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GENERAL SCIENCE AND ABILITY

Q 2. (A) Differentiate between a Star and a Planet. Briefly describe the life cycle of a star from a Nebula to blackhole.

Answer:

Difference Between a Star and a Planet:

Star	Planet
A star is a massive glowing ball of hot gasses (mainly hydrogen and helium) that produces its own light and heat through nuclear fusion.	A planet is a large, spherical body that orbits a star and does not produce its own light; it reflects the star's light.
Stars have extremely high temperature due to fusion reaction in their core	Planets have comparatively lower temperatures and no fusion occurs inside them.
Stars are the centers of solar system	Planets revolve around the stars in fixed orbits.

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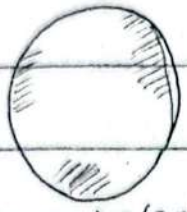
Stars are much larger and more massive than planets	Planets are smaller and much less massive.
Example: Sun	Example: Earth, Mars, Jupiter
 Figure: Sun (a massive star)	 Figure: Earth (a planet)

Life Cycle of a Star: From Nebula to Black Hole

A star's life cycle depends on its mass. The following sequence describes the life cycle of a massive star, which eventually becomes a blackhole

1. **Nebula: Birth-place of a Star:**

A nebula is a huge cloud of gas and dust in space. Gravity causes the cloud of gas and dust to contract and form dense clumps

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2. **Protostar**

As the nebula contracts, it heats up. A proto star forms when the central region becomes hot and dense but nuclear fusion has not yet started.

3. **main Sequence of Star**

When the core temperature becomes high enough, nuclear fusion begins → conversion of hydrogen to helium. The star becomes stable and spends most of its life here (like our sun, though massive stars burn faster).

4. **Red Supergiant**

when hydrogen in the core is exhausted, the stars expand enormously. The core contracts and the outer layers swell, forming a red supergiant.

5. **Supernova:**

The core collapses violently. The outer layers explode in a massive explosion known as supernova. This is one of the

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energetic events in universe.

6. **BlackHole:**

If the remaining core is extremely massive, gravity becomes so intense that not even light can escape. This leads to formation of blackhole. Moreover, if the leftover core is smaller, it forms a neutron star instead.

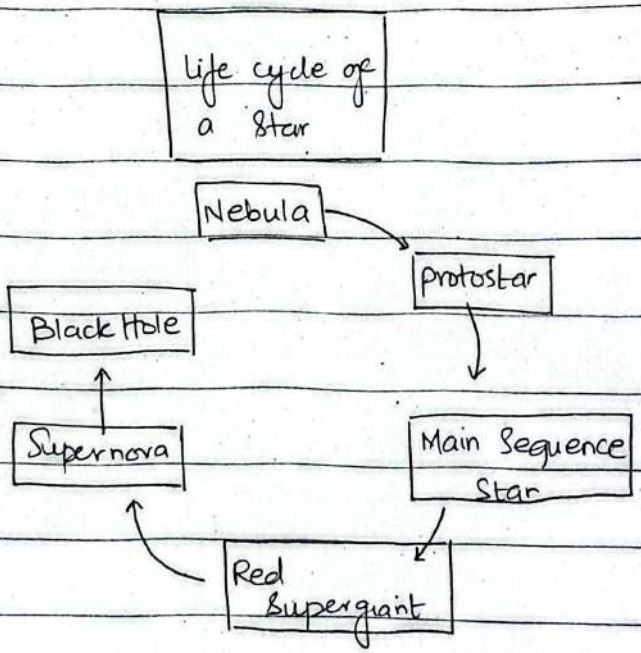

Figure: Holistic figure of life cycle of a star from Nebula to Black Hole.

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(b) What are Semiconductors. Explain the difference between n-type and p-type semiconductors and list two of their modern applications.

Semiconductors:

Semiconductors are materials whose electrical conductivity lies between that of conductors, like metals, and insulators, like rubber. Their conductivity can be controlled by adding impurities (a process called doping) or by making changes in temperature, light or electric field. Some common examples include Silicon (Si) and germanium (Ge).

Difference Between n-Type and p-Type Semiconductors

n-Type Semiconductor	p-Type Semiconductor
Formed by doping pure semiconductor (eg silicon) with a pentavalent impurity	Formed by doping it with a trivalent impurity (3 valence

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(5 valence electrons) like phosphorus or arsenic.	electrons) like boron or gallium
Extra electrons become the majority charge carrier.	A vacancy (called a hole) becomes the majority charge carrier.
It carries current mainly by electrons (negative charge)	Carries current mainly by holes (positive charge).
Impurity is called a donor because it donates electrons	Impurity is called an acceptor because it accepts electrons and create holes.

