STUDENTS WORKSHEET – WIND KIT

Chapter 1 – Wind Basics

1.1 Renewable and non-renewable energy sources

Task 2

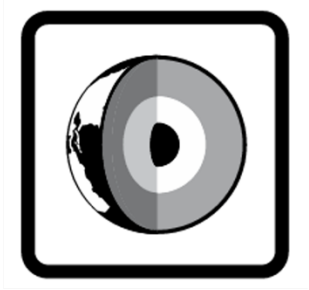
❑ Renewable
❑ Non-Renewable
Name:

❑ Renewable
❑ Non-Renewable
Name:

❑ Renewable
❑ Non-Renewable
Name:

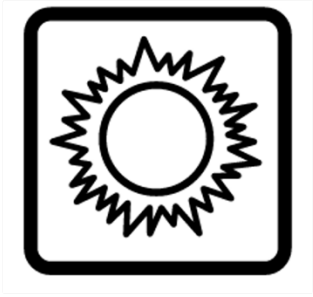
❑ Renewable
❑ Non-Renewable
Name:

❑ Renewable
❑ Non-Renewable
Name:



❑ Renewable
❑ Non-Renewable
Name:

❑ Renewable
❑ Non-Renewable
Name:



❑ Renewable
❑ Non-Renewable
Name:

1.2 Windy Places

Task 1

High places ○

Closed spaces & low places ○

Coasts & offshore (in oceans, seas) wind turbines ○

Open spaces ○

○ **GOOD locations – (very) windy**

○ **BAD locations – hardly any wind**

Draw arrows to the correct answers on the right-hand side

Task 2

1.3 The Wind Atlas

Task 1

Country	Power density (W/m^2)	Speed of wind (m/s)
Ghana		
Germany		
Optional: different country		

Task 2

1.4 Stakeholders in Wind Energy

Task 1

Chapter 2 – Measuring and Working with Wind

2.2 Measuring Wind Speed

Experiment:

Wind strength	Rotations per minute	Observation
Low		
Medium		
High		

Task 1

Task 2

2.3 Wind Can Do Work

Experiment:

Fan speed	Time taken to lift the rope	Observation
Low	10s	
Medium	7s	
High	5s	

Task 1

Task 2

Task 3

Test your Knowledge:

Task 1

- A generator converts _____ (mechanical/thermal/chemical) energy into electrical energy.
- Wind turbines naturally spin _____ (quickly/slowly/moderately), but generators need a _____ (lower/higher/consistent) speed to produce electricity.
- The _____ (rotor/gearbox/stator) in a wind turbine increases the rotational speed of the shaft to match the generator's requirements.
- The process of spinning a generator transforms _____ (kinetic/heat/light) energy into electricity.
- Gearboxes work by adjusting _____ and _____ (force & mass/speed & torque/direction & rotation) in the system.

Task 2

- Wind turbines spin at a high speed naturally, making them directly compatible with generators. (True/False)
- A generator uses electrical energy to create mechanical energy.
- The rotor is the stationary part of a generator. (True/False)
- Gearboxes are used in wind turbines to adjust the rotational speed and torque. (True/False)
- The energy conversion process in wind turbines involves transforming kinetic energy into mechanical energy and then into electrical energy. (True/False)

Task 3

Column A
1. Gearbox
2. Generator
3. Kinetic energy
4. Rotor
5. Electromagnetic induction

Column B
a. Converts mechanical energy into electrical energy
b. Adjusts speed and torque to match system requirements
c. Energy in motion, like wind
d. The rotating part of the generator
e. Process of generating electricity through a magnetic field

