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CHE 574 (ALTERNATIVE ENERGY RESOURCES)

1A With adequate mathematical relations, explains the various forms of energy

In physics, energy is the quantitative property that must be transferred to an object in order to perform work on, or to heat, the object. Energy is a conserved quantity: The SI unit of energy is the joule, which is the energy transferred to an object by the work of moving it a distance of 1metre against a force of 1 Newton.

For instance, living organisms require energy to stay alive, such as the energy humans get from food. Human civilization requires energy to function; which it gets from energy resources such as fossil fuels, nuclear fuel, or renewable energy.

One of the fundamental laws of the universe is that energy is neither created nor destroyed; it only changes forms. Consequently, many formulas for energy exist. In order to understand how these formulas are expressions of the same thing.

However, the various forms of energy are underlisted below:

01 Kinetic energy: An object in motion possesses it's energy of movement, which is the equivalent to work that would be required to bring it to rest. This is called it's Kinetic energy, and it is dependent on the square of the object's velocity (v) as well as one half of it's mass (m).

Mathematically, this is expressed as;

$$E(K) = 0.5 \times m \times v^2$$

2) Potential energy: An object at rest in Earth's gravitational field possesses potential energy by virtue of it's altitude; if it were to fall freely, it would gain kinetic energy equal to this potential energy. Potential energy is dependent on the object's mass, it's height (h) and the acceleration due to gravity (g). Mathematically, $E(p) = m \times g \times h$. A typical example of a potential energy scenario is the concept of a bow and an arrow. Here, the energy is converted from the potential energy in the archer's arm to the potential energy in the bent limbs of the bow when the string is drawn back. When the string is released, the potential energy in the bow limbs is transferred back through the string to become kinetic energy in the arrow as it takes flight.

3 Electrical energy: The calculation of energy in electrical systems depends on the amount of current flowing through the conductor (I) in amperes. This energy is referred to as the energy that has converted from electric potential energy. This energy is supplied by the combination of electric current and electric potential. The mathematical expression for electrical energy in a conducting circuit is $E(e) = P \times t = V \times I \times t$. According to this relationship, leaving a 100-watt lightbulb burning for one minute expends 6,000 joules of energy. This is equivalent to the amount of kinetic energy a 1-kilogram rock would have if you dropped it from a height of 612 m (ignoring air friction).

4 Chemical energy: Chemical energy is energy stored in the bonds of chemical compounds, like atoms & molecules. This energy is released when a chemical reaction takes place.

Usually, once chemical energy has been released from a substance, that substance is transformed into a completely new substance.

Chemical energy is the most widely used type of energy in the world, as it's crucial to the existence of humans.

Dry good contains stored chemical energy.

When you burn that wood in a fireplace, chemical energy is released and converted into thermal energy and light energy.

And what about the wood? Following the chemical reaction, it's now turned into a new substance - ash.

The food we eat contains stored chemical energy. As the bonds between the atoms in food, loosen or break, a chemical reaction takes place, and new compounds are formed.

5 Nuclear Energy: Nuclear energy comes from the nucleus of atoms. The energy is released by nuclear fusion (nuclei are fused together) or nuclear fission (nuclei are split apart).

Nuclear plants use nuclear fission of a radioactive element called Uranium to generate electricity.

Nuclear energy would be defined as the minimum energy that would be required to dis-assemble the nucleus of an atom into it's component parts (ie protons & neutrons)

6 Thermal energy:- Thermal energy (also called heat energy) is produced when a rise in temperature causes atoms and molecules to move faster and collide with each other. The energy that comes from the temperature of the heated sustance is called thermal energy. The molecules and atoms that make up matter are moving all the time. When a substance heats up, the rise in temperature makes these particles move faster and bump into each other. Thermal energy is the energy from a heated up substance. The hotter the substance, the more it's particles move, and the higher the thermal energy.

7. Solar energy: This is the energy that comes from the sun. It's described as an inexhaustible resource that can supply a significant portion of our electricity needs. A range of technologies converts the sun's energy into electricity including solar collectors & photovoltaic cells / panels

8 Biomass Energy: It's energy generated by living or once-living organisms. The most common biomass materials used for energy are plants, such as corn, and soy. The energy from these organisms can be burned to create heat or converted into electricity.

