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MATRIC NO: 15/ENG07/018

COURSE : CHE574

QUESTION ONE

A) EXPLANATION OF THE VARIOUS FORMS OF ENERGY

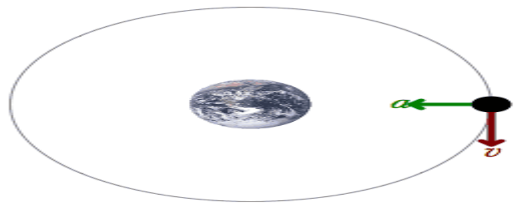
1) **Mechanical energy** is the sum of potential energy and kinetic energy. It is the macroscopic energy associated with a system. The principle of conservation of mechanical energy states that in an isolated system that is only subject to conservative forces, the mechanical energy is constant. If an object moves in the opposite direction of a conservative net force, the potential energy will increase; and if the speed (not the velocity) of the object changes, the kinetic energy of the object also changes. In all real systems, however, nonconservative forces, such as frictional forces, will be present, but if they are of negligible magnitude, the mechanical energy changes little and its conservation is a useful approximation. Mathematically

$E_{mechanical} = U+K$

The potential energy, *U*, depends on the position of an object subjected to a conservative force. It is defined as the object's ability to do work and is increased as the object is moved in the opposite direction of the direction of the force If *F* represents the conservative force and *x* the position, the potential energy of the force between the two positions x_1 and x_2 is defined as the negative integral of *F* from x_1 to x_2

$K = 1 \div 2MV^2$

$$U = -\int_{x_1}^{x_2} \vec{F} \cdot d\vec{x}$$



2.) **Electrical energy** is energy derived from electric potential energy or kinetic energy. When used loosely, electrical energy refers to energy that has been converted from electric potential energy. This energy is supplied by the combination of electric current and electric potential that is delivered by an electrical circuit (e.g., provided by an electric power utility). At the point that this electric potential energy has been converted to another type of energy, it ceases to be electric potential energy. Thus, all electrical energy is potential energy before it is delivered to the end-use. Once converted from potential energy, electrical energy can always be called another type of energy (heat, light, motion, etc.). Electrical energy is usually sold by the kilowatt hour (1 kW·h = 3.6 MJ) which is the product of the power in kilowatts multiplied by running time in hours. Electric utilities measure energy using an electricity meter, which keeps a running total of the electric energy delivered to a customer. 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. Where amount of current flowing through a conductor (I) in amperes, as well as on the electrical potential, or voltage (V), driving the current, in volts and the electricity flows (t) in seconds gives the amount of electrical energy in the system, in joules.

3.) Magnetic energy and electrostatic potential energy are related by Maxwell's equations. The potential energy of a magnet of magnetic moment in a magnetic field is defined as the mechanical work of the magnetic force (actually magnetic torque) on the re-alignment of the vector of the magnetic dipole moment and is equal to:

$$E_{p,m} = -\mathbf{m} \cdot \mathbf{B}$$

while the energy stored in an inductor (of inductance) when a current flows through it is given by:

$$E_{p,m} = \frac{1}{2}LI^2.$$

This second expression forms the basis for superconducting magnetic energy storage.

Energy is also stored in a magnetic field. The energy per unit volume in a region of space of permeability containing magnetic field is:

$$u = \frac{1}{2}\frac{B^2}{\mu_0}$$

More generally, if we assume that the medium is paramagnetic or diamagnetic so that a linear constitutive equation exists that relates and, then it can be shown that the magnetic field stores an energy of

$$E = \frac{1}{2}\int \mathbf{H} \cdot \mathbf{B} \, \mathrm{d}V$$

where the integral is evaluated over the entire region where the magnetic field exists