Modern Application of Semiconductors:

1. Computer and Smartphones:

Microprocessors and memory chips are made up of semiconductors.

2. Solar cells:-

Use p-n junction to convert sunlight into electricity.

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3. LEDs (Light Emitting Diodes):

Work through electron-hole recombination in semiconductors.

4. Diodes and Transistors:

The basic building blocks of all modern electronic ~~system~~ circuits.

5. Integrated Circuits (ICs):

Used in almost all electronic devices.

(c) Define Global warming. Explain the mechanism of Greenhouse Effect and list three major greenhouse gasses.

Definition of Global Warming.

Global warming refers to the long-term increase in Earth's average surface temperature due to the rising concentration of greenhouse gasses in atmosphere.

It is mainly caused by human activities such as burning fossil fuels, deforestation and industrial emissions.

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Mechanism of the Green House Effect:

1. Incoming solar radiation (sunlight) reaches the earth's surface.

2. The earth absorbs this energy and warms up.

3. The warmed earth then emits energy back into the atmosphere as infrared radiation (heat).

4. Greenhouse gasses in the atmosphere absorb and trap this heat instead of letting it escape into space.

5. These gases then re-radiate some of the heat back toward the Earth's surface, causing additional warming.

6. When concentrations of greenhouse gasses increase, the natural effect becomes stronger, leading to global warming.

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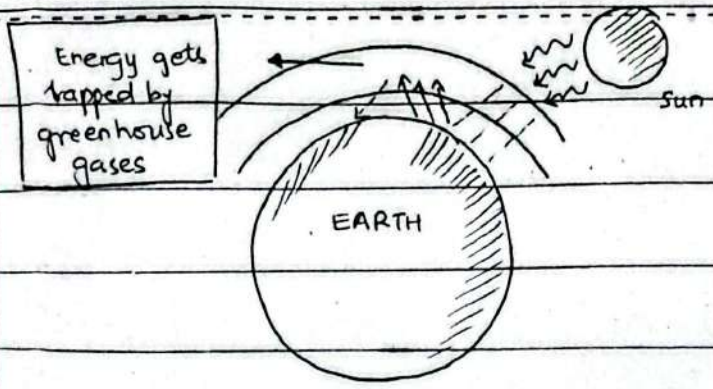

Figure: Greenhouse gasses and global warming

Three Major Greenhouse Gases:

1. Carbon dioxide (CO_2)
2. Methane (CH_4)
3. Nitrous Oxide (N_2O)
4. O_3 (Ozone)
5. ~~Wat~~

d) What is a Tsunami? Explain natural processes that trigger a tsunami and the potential impact on coastal areas.

A Tsunami:

A tsunami is a series of a large, powerful ocean wares caused by the sudden displacement of large volume of water. These wares can travel across the entire ocean basins at high speeds and become extremely

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destructive when they reach shallow coastal areas.

Natural processes that Trigger a Tsunami:

1. Undersea Earthquakes:

It is the most common cause. when tectonic plates shift abruptly along a fault, the seafloor moves upward or downward, displacing water above it.

2. Volcanic Eruptions

Underwater or coastal volcanic explosions can push water outward with great force

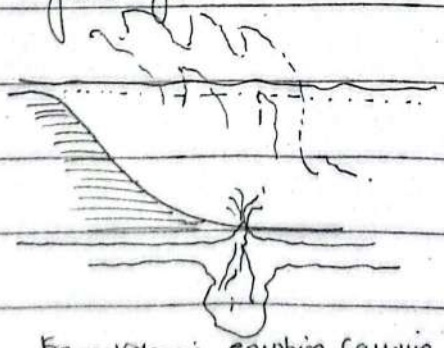

Figure: Volcanic eruption causing Tsunami

- Landslides:

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Submarine landslides or large coastal landslides falling into the ocean can generate powerful waves.

4. **Undersea Explosions or Asteroid Impacts:**

These are rare but can display displace massive amounts of water instantly.

Potential Impact on Coastal Areas:

1. **Flooding:** Entire coastal regions can be submerged within minutes, destroying homes and infrastructure.

2. **Loss of life:** High-speed waves and flooding can cause mass casualties.

3. **Erosion and environmental damage:**

Tsunamis erode ~~casualties~~ coastlines, damage ecosystems and contaminate freshwater supplies.

