

Q. No 2:

(a) Define Ceramic and nano-ceramic materials. Why the nano-ceramics show better properties than their ceramic counterparts? Write the application of ceramic materials.

**Ceramic Materials:**

Ceramic materials are inorganic, non-metallic solids formed from metallic and non-metallic elements. Clay, bricks, porcelain and glass are examples of ceramics. These materials are known for high melting points, hardness and resistance to wear and corrosion.

**Nano-Ceramic Materials:**

Nano-ceramic materials are engineered at the nanometer scale (less than 100 nanometers). Due to

nano scale structure mechanical, thermal and electrical properties are enhanced in nano-ceramic materials.

### Why Nano-Ceramics Show Better Properties?

- i- Large surface area enhances reactivity and performance.
- ii- At nanoscale, unique properties like superconductivity and magnetism emerge.
- iii- Fine microstructure leads to enhanced strength, toughness, and hardness.

### Application of Ceramic Material:

- i- Ceramic material is used in electronics as integrated circuits, sensors and actuators.
- ii- In aerospace technology ceramics are used for heat shields, turbine blades and structural components.

- iii- In medical sciences ceramics are used in dental implants, bone replacements and drug delivery systems.
- iv- In field of energy are used for fuel cells, batteries and solar cells.
- v- In construction ceramics are used as bricks, tiles and cement.

(b) What is 'Black Hole'? How Black Holes are formed and discovered?

**Black Hole:**

A black hole is a region in space with very strong gravitational pull that even light cannot escape. Black holes are formed when massive stars collapse under its own gravity.

## Formation of Black Hole:

Black holes are occurred when a massive star exhausts its nuclear fuel and collapses.

The collapse creates a singularity, a point of infinite density and zero volume.

Discuss these in more detail

## Discovery of Black Holes:

Black holes were detected indirectly through gravitational effects on nearby objects and X-ray emissions. First image of a black hole was captured in 2019 by the Event Horizon Telescope.

(C) Write two applications of each of the following electromagnetic radiations.

## i- Ultraviolet :

- ✓ Ultraviolet (UV) radiations are used to kill bacteria and viruses for medical equipment and water purification.
- ✓ UV radiations help in forensic analysis to detect biological traces in criminal investigations.

## ii- Infrared:

- ✓ Infrared (IR) radiations are used in thermal imaging to detect heat patterns, useful in medical diagnostics and building inspections.
- ✓ IR radiations are also useful in night vision. As these radiations enhance visibility in low light conditions for military and surveillance applications.

iii- Microwaves:

- ✓ Microwaves are helpful in communication, as are used in mobile networks and satellite communications.
- ✓ Microwaves are also used to heat food by causing water molecules to vibrate in microwave oven.

iv- Radio Waves:

- ✓ Radio waves are used in broadcasting to transmit radio and TV signals from mass media.
- ✓ Radio waves are also helpful in navigation where these are used in GPS systems for location tracking.

## V- X-Rays:

✓ X-rays are: useful in medical imaging to diagnosing fractures, tumors and other conditions.

✓ X-rays are also used for security purposes, employed in scanners for baggage inspection on airports.

(d) What is wildfire? Explain its types, causes, spread and preventions.

## Wildfire:

An uncontrolled fire that spreads rapidly through vegetation, causing significant damage to property, ecosystems and human life.

## Types of Wildfires:

✓ Surface Fires: Burn through grass and shrubs at ground level.

✓ Ground Fires: Smolder beneath the surface, burning organic material like peat.

✓ Crown Fires: Spreads rapidly through the treetops, challenging to control.

## Causes of Wildfires:

✓ Natural Causes: Natural causes events like lightning strikes and volcanic eruptions.

✓ Human Causes: Human causes include unattended campfires and discarded cigarettes.

✓ Climate Change: Rising temperatures and prolonged droughts increase wildfire frequency.

## Spread of Wildfire:

Wildfires especially crown fires are spread rapidly influenced by wind, humidity, temperature, and fuel availability. Wind can carry embers over large distances, which again ignites new fires.

## Prevention of Wildfires:

- ✓ **Controlled Burns:** Reduce fuel by deliberately starting small fires.
- ✓ **Public Education:** Raise awareness regarding safety and prevention.
- ✓ **Forest Management:** Clearing vegetation can reduce wildfire risks.
- ✓ **Early Detection:** Wildfires are critical to control before spread rapidly.

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**Overall good answers!!**