position illustrated.
Attach the motor to the left-hand part of the left-hand slider with the pin preventing it from turning to the side. Then attach the ring on a rod to the right-hand side of the slider and align it at right angles to the rail. Next push a 4-blade rotor onto the shaft of the motor.
Connect the motor to the power supply using experiment leads. Make sure the supply is switched off when you do this. Set the knob on the supply to “0 V”.
Plug the generator into the centre plug of the right-hand slider. Attach a 3-blade rotor to its shaft. Connect the outputs from the generator to the socket for plug-in components via experiment leads, having first removed the jumpers. Insert the plug-in component with the lamp socket but do not yet screw a 1.5-V bulb into it.
Connect a meter in parallel with the lamp, having set it to measure a DC range of 5 V.

Experiment

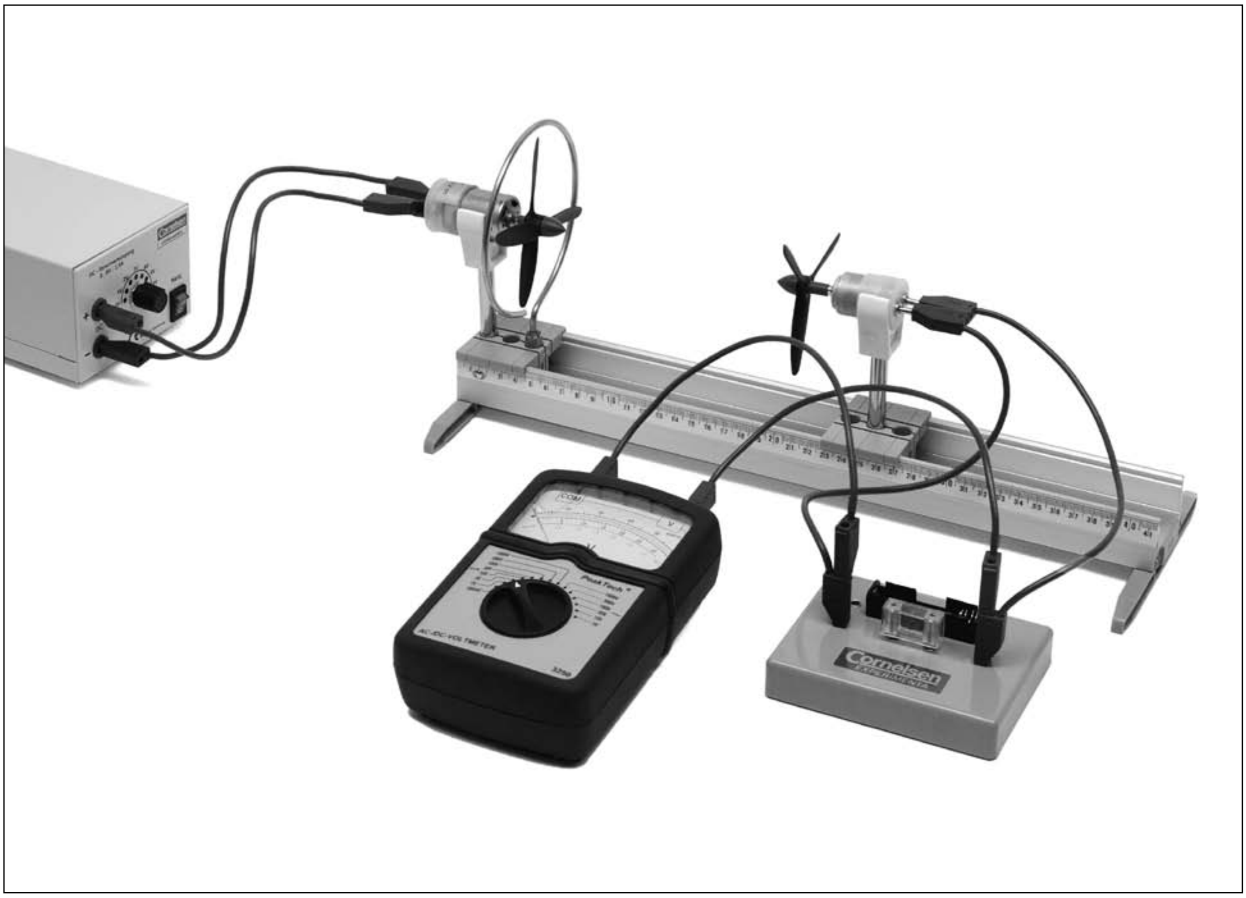
Set the knob on the supply to “3 V”, turn it on and observe what happens to the generator rotor. Read off the voltage from the meter.
Then, screw a bulb into the socket and observe how this affects the speed of the rotor and the behaviour of the lamp filament. Read off the voltage again.
Next, the knob on the supply should briefly be set to “4 V”, “5 V” and then “6 V” and you should observe the lamp filament and the meter display at each of those settings. Turn the supply off again afterwards.

For the second part of this experiment, the clamp slider should first be moved to the right-hand end of the rail and the knob of the power supply set to “4 V”.
Turn on the supply and observe the behaviour of the rotor and the lamp for about a minute. Read off the generated voltage.
Afterwards, the slider should be gradually moved towards the generator in steps of 5 cm at a time. In each position, observe the equipment for about a minute and read off the generated voltage.

Results

When a load is placed on the generator by connecting a lamp to it, both the speed of the rotor and the voltage produced are lower than when there is no load. This is because the energy supplied by the air flow is no longer being used solely to overcome the generator’s own friction. A considerable fraction of it is now being used to light the lamp.
Increasing the energy in the air flow by increasing wind speed on the fan and using more of the energy from the air by moving the generator closer towards the fan causes the rotor speed to increase. This, in turn, increases the voltage produced by the generator and the lamp also gets brighter.
Both cases lead to the amount of energy transferred being greater.