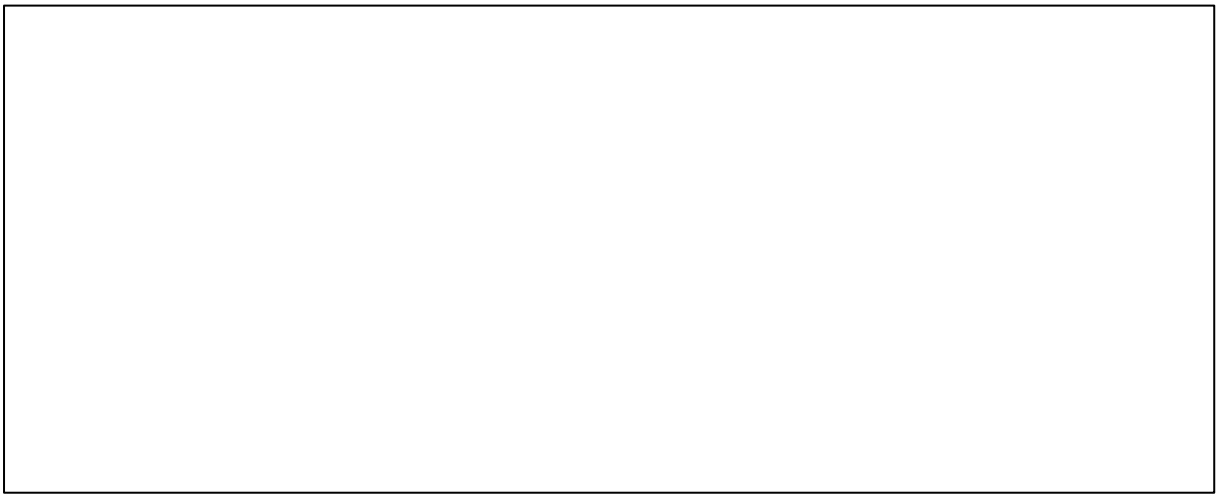
Chapter 3 – Airfoils

3.1 Let´s make an Airfoil

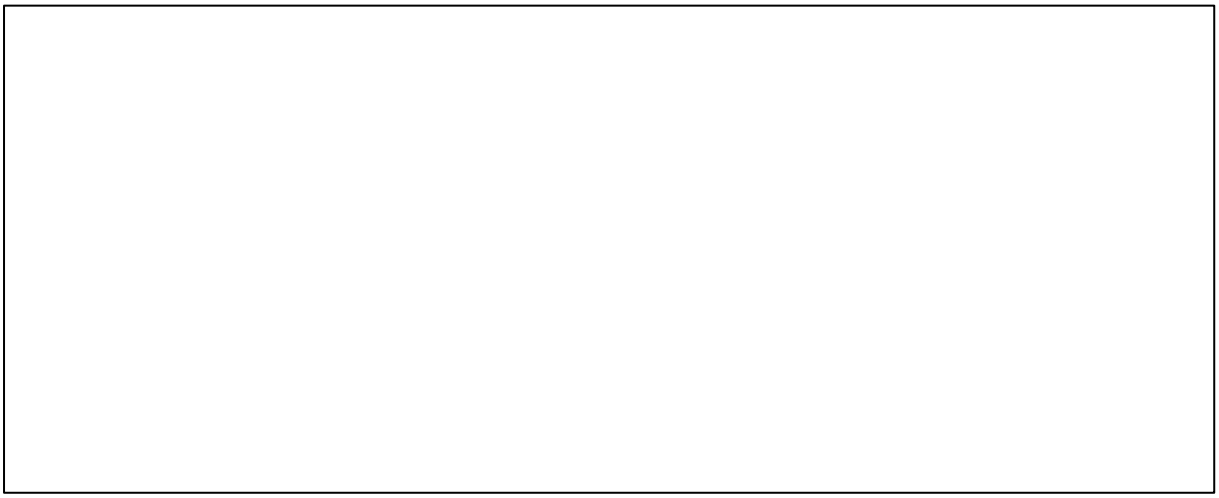
Task 1

Task 2

Task 3



Task 4



Chapter 4 - Experiments with a Wind Turbine

4.4 Changing Direction of Wind

Task 1

Experiment:

Direction of fan	Wind strength	Voltage mV (AC)
Front view	Low	
Front view	Medium	
Front view	High	
Side view (45°)	Low	
Side view (45°)	Medium	
Side view (45°)	High	
Side view (90°)	Low	
Side view (90°)	Medium	
Side view (90°)	High	

Task 2

4.5 Angle of Attack

Task 1

4.6 Using a Tail Fin

Experiment:

Direction of Tain Fin	Voltage mV (AC)
Tail fin in work	
Tail fin not in work	

Task 1

Task 2

Test your Knowledge:

Task 1

- The _____ (direct/side) wind has more power.
- To make the wind turbine face the wind, we attach a _____ (tail fin/rotor blade).
- The _____ (turbine/generator) spins to face the direct wind direction.
- The turbine moves to reduce _____ (power/drag) on the tail fin.
- The _____ (speed/angle) of attack affects how the turbine faces the wind.
- _____ (Direct/Side) wind has more power to move wind turbines.
- Wind turbines need _____ (less/more) wind to produce much energy.