9 Geothermal Energy: It's the heat derived within the sub-surface of the earth. Water and/or steam carry the geothermal energy

3 Distinguish between the sustainable energy and resources and non-sustainable energy and resources.

1 Sustainable energy and resources:-

"The concept of sustainable development was described by the World Commission on Enviroment and Development in its 1987 book our common future"[1]. It's definition of 'sustainability", now used widely, was, "sustainable development should meet the needs of the present without compromising the ability of future generations to meet their own needs." However various definitions of sustainable energy have been offerred since then which are also based on three pillars of sustainable development, namely; enviroment, economy, society.

01 ENVIRONMENTAL:- criteria include greenhouse gas emissions, impact on biodiversity, and the production of hazardous waste and toxic emissions

02 ECONOMIC: criteria include the cost of energy, whether energy is delivered to users with high reliability, and effects on jobs associated with energy production.

03 SOCIO-CULTURAL: criteria include the prevention of wars over the energy supply (energy security) and long-term availability of energy.

Sustainable energy and resources: include hydroelectricity, biomass, geothermal, wind, wave, tidal and solar energies.

Non-sustainable energy & resources:

This type of energy comes from sources that will run out or will not be replenished for thousands or even millions of years. It can also be defined as a natural resource that cannot be readily replaced by natural means at a quick enough pace to keep up with the consumption. Most non-renewable energy sources are: fossils, petroleum, and natural gas.

The advantage of these non-sustainable energies is that power plants that use them are able to produce more power on demand.

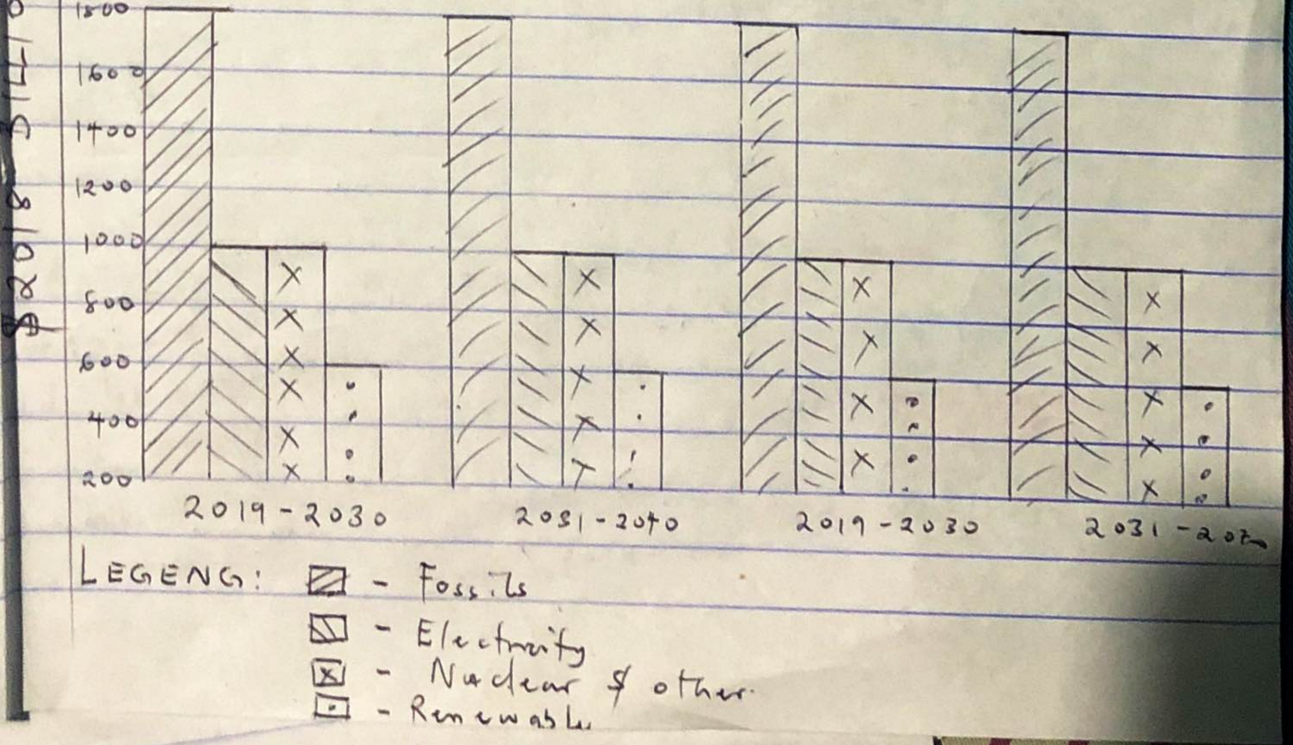
However, these energies account for the majority of the world's greenhouse emissions.