5 Influence of wind direction



Material

Rail	1
Pair of feet for rail	2
Clamp sliders (2x)	3
Motor on rod	4
Generator on rod	5
Rotor with 3 blades	7
Rotor with 4 blades	8
Experiment leads, red (3x)	9
Experiments leads, blue (3x)	10
Socket for plug-in components	12
LED red	13
Power supply	18

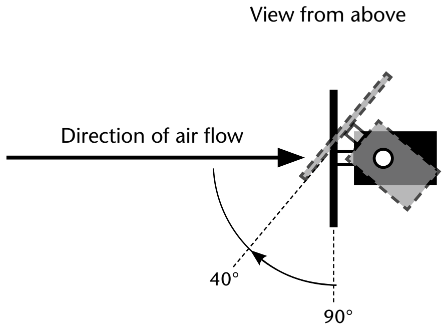
Additionally required:
Meter with a DC voltage measuring range of 5 V

Experiment set-up

Attach feet to both ends of the rail and place the clamp sliders at the position illustrated.
Attach the motor to the left-hand part of the left-hand slider with the pin preventing it from turning to the side. Then attach the ring on a rod to the right-hand side of the slider and align it at right angles to the rail. Next push a 4-blade rotor onto the shaft of the motor.
Connect the motor to the power supply using experiment leads. Make sure the supply is switched off when you do this. Set the knob on the supply to "0 V".
Plug the generator into the centre plug of the right-hand slider. Attach a 3-blade rotor to its shaft. Turn the generator around in the slider so that the rotor is aligned at right angles to the rail. Use experiment leads to connect the generator outputs to the socket for plug-in components, having first removed the jumpers. Plug the LED component into the socket. Set a meter to a DC measuring range of 5 V and connect it in parallel with the LED.

Experiment

Set the knob on the supply to "4 V", turn it on and observe what happens to the LED. If the LED fails to light up, swap over the leads connecting the terminals of the generator.
When the LED is lit, read off the voltage from the meter and enter it into the following table.
Next, slowly turn the generator and rotor to the angles indicated and, in each case, observe the LED and read off the voltage, making a note of it in the table.



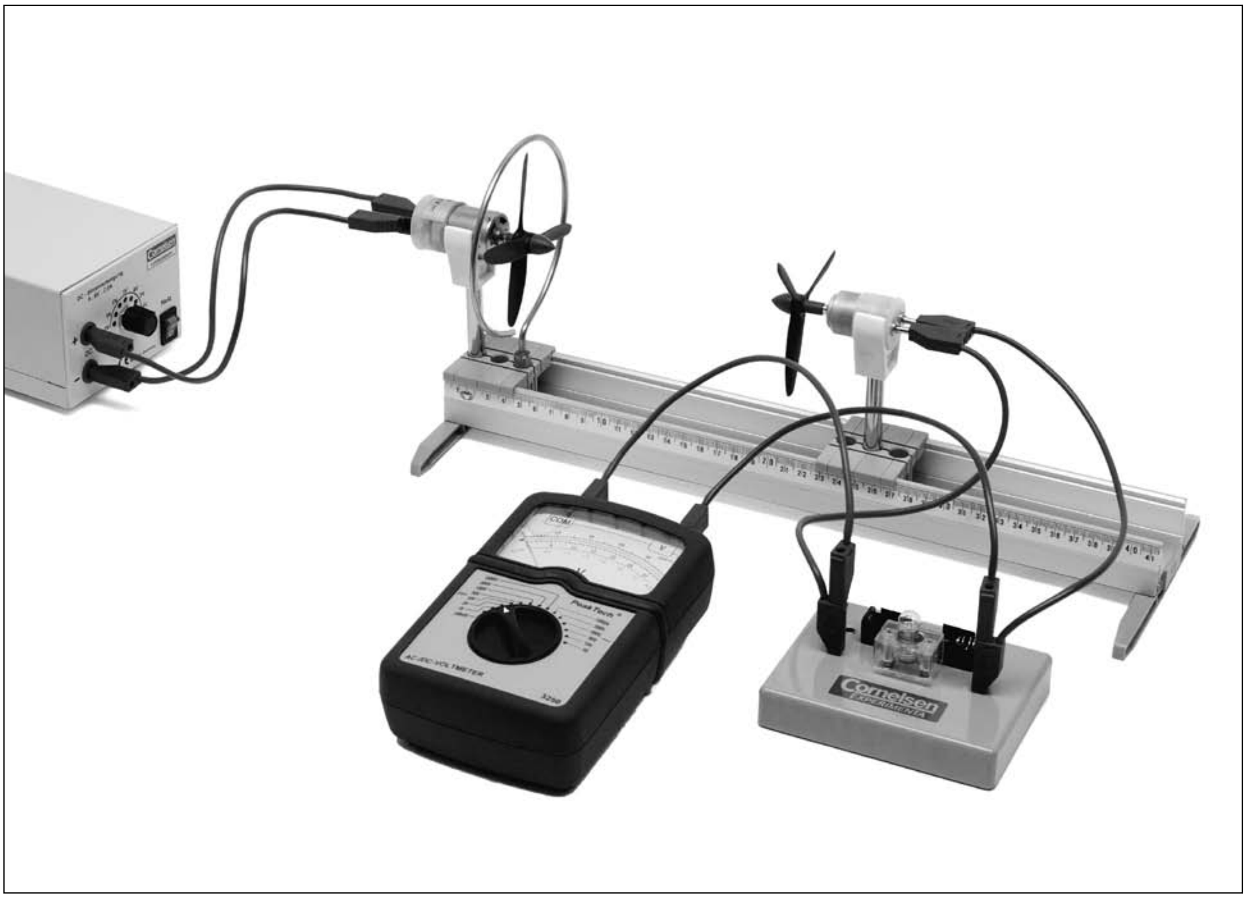
Angle between rotor and air flow	90°	80°	70°	60°	50°	40°
Voltage [V]						

Results

The generator produces the highest voltage when the rotor plane is at right angles to the flow of air. The further away the rotor gets from that optimum position, the lower the voltage generated.