Task 2

- Direct wind has more power than side wind.
    - True
    - False
- The tail fin is attached to make the turbine face away from the wind.
    - True
    - False
- The turbine moves to reduce drag on the tail fin.
    - True
    - False
- Wind turbines do not need to face the wind to generate the most power.
    - True
    - False
- The tail fin helps the turbine align with the wind direction.
    - True
    - False

4.7 Changing Blade Pitch

Experiment:

Blade Pitch	Wind strength	Voltage mV (AC)
Angle of 90°	Low	
Angle of 90°	Medium	
Angle of 90°	High	
Angle of 45°	Low	
Angle of 45°	Medium	
Angle of 45°	High	
Flat	Low	
Flat	Medium	
Flat	High	

4.8 Changing Blade Length

Experiment:

Blade Length	Wind strength	Voltage mV (AC)
Short blade	Low	
Short blade	Medium	
Short blade	High	
Medium blade	Low	
Medium blade	Medium	
Medium blade	High	
Large blade	Low	
Large blade	Medium	
Large blade	High	

Task 1

4.9 Changing Number of Blades

Experiment

Blade Length	Wind strength	Voltage mV (AC)
2 blades	Low	
2 blades	Medium	
2 blades	High	
3 blades	Low	
3 blades	Medium	
3 blades	High	
6 blades	Low	
6 blades	Medium	
6 blades	High	

Task 1

Task 2

Task 3

4.10 What Happens With A Wind Turbine With Only One Blade?

Experiment

Number of blades	Wind strength	Voltage mV (AC)
1 blade, long size, really near to the fan	High	
3 blades, long size, really near to the fan	High	

Task 1

Task 2

Task 3

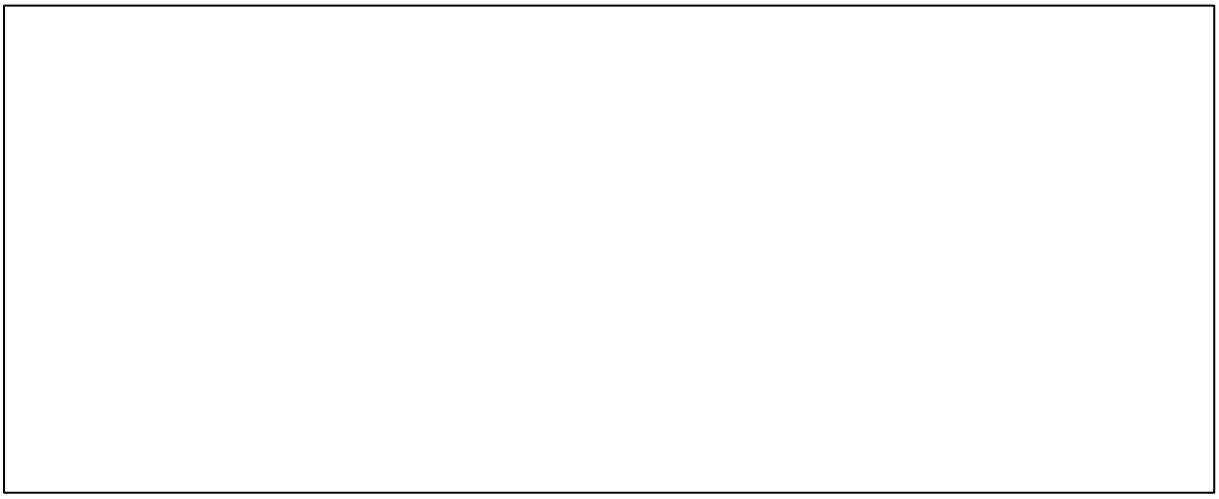
Task 4

Test your Knowledge:

Task 1

- The direction of wind has _____ (no/an) influence on the generation of wind.
- To make the wind turbine face the wind, we attach a _____ (tail fin/rotor blade).
- The pitch of the blade if it is optimal when it is _____ (angled/flat).
- The _____ (shorter/longer) the blade is, the power production increases.
- If the blade is really heavy, the power will _____ (drop/increase).
- To generate the optimal power output with a wind turbine and have a balanced wind turbine system, the number of blades should be _____ (one/two/three/six).
- The turbine turns in an asymmetrical way if the number of blades is _____ (one/two/three/six).