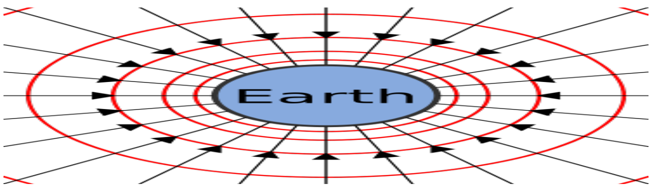
4.) **Gravitational energy (GPE)** is the potential energy a physical object with mass has in relation to another massive object due to gravity. It is potential energy associated with the gravitational field. Gravitational energy is dependent on the masses of two bodies, their distance apart and the gravitational constant (*G*). In everyday cases (i.e. close to the Earth's surface), the gravitational field is considered to be constant. For such scenarios the Newtonian formula for potential energy can be reduced to:

U = mgh

Gravitational Potential Energy

$$U = -G\frac{mM}{R}$$

where is the gravitational potential energy, is the mass, is the gravitational field, and is the height. This formula treats the potential energy as a positive quantity



Gravitational field earth lines equipotential

5.) **Chemical energy** is the potential of a chemical substance to undergo a chemical reaction to transform into other substances. Examples include batteries, food, gasoline, and etc. Breaking or making of chemical bonds involves energy, which may be either absorbed or evolved from a chemical system. Energy that can be released or absorbed because of a reaction between a set of chemical substances is equal to the difference between the energy content of the products and the reactants, if the initial and final temperatures are the same. This change in energy can be estimated from the bond energies of the various chemical bonds in the reactants and products. Mathematically

$$\mathrm{d}U = T\,\mathrm{d}S - P\,\mathrm{d}V + \sum_{i=1}^{n} \mu_i \,\mathrm{d}N_i,$$

where dU is the infinitesimal change of internal energy U, dS the infinitesimal change of entropy S, and dV is the infinitesimal change of volume V for a thermodynamic system in thermal equilibrium, and dN_i is the infinitesimal change of particle number N_i of species i as particles are added or subtracted. T is absolute temperature S is entropy, P is pressure, and V is volume. Other work terms, such as those involving electric, magnetic or gravitational fields may be added

6.) **Ionization energy** denoted E_i, is the minimum amount of energy required to remove the most loosely bound electron, the valence electron, of an isolated neutral gaseous atom or molecule. It is quantitatively expressed as

$$X(g) + energy \rightarrow X^+(g) + e^-$$

where X is any atom or molecule capable of ionization, X^+ is that atom or molecule with an electron removed, and e^- is the removed electron.[1] This is generally an endothermic process. Generally, the closer the outermost electrons to the nucleus of the atom, the higher the atom's or element's ionization energy.

In chemistry, the unit is the amount of energy required for all of the atoms in a mole of substance to lose one electron each: molar ionization energy or enthalpy, expressed as kilojoules per mole (kJ/mol) or kilocalories per mole (kcal/mol).[2]

Comparison of E_i of elements in the periodic table reveals two periodic trends:

1. E_i generally increases as one moves from left to right within a given period (that is, row).

2. E_i generally decreases as one moves from top to bottom in a given group (that is, column).

The latter trend results from the outer electron shell being progressively farther from the nucleus, with the addition of one inner shell per row as one moves down the column.

The *n*th ionization energy refers to the amount of energy required to remove an electron from the species having a charge of (n-1). For example, the first three ionization energies are defined as follows:

1st ionization energy

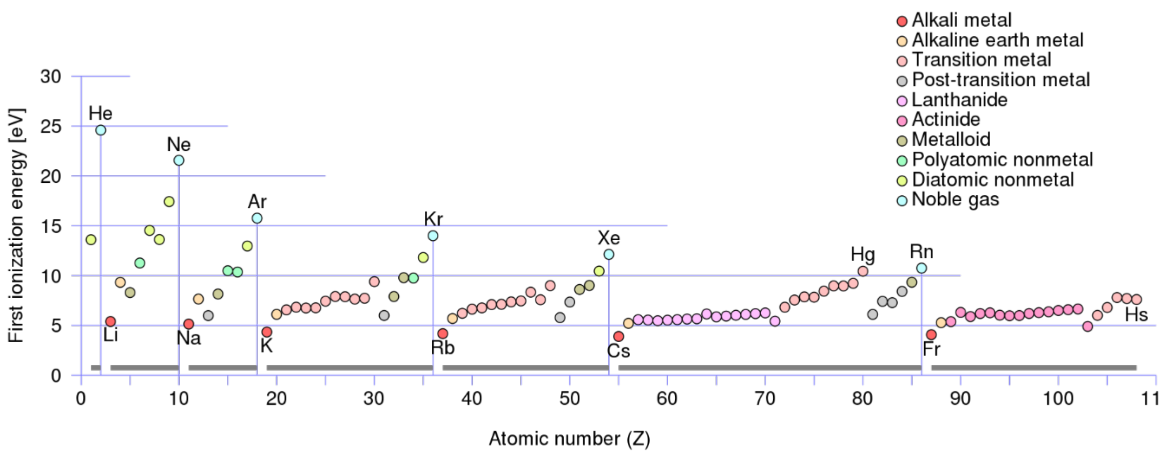
$X \rightarrow X^{+} + e^{-}$

2nd ionization energy

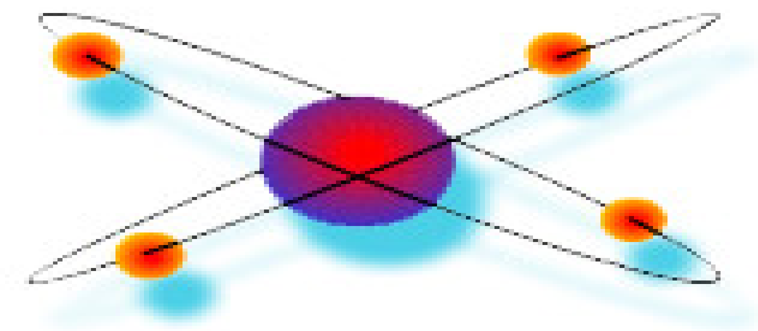
$X^{+} \rightarrow X^{2+} + e^{-}$

3rd ionization energy

$X^{2+} \rightarrow X^{3+} + e^{-}$



7.) **Nuclear energy** is energy that comes from a nucleus, the core of an atom. Atoms are particles that make up every object; and there exists a lot of energy (binding forces) which holds these atoms together. Nuclear energy can be used to make electricity, but for this to happen the energy has to be released from atoms. Nuclear energy harvests the powerful energy in the nucleus, or core, of an atom. Nuclear energy is released through nuclear fission, the process where the nucleus of an atom splits. Nuclear power plants are complex machines that can control nuclear fission to produce electricity. The material most often used in nuclear power plants is the element uranium. Although uranium is found in rocks all over the world, nuclear power plants usually use a very rare type of uranium, U-235. Uranium is a non-renewable resource.



Mathematically one of the laws of the universe is that matter and energy can neither be created nor destroyed. But they can be changed in form. Matter can be changed into energy. Albert Einstein's famous mathematical formula $E = mc^2$ explains this. The equation says: E [energy] equals m [mass] times c^2 [c stands for the speed or velocity of light]. This means that it is mass multiplied by the square of the velocity of light.

8.) **Heat** is energy in transfer to or from a thermodynamic system, by mechanisms other than thermodynamic work or transfer of matter. The various mechanisms of energy transfer that define heat are stated in the next section of this article. Like thermodynamic work, heat transfer is a process involving more than one system, not a property of any one system. In thermodynamics, energy transferred as heat (a process function) contributes to change in the system's cardinal energy variable of state, for example its internal energy, or for example its enthalpy. This is to be distinguished from the ordinary language conception of heat as a property of an isolated system. The quantity of energy transferred as heat in a process is the amount of transferred energy excluding any thermodynamic work that was done and any energy contained in matter transferred. For the precise definition of heat, it is necessary that it occur by a path that does not include transfer of matter.