When putting wind generators to practical use for generating energy, care needs to be taken to ensure that the rotors are always aligned optimally with respect to the wind direction.

6 Influence of a load on a wind turbine



Material

Rail	1
Pair of feet for rail	2
Clamp sliders (2x)	3
Motor on rod	4
Generator on rod	5
Rotor with 3 blades	7
Rotor with 4 blades	8
Experiment leads, red (3x)	9
Experiments leads, blue (3x)	10
Socket for plug-in components	12
Lamp holder, E10	15
Bulb, 1.5 V/0.15 A	16
Power supply	18
Ring on rod	21

Additionally required:
Meter with a DC voltage measuring range of 5 V

Experiment set-up

Attach feet to both ends of the rail and place the clamp sliders at the position illustrated.
Attach the motor to the left-hand part of the left-hand slider with the pin preventing it from turning to the side. Then attach the ring on a rod to the right-hand side of the slider and align it at right angles to the rail. Next push a 4-blade rotor onto the shaft of the motor.
Connect the motor to the power supply using experiment leads. Make sure the supply is switched off when you do this. Set the knob on the supply to “0 V”.
Plug the generator into the centre plug of the right-hand slider. Attach a 3-blade rotor to its shaft.
Connect the outputs from the generator to the socket for plug-in components via experiment leads, having first removed the jumpers. Insert the plug-in component with the lamp socket but do not yet screw a 1.5-V bulb into it.
Connect a meter in parallel with the lamp, having set it to measure a DC range of 5 V.

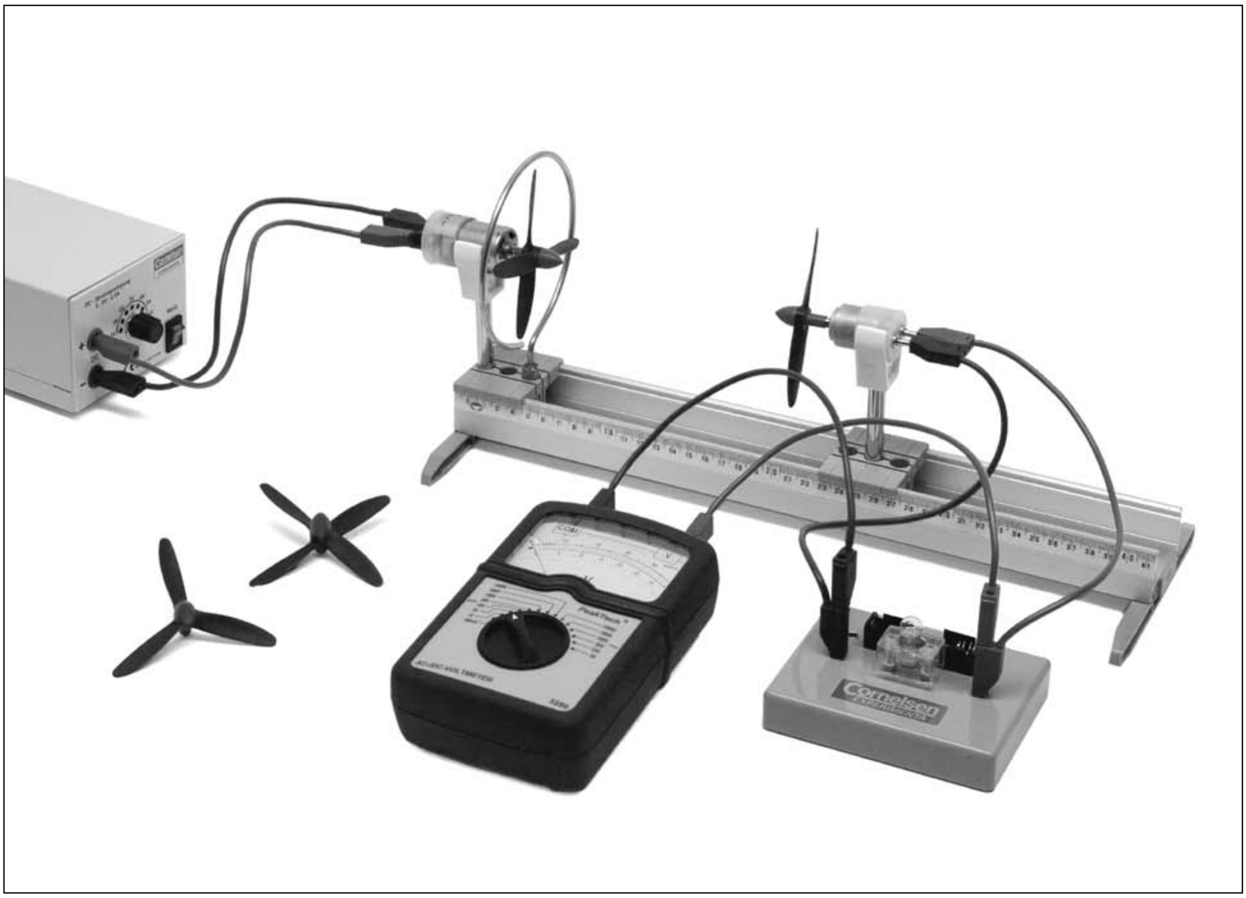
Experiment

Set the knob on the supply to “4 V”, turn it on and observe what happens to the generator rotor. Read off the voltage from the meter. Then, screw a bulb into the socket and observe how this affects the speed of the rotor and the behaviour of the lamp filament. Read off the voltage again. Now screw the bulb in and out a few times and observe what happens to the rotor and the lamp filament.
Finally, turn off the power supply.