to the Earth's surface; Depending on it's characteristics, geothermal energy can be used for heating & cooling purposes or can be harnessed to generate clean electricity

2) No single energy resource can sustainably meet the energy demands of any country. Integrating all exploitable energy ~~resources~~ sources is a viable way of achieving stability in energy supply for Nigeria. The existing energy mix includes: Crude oil, coal and electricity on sustainable development in Nigeria. Empirical results indicate that existing energy mix has no significantly influenced sustainable development, given that electricity generation is inadequate and coal is no longer in use.

Lastly, exploitable energy sources were however indentified in anticipation that an integrated energy plan with emphasis on renewable energy sources for off-grid areas would promote stability in energy supply and sustainable development

GLOBAL AVERAGE ANNUAL ENERGY



2 How much energy is been produced from Nigeria Dams and compare with the one produced from crude oil

HYDROPOWER(H.E.P)

Hydropower or hydroelectric power (H.E.P) comes from the potential energy of dammed water driving a water turbine and generator. The Rivers from Niger and Benue and their tributaries form the core of the Nigerian river system with potential for large-scale. An Estimate of total exploitable large-scale hydropower potential in Nigeria is over 10,000 MW, capable of producing 36,000GWh of electricity annually, only about one fifth had been developed as at 2001. Likewise, estimate of exploitable small-scale hydropower potential is at 734MW.

N/B: Name of Dam: Kainji:
Location: Kainji, Niger, Nigeria

The dam was designed to have a generating capacity of 960 megawatts (1,290,000hp); however, only 8 of its 12 turbines have been installed; reducing the capacity to 760 megawatts (1,020,000hp). The dam generates electricity for all the large cities in Nigeria.

In conclusion, By 1999, hydropower represented about 32% of the installed grid-connected electricity generation capacity (FGN, 2003)

3)

Day	Average Ambient Temperature Day time	Night time
Monday 17-02-20	35°c	25°c
Tuesday 18-02-20	36°c	25°c
Wednesday 19-02-20	35°c	25°c
Thursday 20-02-20	36°c	25°c
Friday 21-02-20	37°c	25°c
		25°c

Solution

$P = \frac{\Delta Q}{\Delta t}$; $P = \frac{K \cdot A \cdot \Delta T}{L}$; $Q = P \times \Delta T$

P = rate of energy transfer in Watts (W)
Q = Energy transfer in Joules
A = Area
Δt = Change in time in seconds
L = thickness of material
ΔT = difference in temperature

Assuming that
K_{air} at (35°c - 37°c) = 1.4
A = Area of land in abuad = 1,300,000m²
L = Average thickness = 0.991m

For Monday = ΔT = 35 - 25 = 10°c
- Tuesday = ΔT = 36 - 25 11°c
- Wednesday = ΔT = 35 - 25 10°c
- Thursday = ΔT = 36 - 25 11°c
- Friday = ΔT = 37 - 25 12°c

Monday $P = \frac{1.4 \times 1300,000 \times 10}{0.991}$

= 18365287.59W

$Q = P \times \Delta t$, where Δt = 6hrs = 6 × 3600
= 21600s

$Q = 18365287.59 \times 21600$
$= 396700 MJ$

For Tuesday, $P = \frac{1.4 \times 1,300,000 \times 11}{0.991}$
$= 20201816.35 W$
$Q = 20201816.35 \times 21600$
$= 436300 MJ$

For Wednesday = $P = \frac{1.4 \times 1,300,000 \times 10}{0.991}$
$= 18365287.59 W$
$Q = 18365287.59 \times 21600$
$= 396700 MJ$