9). **Sound energy** is a form of energy that can be heard by humans. Sound is a mechanical wave and as such consists physically in oscillatory elastic compression and in oscillatory displacement of a fluid. Therefore, the medium acts as storage for both potential and kinetic energy Consequently, the sound energy in a volume of interest is defined as the sum of the potential and kinetic energy densities integrated over that volume:

$$W = W_{\text{potential}} + W_{\text{kinetic}} = \int_V \frac{p^2}{2\rho_0 c^2}\,\mathrm{d}V + \int_V \frac{\rho v^2}{2}\,\mathrm{d}V,$$

Here:

- *V* is the volume of interest;
- *p* is the sound pressure;
- *v* is the particle velocity;
- ρ_0 is the density of the medium without sound present;
- *ρ* is the local density of the medium;
- *c* is the speed of sound.

10)

B) DIFFERENCE BETWEEN SUSTAINABLE ENERGY AND NON SUSTAINABLE ENERGY

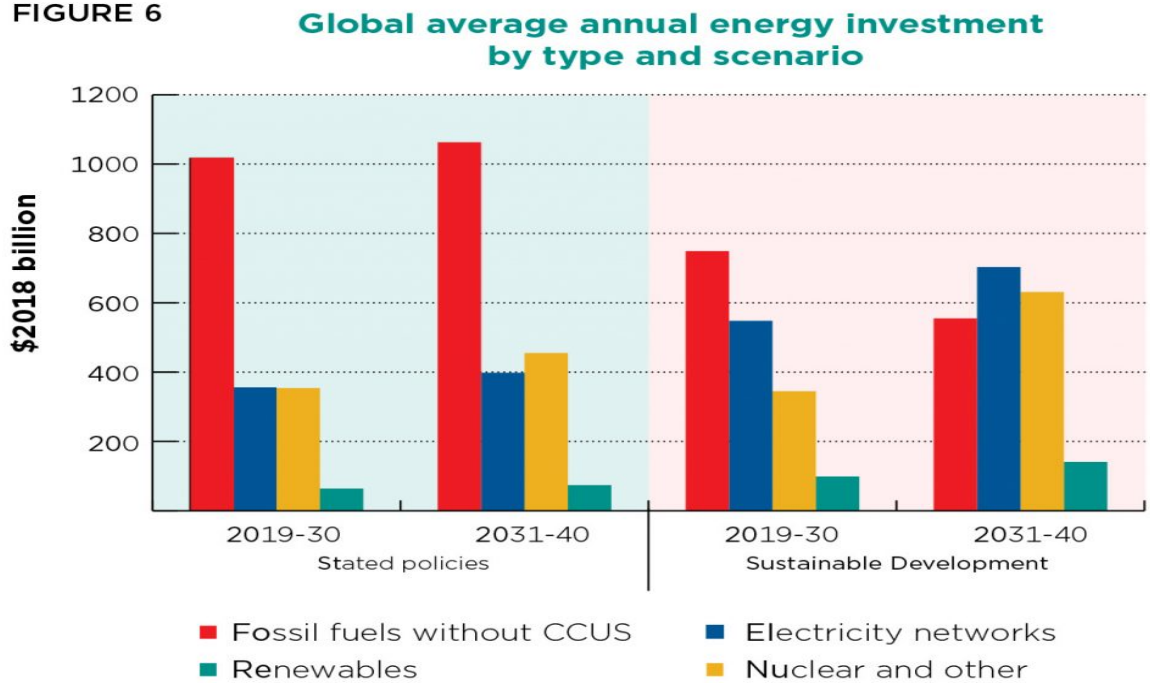
I) Sustainable energy is a form of energy that meet our today's demand of energy without putting them in danger of getting expired or depleted and can be used over and over again. Sustainable energy should be widely encouraged as it do not cause any harm to the environment and is available widely free of cost. All renewable energy sources like solar, wind, geothermal, hydropower and ocean energy are sustainable as they are stable and available in plenty.Sun will continue to provide sunlight till we all are here on earth, heat caused by sun will continue to produce winds, earth will continue to produce heat from inside and will not cool down anytime soon, movement of earth, sun and moon will not stop and this will keep on producing tides and the process of evaporation will cause water to evaporate that will fall down in the form of rain or ice which will go through rivers or streams and merge in the oceans and can be used to produce energy through hydropower. This clearly states that all these renewable energy sources are sustainable and will continue to provide energy to the coming generations. There are many forms of sustainable energy sources that can be incorporated by countries to stop the use of fossil fuels. Sustainable energy does not include any sources that are derived from fossil fuels or waste products. This energy is replenishable and helps us to reduce greenhouse gas emissions and causes no damage to the environment. If we are going to use fossil fuels at a steady rate, they will expire soon and cause adverse affect to our planet