Results

Once the power is turned on, the rotor starts to turn, the bulbs lights up and the generated voltage can be read off from the meter.
When the bulb is screwed out, the speed of the rotor increases markedly, since the generator is not supplying any energy to the bulb and thus rotates fast without a load.
The voltage generated is much higher than when there is a load.
When the bulb is screwed back in, it lights up again and the rotor speed, as well as the voltage, drops back to where it was before.

7 Influence of the number of rotor blades



Material

Rail	1
Pair of feet for rail	2
Clamp sliders (2x)	3
Motor on rod	4
Generator on rod	5
Rotor with 2 blades	6
Rotor with 3 blades	7
Rotors with 4 blades (2x)	8
Experiment leads, red (3x)	9
Experiments leads, blue (3x)	10
Socket for plug-in components	12
Lamp holder, E10	15
Bulb, 1.5 V/0.15 A	16
Power supply	18
Ring on rod	21

Additionally required:
Meter with a DC voltage measuring range of 5 V

Experiment set-up

Attach feet to both ends of the rail and place the clamp sliders at the position illustrated.
Attach the motor to the left-hand part of the left-hand slider with the pin preventing it from turning to the side. Then attach the ring on a rod to the right-hand side of the slider and align it at right angles to the rail. Next push a 4-blade rotor onto the shaft of the motor.
Connect the motor to the power supply using experiment leads. Make sure the supply is switched off when you do this. Set the knob on the supply to "0 V".
Plug the generator into the centre plug of the right-hand slider. Attach a 2-blade rotor to its shaft. Connect the outputs from the generator to the socket for plug-in components via experiment leads, having first removed the jumpers. Insert the plug-in component with the lamp holder and screw a 1.5-V bulb into it. Connect a meter in parallel with the lamp, having set it to measure a DC range of 5 V.
Have the 3-blade and 4-blade rotors ready to use as well.

Experiment

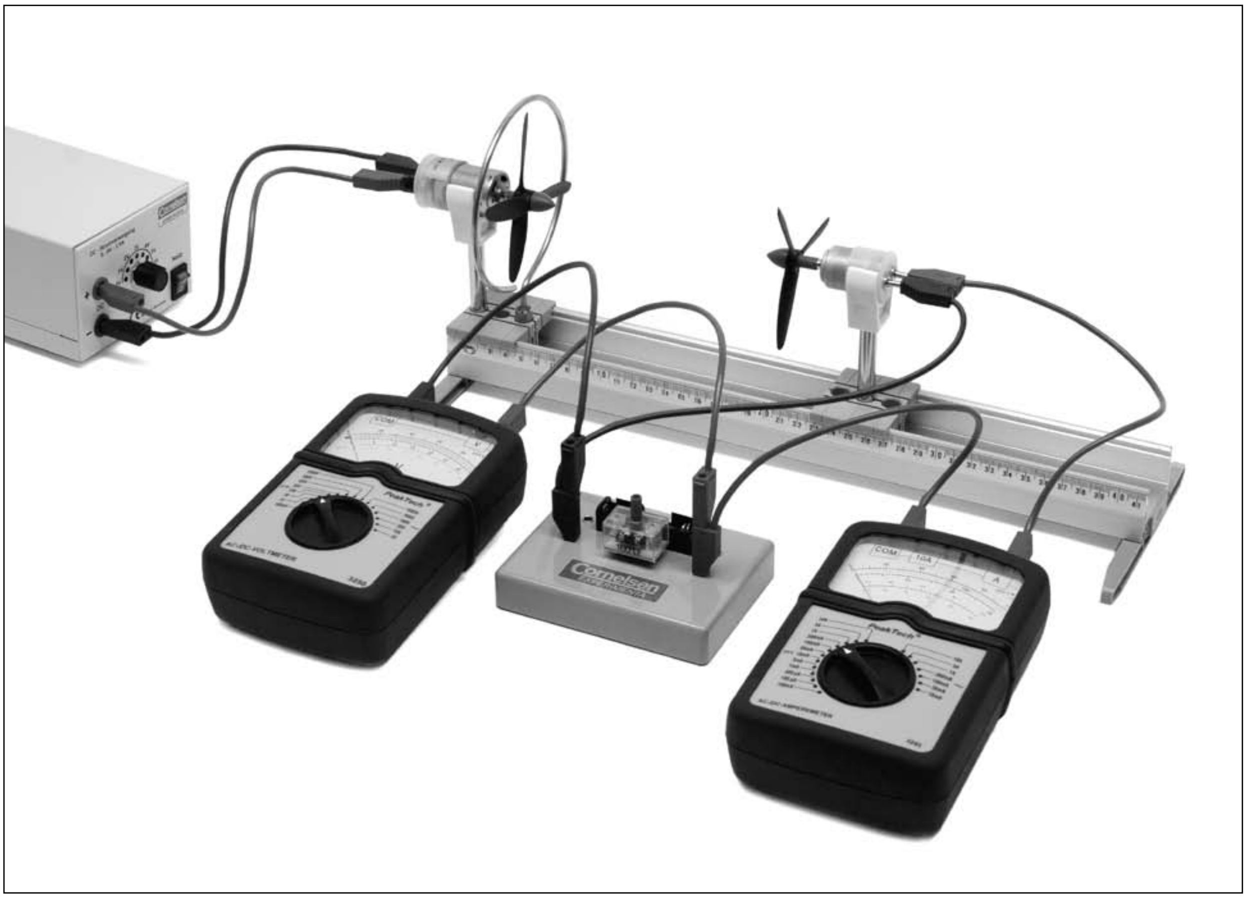
Set the knob on the supply to "4 V", turn it on and observe what happens to the generator rotor and the lamp filament. Read off the voltage from the meter.
Write down the results in the following table.
Repeat the whole procedure with a 3-blade rotor and then with a 4-blade rotor and write the results with those into the table too.
Finally turn off the power supply.