Task 2



Task 3

- The Maximum Power Point (MPP) is the point where a wind turbine generates the _____ (lowest/highest/moderate) power output under given wind conditions.
- To optimize energy capture, the blade angle (pitch) should be _____ (adjusted/fixed/ignored) according to wind speed.
- Yaw control helps the turbine _____ (stay fixed/rotate towards/rotate away from) the wind direction for maximum efficiency.
- Wind turbines use _____ (sensors/batteries/magnets) to monitor wind speed and adjust for MPP in real time.
- Increasing rotor speed beyond MPP results in _____ (optimal performance/energy loss/increased efficiency).

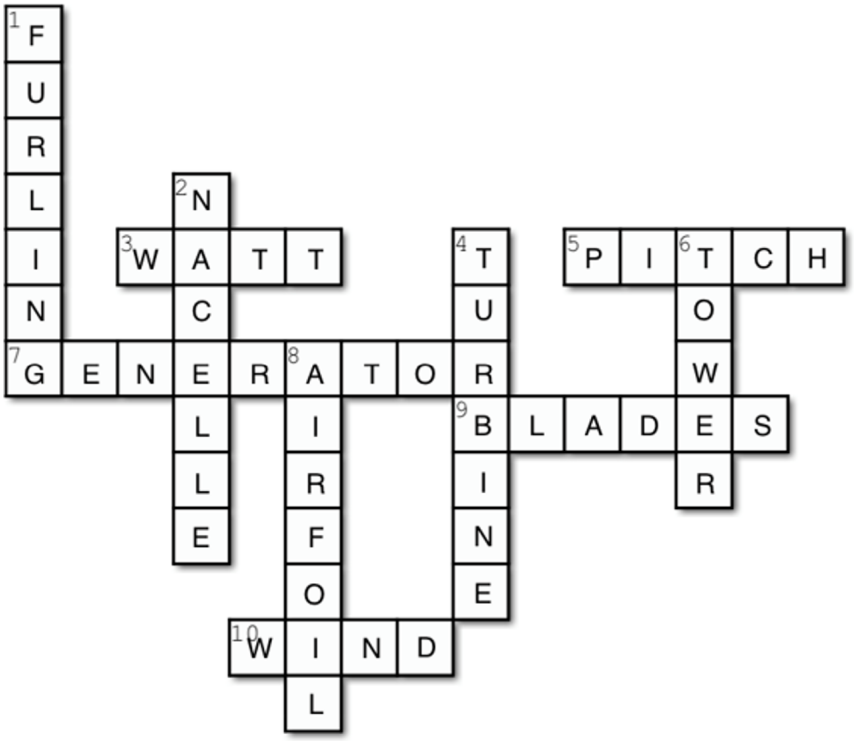
Task 4

1. MPP ensures a wind turbine always operates at its maximum efficiency.
    - True
    - False
2. Blade pitch control is unnecessary for maintaining MPP.
    - True
    - False
3. Offshore wind farms use advanced control systems to optimize MPP in real-time.
    - True
    - False
4. Wind turbines naturally adjust to MPP without any external systems.
    - True
    - False
5. Dynamic wind conditions do not affect the Maximum Power Point.
    - True
    - False

Task 5

Column A	Column B
1. MPP	a. Rotates the turbine to face the wind direction.
2. Yaw control	b. Adjusts blade angles for optimal energy capture.
3. Blade pitch control	c. Ensures the highest possible power output.
4. Sensors	d. Monitors wind speed, direction and rotor performance.
5. Wind speed variability	e. Affects turbine efficiency and energy production.

Playtime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