II) **Non- Sustainanble Energy** is a natural resource that cannot be readily replaced by natural means at a quick enough pace to keep up with consumption. An example is carbon-based fossil fuel. The original organic matter, with the aid of heat and pressure, becomes a fuel such as oil or gas. Earth minerals and metal ores, fossil fuels (coal, petroleum, natural gas) and groundwater in certain aquifers are all considered non-renewable resources, though individual elements are always conserved (except in nuclear reactions).

Conversely, resources such as timber (when harvested sustainably) and wind (used to power energy conversion systems) are considered renewable resources, largely because their localized replenishment can occur within time frames meaningful to humans as well.

B) With the aid of a pie chart or bar chart briefly discuss the typical energy resource mix for sustainable energy development and provide your own view the case for Nigeria

FIGURE 6



SOURCE: International Energy Agency

No single energy resource can sustainably meet the energy demands of any country. Integrating all exploitable energy sources is a viable way of achieving stability in energy supply for Nigeria Energy availability, economic growth and sustainable development are grossly inseparable. Generating adequate power has been a major challenge for successive Nigerian governments. Hydro-powers and thermal plants were established between 1960 and 1979. No other successful attempt was made to increase the energy generating capacity till 1999. First, that energy sources should be diversified. Since power failure is a regular occurrence in Nigeria with attendant negative impact on the quality of living and business productivity, a new approach to electricity generation in which a mix of several energy sources including renewable sources is optimally utilized should be vigorously pursued and adopted. Second, the utilization of renewable energy technologies especially solar energy to provide off-grid electricity to remote communities should be intensified. The scenario whereby combustible renewable and waste accounted for 80.2 percent of total energy consumption in Nigeria (fig.1) and mainly utilized by the rural areas to meet off-grid heating and cooking needs is not sustainable as it does not only contribute to green house gas but also portends a threat to health, woodlands and the economy. Third, it is imperative to intensify research and development in the energy sector, especially renewable energy to increase energy sources and improve energy management systems that will promote sustainable development. Last, there should be increased funding in energy sector, which is capital intensive and requires huge amount of investment. The public and private sector could form a partnership to tackle this investment problem. Government should also increase the budgetary allocation to the energy sector and release these funds duly. Integrating energy sources is a viable way to address the energy problems of Nigeria, which include irregular power supply and rising costs / scarcity of conventional or traditional energy sources.

QUESTION 2: HOW MUCH ENERGY IS BEEN PRODUCED FROM NIGERIA DAMS AND COMPARE WITH THE ONE PRODUCE FROM CRUDE OIL

HYDROPOWER

Hydroelectric power comes from the potential energy of dammed water driving a water turbine and generator. The Niger and Benue Rivers and their tributaries form the core of the Nigerian river system with potential for large-scale (greater than 100MW) hydropower development. Several small rivers and streams also provide opportunities for small-scale (less than 10MW) hydropower projects. Estimate of total exploitable large-scale hydropower potential in Nigeria is over 10,000MW, 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. Small hydropower plants for electricity provision are suitable in remote areas. By 1999, hydropower represented about 32% of the installed grid-connected electricity generation capacity (FGN, 2003).