Rotor	**Voltage [V]**
2 blades	
3 blades	
4 blades	

Results

The voltage from the generator is only high enough to light the bulb when the rotor has reached a certain speed. In order to achieve this speed, enough energy needs to be transferred to the rotor from the flow of air.
The 2-blade rotor is unable to gain enough energy from the air because the area of the two rotor blades in the air flow is too small.
Since 3- and 4-blade rotors have a greater area for the air to catch, they can get enough energy from the air to pass to the generator.
It is nevertheless impossible to detect any superiority of the 4-blade rotor over the 3-blade one, because when the number of blades is increased, the air resistance on the rotor as a whole also increases, which reduces the amount of energy which can be transferred.
In practical use where wind turbines are being used for energy generation, it has been found that triple bladed rotors are a convenient compromise.

8 Power output of a wind turbine



Material

Rail	1
Pair of feet for rail	2
Clamp sliders (2x)	3
Motor on rod	4
Generator on rod	5
Rotors with 4 blades (2x)	8
Experiment leads, red (3x)	9
Experiments leads, blue (3x)	10
Socket for plug-in components	12
Variable resistor, 100 Ω	17
Power supply	18
Ring on rod	21

Additionally required:

Meter with a DC voltage measuring range of 5 V

Meter with a DC current measuring range of 500 mA

Experiment set-up

Attach feet to both ends of the rail and place the clamp sliders at the position illustrated.
Attach the motor to the left-hand part of the left-hand slider with the pin preventing it from turning to the side. Then attach the ring on a rod to the right-hand side of the slider and align it at right angles to the rail. Next push a 4-blade rotor onto the shaft of the motor. Connect the motor to the power supply using experiment leads. Make sure the supply is switched off when you do this. Set the knob on the supply to "0 V".
Plug the generator into the centre plug of the right-hand slider. Attach a 3-blade rotor to its shaft. Connect the outputs from the generator to the socket for plug-in components via experiment leads, having first removed the jumpers. This time connect a meter set to measure a direct current of 500 mA into one of the connections.
Use the plug-in component with the variable resistor and use experiment leads to connect another meter in parallel with it, this one being set to measure a DC voltage range of 5 V.

Experiment

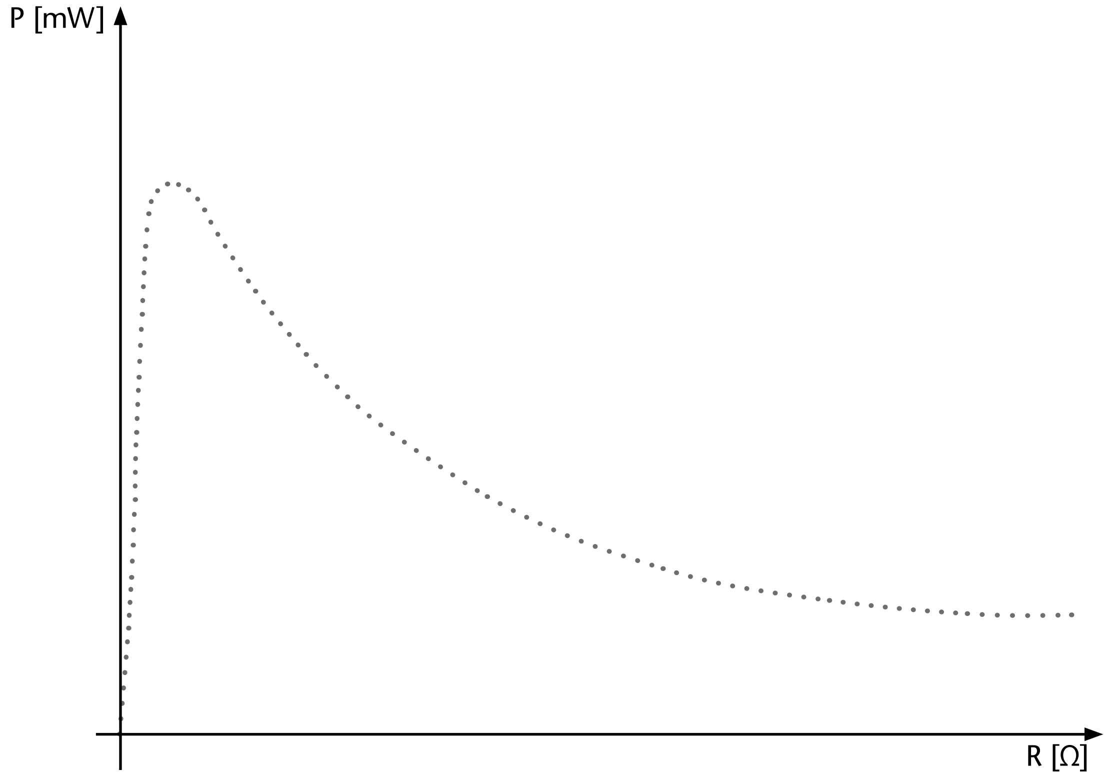
Set the knob on the supply to "4 V", turn it on and observe what happens to the generator rotor.
Read off the voltage and the current flowing through the variable resistor from the meters.
Enter both values into the table.
Turn the knob of the variable resistor slowly and carefully in order to reduce the voltage displayed in steps of 0.2 V. In each case, read off the current and write it down in the table.
Turn off the power supply when you have finished.
Now calculate the resistance corresponding to each pair of voltage and current values (R =U/I) and also the power supplied to the resistor (P = U x I) in each case. Write these down in the table as well.