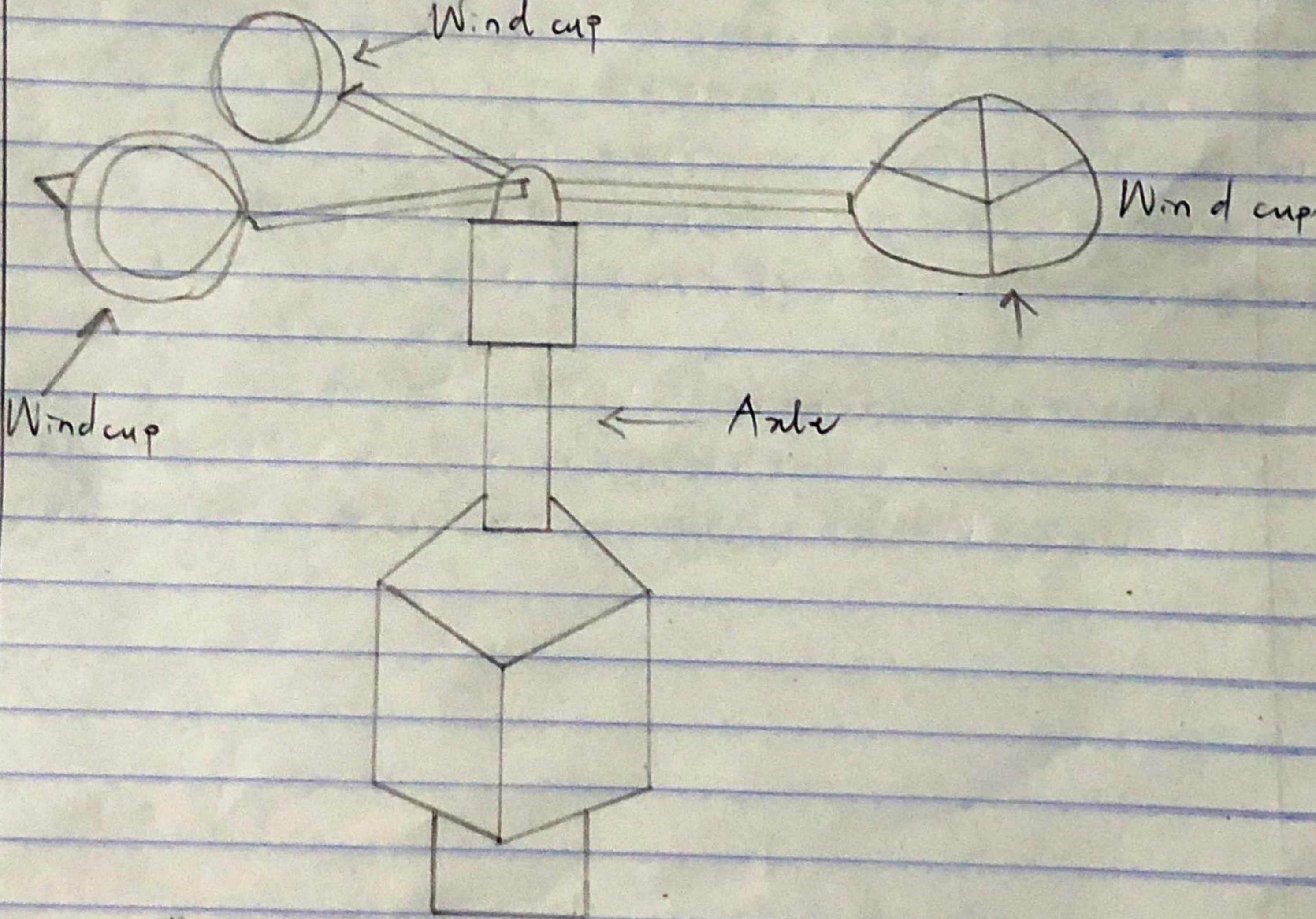
For Thursday: $P = \frac{1.4 \times 1,300,000 \times 11}{0.991}$
$= 20201816.35 W$
$Q = 20201816.35 \times 21,600$
$= 436300 MJ$

For Friday $P = \frac{1.4 \times 1,300,000 \times 11}{0.991}$
$= 22038345.11 W$
$Q = 22038345.11 \times 21,600$
$= 476000 MJ$

Average = $\frac{396700 + 436300 + 396700 + 436300 + 476000}{5}$

$= 428400 MJ$

The avg. daily thermal energy from the sun in ABUAD is 428400MJ b)



AN ANEMOMETER

An aneomometer is a device used for measuring wind speed and direction, It's also a common weather station instrument.

N/B: The first known description of an anemometer was given by Leon Battista Alberti in 1450. Here, the revolving cups drive an electric generator. The output of the generator operates an electric meter that is calibrated in wind speed.