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Qn. 2 (a) Define ceramics and nano-ceramic materials. Why the nano-ceramics show better properties than their ceramic counterparts? Write the applications of ceramics materials.

- **Ceramic:**

Ceramic materials are inorganic, non-metallic solids that are generally hard, brittle, and resistant to corrosion. They are usually made from natural or synthetic materials such as clay, silicates, or oxides which are processed at high temperatures to achieve the desired properties.

- **Nano-Ceramic Materials:**

Nano-ceramic materials are a class of ceramic materials that

have at least one dimention in the nanoscale range (typically 1-100 nanometers). These materials show unique properties, such as enhanced mechanical strength, toughness, and thermal resistance, due to their nanoscale structure.

Reasons why Nano-ceramics show better properties than their ceramics counterparts:

There are some reasons why Nano-ceramics show better properties than their ceramics counterparts. They are as follows:

• Increased Surface Area:

Nano-ceramics have a larger surface Area-to-volume ratio, which enables them to interact more effectively with their environment. It results in reactivity, increased strength and

better thermal conductivity.

- **Improved Mechanical Properties:**

The nanoscale structure of nano ceramics allow for the formation of stronger and more uniform bonds between particles.

- **Reduced defects of Pores:**

Nano ceramics have fewer defects and pores compared to their ceramic counterparts.

- **Applications of Ceramic Materials.**

There are certain applications which are listed below:

- Cookware and Tableware
- Construction and building materials
- Electrical and Electronic components.
- Medical and Biomedical Applications.
- Automative Applications.

Mention full qs statement for proper evaluation; without that, these are just notes and cannot be awarded marks

(b) Black Holes

A black hole is a region in space where the gravitational pull is so strong that nothing, including light, can escape.

Formation of Black Holes:

Black Holes are formed when a massive star runs out of fuel and dies. If the star is massive enough (about 3-4 times the size of the Sun), its gravity will collapse the star in one itself causing a supernova explosion.

If the star is even more massive (about 10-20 times the size of the Sun), the collapse will continue, and the star will shrink down to a tiny point called a Singularity.

• Discovery of Black Holes:

Black Holes are discovered through indirect methods, as they do not emit any electromagnetic radiation, making them invisible to the telescope.

Here are some discovered black holes ways that are given below:

- x-rays and Game Rays.
- Radio Waves.
- Star Motion
- Gravitational Waves.
- Astrometry.

Here, these methods have allowed astronomers to discover thousands of black holes in the Universe.

(c) Applications of Electromagnetic radiations:

There are two applications of each of the following electromagnetic radiations which are as follows:

i) Ultraviolet:

- Disinfection and sterilization:
UV light is used to distinct and sterilize surfaces, air, and water. It is mostly used in hospitals, laboratories, and food processing industries.

- Medical Treatment:
It is used to treat various medical conditions, like jaundice, psoriasis, and vitiligo.

ii) Infra-red:

- Thermal Imaging:
IR radiation is used in

thermal imaging cameras to detect temperature differences in objects or environments. Such as predictive maintenance and building inspection.

- Heating and Drying:

IR is used in various industrial and commercial applications for heating and drying purposes, such as industrial drying: to dry paints, coating, and inks.

iii) **Microwaves:**

- Heating and cooking:

Microwaves are widely used in household microwave ovens for heating and cooking.

- Wireless communications:

They are also used in wireless communication systems, such as satellite communications, cellular networks and wireless local area networks (WLANs).

iv) Radiowaves:

- Wireless communication:

Radiowaves are used in wireless communication systems, such as radio broadcasting, mobile phones, and satellite communications.

- Radar Technology:

They are also used in radar technology to detect and track objects, like aircraft, ships, and weather patterns.

v) X-rays

- Medical Imaging:

X-rays are widely used in medical imaging to produce images of the internal structures of the body. They are also used to diagnose bone fractures, lung diseases, and tumors.

Security Screening:
X-rays are used in security screening applications such as airport security scanners.

(d) Wildfire:

Wildfire is an uncontrolled fire that occurs in wildland areas, such as forests, grasslands, and brushlands.

• Types of Wildfire:

There are some types of wildfires which are explained as under:

i) Surface Fires:
These fires burn vegetation and other materials on the surface like grass, leaves, and small twigs.

ii) Ground Fires:
These fires burn underground vegetation and other materials, such

as roots, stumps and other burried fuels.

iii) Running Fires:

These fires often spread quickly, driven by wind and are difficult to control.

iv) Spot Fires:

These fires start as small, isolated blazes, usually ignited by embers or sparks, and they can spread quickly if not contained.

• Causes of Wildfires:

There are some causes of wild-fires which are listed below:

- Natural causes that include, Lightning, Spontenous combustion, Volcanic activity.
- Humans cause wildfires that include, Arson, carelessness and

accidental ignitions etc.

- **Preventions:**

Here are some prevention measures to reduce the risk of wildfires:

- Fully Extinguishing Campfires.
- Dispose of Cigarretes
- Being mindful to fire restrictions.
- Creating defensible space.
- Monitoring weather conditions and so on.