Setting	Voltage [V]	**Current [mA]**	Resistance [Ω]	**Power [mW]**
Fully anti-clockwise				
Step 1				
Step 2				
Step 3				
Step 4				
Step 5				
Step 6				
Step 7				
Step 8				
Step 9				
Step 10				

Experiment 8 continued:

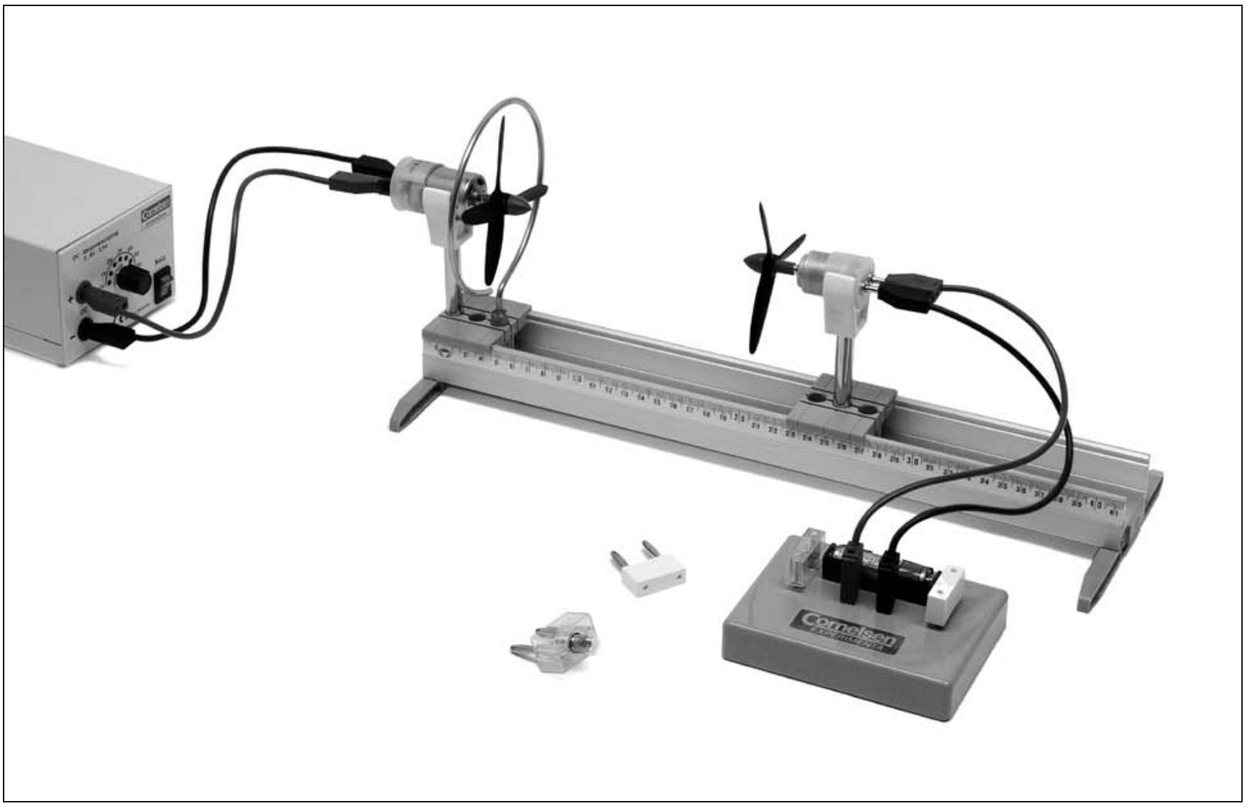
Results

The current flowing through the variable resistor means that there is a load on the generator. It produces electrical energy, which is converted to heat by the resistor, the amount of heat being dependent on the resistance value itself. Any change in the resistance causes the amount of energy converted to be different. This should be apparent from the resistance and power values you have calculated. The nature of this dependence can easily be seen by drawing a graph. This sort of representation makes it very clear for which resistance values (i.e. degree of loading) maximum power can be supplied..



In practical use where wind turbines are being used for energy generation, the generators can be optimised to maximum output using graphs just like this.