4. **Economic Losses:**

Ports, fisheries, tourism and coastal

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industries suffer severe destruction.

Q4. (a) Explain the Rock Cycle. Differentiate between Igneous, Sedimentary and metamorphic rocks with examples.

Rock Cycle:

The rock cycle is a continuous process through which rocks are formed, broken down, and transformed into new types of rocks. Heat, pressure, weathering, erosion, melting, and cooling all drive this cycle. Igneous, Sedimentary, and metamorphic rocks can each change into one another over geological time.

Differences Between Igneous, Sedimentary and Metamorphic Rocks

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	Types of Rock	How it Forms	Key Features	Example
1	Igneous Rock	Formed by Cooling and Solidification of magma or lava	Hard, crystaline formed either underground (intrusive) or on the surface (extrusive)	Granite (intrusive) Basalt (extrusive)
2	Sedimentary Rocks	Formed by compaction and cementation of sediments such as sand, silt, and clay	Often layered, may contain fossils	Sandstone, Limestone
3	Metamorphic Rocks	Formed when existing rocks undergo heat and pressure without melting	Harder, more compact, foliated or non-foliated texture	Marble (from limestone), Slate (from Shale.

(b) What is Acid Rain? Discuss chemical reactions involved in its formation and its harmful effects on aquatic life and vegetation.

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Acid Rain:

Acid rain refers to rain water, snow or fog with a pH lower than 5.6 due to the presence of acidic pollutants in the atmosphere, mainly sulfur dioxide (SO_2) and nitrogen (NO_x). It forms when these gases react with water vapours and oxygen in atmosphere to produce strong acids that fall back to earth.

Chemical Reactions Involved in its Formation:

1. Formation of Sulfuric Acid (H_2SO_4)

Emissions of sulfur dioxide (SO_2) from industries and power plants:

$$SO_2 + O_2 \rightarrow SO_3 \text{ (sulfuric trioxide)}$$

Sulfuric trioxide reacts with water to form sulfuric acid

$$SO_3 + H_2O \rightarrow H_2SO_4$$

2. Formation of Nitric Acid (HNO_3)

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Nitrogen oxides produced from vehicles and combustion

$$2NO + O_2 \rightarrow 2NO_2$$

Nitrogen dioxide reacts with water

$$3NO_2 + H_2O \rightarrow 2HNO_3 + NO$$

These acids mix with rain water, producing acid rain.

Harmful Effects on Aquatic Life:

1. **Lowering of pH:** Acidic water makes rivers and lakes too acidic for fish and aquatic organisms.
2. **Disruption of Reproduction:** Fish eggs fail to hatch in highly acidic environment.
3. **Toxicity:** Acid rain release toxic metals like aluminium from soil water into water, poisoning the fish.

Harmful Effects on Vegetation:

1. **Nutrient Loss:**

Acid rain leaches essential nutrients (Ca, Mg, K) from soil.

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2. **Leaf Damage:**

Acids destroy leaf surfaces, reducing photosynthesis.

3. **Weakening trees:**

Roots are damaged, making plants more vulnerable to diseases and harsh ~~water~~ weather.

(c) ~~Rote~~ Discuss Role of Remote ....

Role of Remote Sensing and GIS in Environmental Monitoring and Disaster Management

1. **Remote Sensing**

Remote sensing involves using satellites or aerial sensors to collect information about the Earth's surface without physical contact.

Role in Environmental monitoring

- Detects environmental changes such as deforestation, desertification, melting

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glaciers, and water pollution.

- Monitors climate variables (temperature, rainfall patterns, sea level rise)
- Assesses land use and land cover changes for sustainable planning.

Role in Disaster Management

- Provides real time images to detect and track natural disasters, cyclones, floods, wildfires, droughts, and earthquakes.
- Helps identify ~~risks~~ high-risk zones and predict disaster intensity.
- Support search and rescue operations by locating affected areas quickly.

2. Geographical Information System (GIS)

GIS is a computer based system that stores, analyzes, and maps spatial data.

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Role in Environmental Monitoring.

Integrates different datasets (climate, soil, water, vegetation) for environmental impact assessment (EIA)

Helps monitor pollution hotspots and manage natural resources.

Role in Disaster Management

Besides, it creates hazard maps for floods, landslides, tsunamis and earthquakes.

It supports evacuation planning, ~~rescue~~, resource allocation and risk assessment.

It also helps in post-disaster damage assessment and planning for rehabilitation.