CRUDE OIL

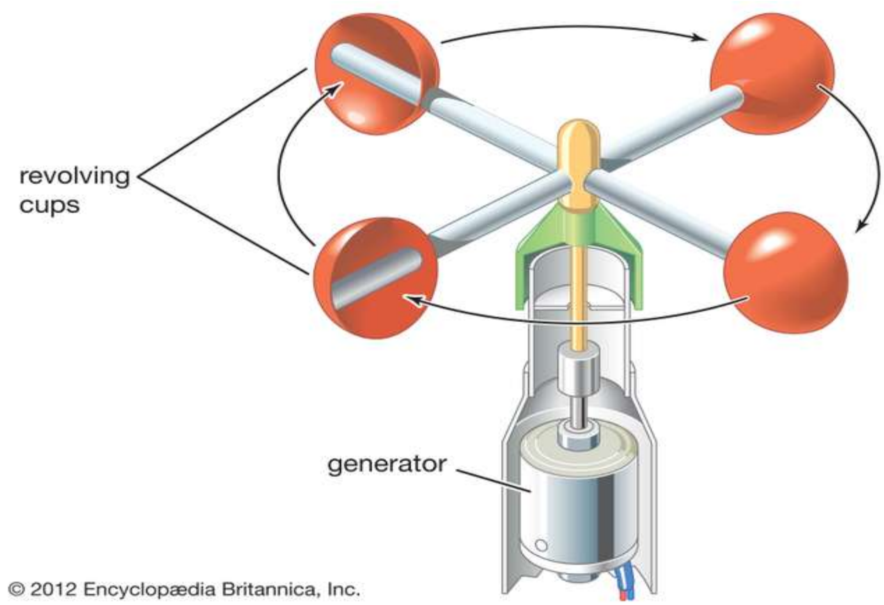
Following its discovery at Oloibiri, Delta State in 1956 (MBendi, 2011) oil would eventually become dominant in Nigeria's energy scenario as the economic mainstay. Presently, oil accounts for over 95% of export earnings and over 65% of government revenue according to the International Monetary Fund- IMF (EIA, 2010). However, according to Odularu (2007) petroleum production and export, which play a dominant role in Nigeria's economy accounts for about 90% of gross domestic earnings making Nigeria the "13thoil producer in the world" (Nation Master, 2008). Nigeria has an estimated 37.2 billion barrels of proven oil reserve situated

along the Niger River Delta and offshore in Bight of Benin, Gulf of Guinea and Bight of Bonny. Production capacity as at 2009 was over 2.2 million b/d making Nigeria the largest oil producer in Africa (EIA, 2010). An oil boom in the early 1970s drew the country's attention away from agriculture, which hitherto was the mainstay and contributed an average of 72% of GDP between 1955 and 1969 (Folawewo & Olakojo, 2010). Since then, oil has been dominant in the energy scene of the country at all levels of economic activities.

QUESTION 3

A) Diagram Of Anemometer

Anemometer, device for measuring the speed of airflow in the atmosphere, in wind tunnels, and in other gas-flow applications. Most widely used for wind-speed measurements is the revolving-cup electric anemometer, in which the revolving cups drive an electric generator. The output of the generator operates an electric meter that is calibrated in wind speed. The useful range of this device is approximately from 5 to 100 knots. A propeller may also be used to drive the electric generator, as in the propeller anemometer. In another type of wind-driven unit, revolving vanes operate a counter, the revolutions being timed by a stopwatch and converted to airspeed. This device is especially suited for the measurement of low airspeeds.



B) Monitor abuad average ambient temperature