9 Storage of energy



Material

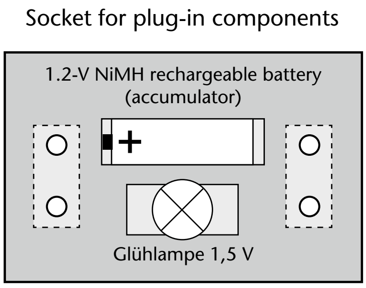
Rail	1	Mignon NiMH accumulator battery, 1.2 V	11
Pair of feet for rail	2	Socket for plug-in components	12
Clamp sliders (2x)	3	Silicon diode	14
Motor on rod	4	Lamp holder, E10	15
Generator on rod	5	Bulb, 1.5 V/0.15 A	16
Rotor with 3 blades	7	Power supply	18
Rotor with 4 blades	8	Ring on rod	21
Experiment leads, red (2x)	9		
Experiment leads, blue (2x)	10		

Experiment set-up

Attach feet to both ends of the rail and place the clamp sliders at the position illustrated.
Attach the motor to the left-hand part of the left-hand slider with the pin preventing it from turning to the side. Then attach the ring on a rod to the right-hand side of the slider and align it at right angles to the rail. Next push a 4-blade rotor onto the shaft of the motor.
Connect the motor to the power supply using experiment leads. Make sure the supply is switched off when you do this. Set the knob on the supply to "0 V".
Plug the generator into the centre plug of the right-hand slider. Attach a 3-blade rotor to its shaft. Initially the generator outputs should not be connected to anything.
Remove the jumpers from the socket for plug-in components and insert a battery in the holder on the socket base. Insert the plug-in component with the lamp socket and screw a 1.5-V bulb into it.

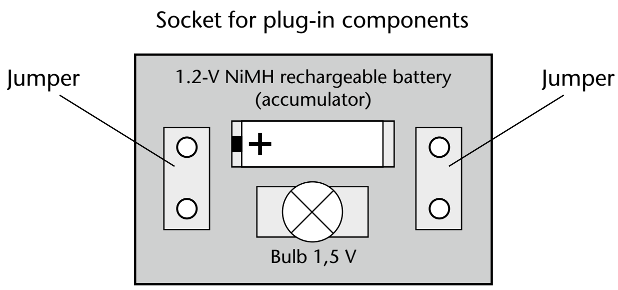
Wind energy

Make sure you are careful to get the polarity right.



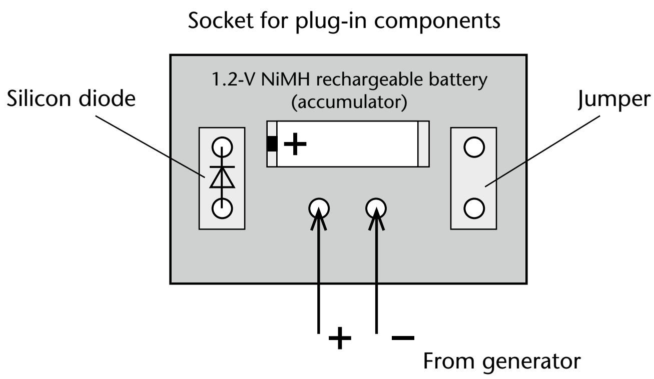
Experiment

Inserting the jumpers connects the terminals of the battery to those of the lamp.



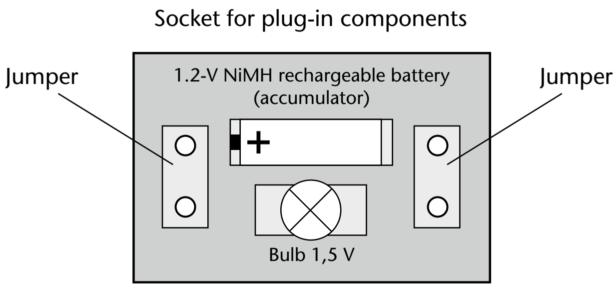
Observe what happens.

Afterwards, remove the left-hand jumper and the plug-in component with the lamp from the socket. Now use experiment leads to connect the outputs from the generator to the socket base as shown and plug in the component with the diode in place of the removed jumper.



Make sure you are careful to get the polarity right when connecting the leads and plugging in the diode.

Set the knob on the power supply to “4 V”, turn it on and leave it on for about 5 minutes.
When the time is up, turn the supply off again and disconnect the generator from the socket. Take out the plug-in component with the diode again and replace it with the jumper you removed previously.
Now plug the lamp component back in and observe what happens to the bulb.



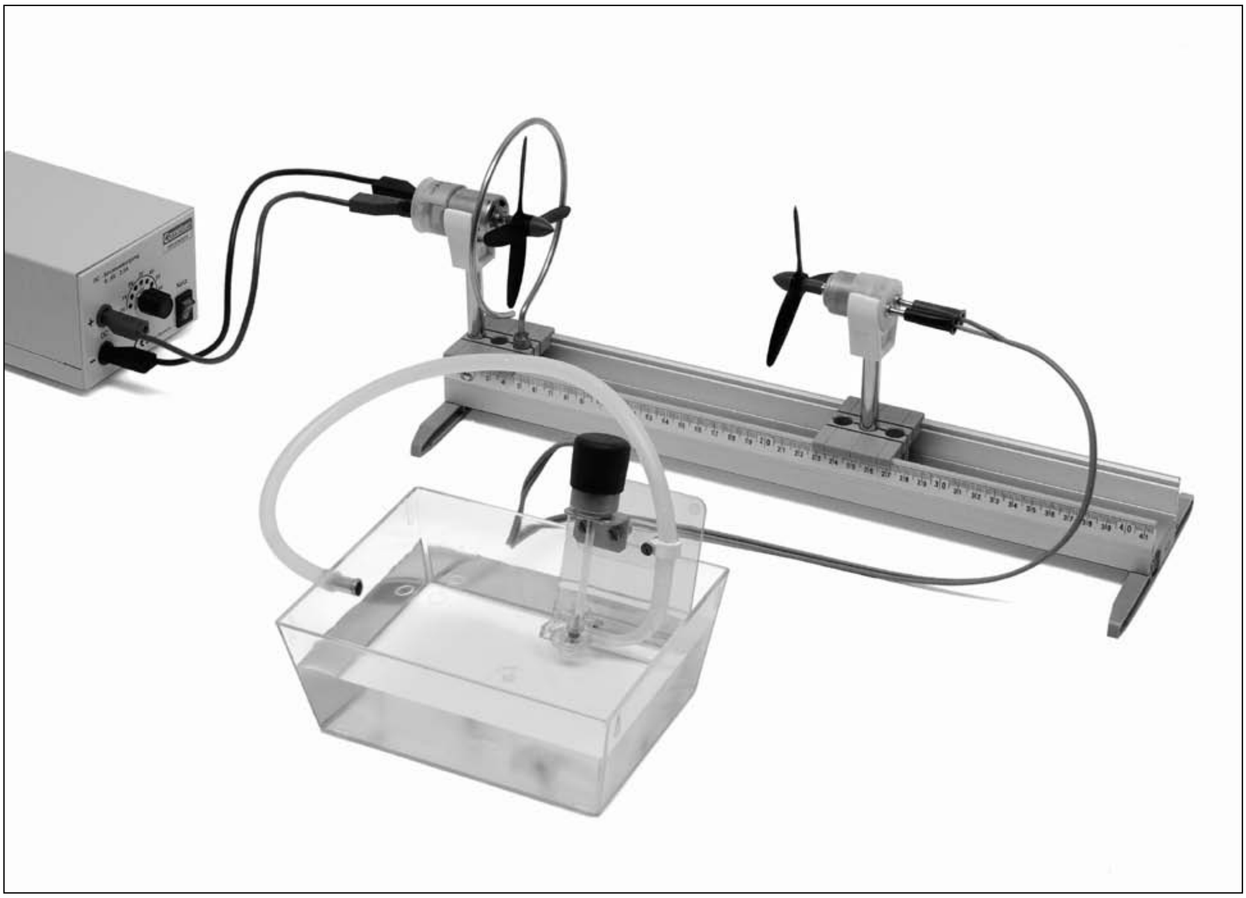
Turn off the power supply when you are finished.

Results

A lamp will only light if it is getting enough electrical energy fed to it. This energy can come from a fully charged battery, for example. Since the lamp does not light up in the first part of the experiment, it can be deduced that the battery was not charged up with enough energy.
Connecting the accumulator battery to the generator with the correct polarity allows energy to be transferred from the generator to the battery to charge it up. Electrical energy is thus stored in the battery. The charging procedure needs a certain amount of time as it occurs due to electrochemical processes inside the battery itself. The amount of energy stored depends on the time it has been allowed to charge, the current flowing to it and the storage capacity of the battery itself.
Inserting a diode prevents any energy already stored flowing back to the generator, since the diode only allows current to flow towards the battery.
Once it has been allowed to charge for a sufficient amount of time, the battery will have accumulated and stored so much electrical energy that it can now light the bulb when it is connected, as happens in the second part of the experiment.

In practical use where wind turbines are being used for energy generation, the energy produced can be stored in accumulator batteries like this for later use.

10 Utilization of wind energy



Material

Rail	1
Pair of feet for rail	2
Clamp sliders (2x)	3
Motor on rod	4
Generator on rod	5
Rotor with 3 blades	7
Rotor with 4 blades	8
Experiment lead, red	9
Experiment lead, blue	10
Power supply	18
Water basin	19
Pump with motor and hose	20
Ring on rod	21

Experiment set-up

Attach feet to both ends of the rail and place the clamp sliders at the position illustrated.
Attach the motor to the left-hand part of the left-hand slider with the pin preventing it from turning to the side. Then attach the ring on a rod to the right-hand side of the slider and align it at right angles to the rail. Next push a 4-blade rotor onto the shaft of the motor.
Connect the motor to the power supply using experiment leads. Make sure the supply is switched off when you do this. Set the knob on the supply to “0 V”.
Plug the generator into the centre plug of the right-hand slider. Attach a 3-blade rotor to its shaft.
Attach the pump to the side of the water basin and push a hose over the nozzles in the basin itself.
Then connect the terminals of the pump motor with the correct polarity to the outputs of the generator (red plug to the positive pole) and fill the basin up to the height of the nozzles.

Experiment

Set the knob on the supply to “4 V”, turn it on and observe what happens to the generator rotor and how the pump behaves. If the pump does not start running of its own accord, turn the knob of the power supply up to “5 V” and then up to “6 V”. You may still need to give the shaft a slight push with your fingers to get it going.

Note: the hose should be kept as level as possible so that it fills up quickly without pumping water uphill unnecessarily.

Observe the experiment for about two minutes, turning the knob of the power supply back to “5 V”, then to “4 V” and finally back to “5 V” again.
Turn off the power supply when you are finished.

Results

The pump may not start running of its own accord, or at least be somewhat hesitant, since it is first necessary for it to overcome its own internal friction and the static resistance of the water.
Once these problems starting up have been overcome, the pump then has to create enough pressure to fill the hose completely with water. Once the circuit for pumping the water is working fully, the amount pumped depends directly on the energy produced by the flow of air.

Such combinations of wind generators and water pumps are put to practical use in watering or draining agricultural fields and storing water in elevated tanks.

Experiment description/Manual
Demonstration kit ‘Wind energy’
Order number 546206

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