GSA - 2023 Date: _____

PART-II "SECTION-A"

Q.NO.02.(a)

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

CERAMIC AND NANO-CERAMIC MATERIALS

DEFINITION OF CERAMIC MATERIALS

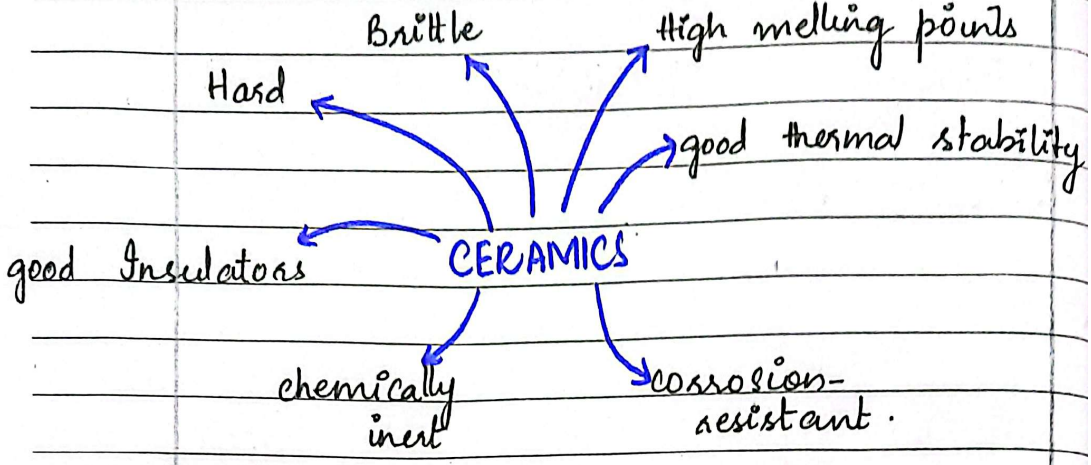
"Ceramics are non-metallic, inorganic solids that are typically made by heating and cooling a mixture of metallic and non-metallic elements."

Ceramics are either crystalline or partly-crystalline in structure and are produced from materials like clay, silica, alumina, and other oxides

General composition:

Metal or metalloid elements are bonded with oxygen, nitrogen, or carbon (e.g: Al_2O_3, SiO_2).

Date:



DEFINITION OF NANO-CERAMIC MATERIALS

"Nano-ceramics are ceramic materials with grain sizes in the nano-meter range (1-100nm). These are synthesized by nano-technology."

EXAMPLES OF NANO-CERAMICS

- Nano-alumina (Al_2O_3)
- Nano-silica (SiO_2)

WHY NANO-CERAMICS SHOW BETTER PROPERTIES THAN OTHER CERAMICS:

The scientific explanation as

Date: _____

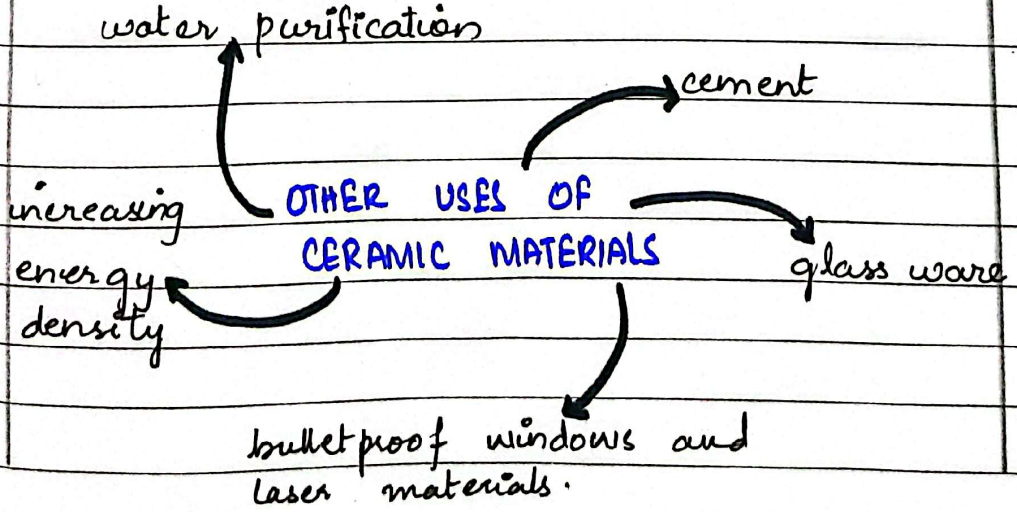
to why nano-ceramics are better is that their particle size decreases to nano-meters. Due to extremely small particles, the surface to volume ratio increases dramatically. The surface atoms have higher energy and reactivity, leading to improved mechanical strength, chemical reactivity, and functional performance.

APPLICATIONS OF CERAMIC MATERIALS

1. They are used in structural appliances in armor plates, aircraft components etc.

2. Also used in construction materials such as; tiles, sanitary ware, etc.

3. Ceramic materials are also used in the manufacturing of optical and coating applications.



Date:

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

BLACK HOLE : FORMATION AND DISCOVERY

DEFINING A BLACK HOLE:

"A black hole is a region in space with extremely strong gravity from which nothing, not even light, can escape."

DISCOVERY OF BLACK HOLE

Black Holes were first predicted by Albert Einstein's General theory of Relativity in 1915, and was mathematically described by Karl Schwarzschild in 1916. They are detected indirectly through X-ray emissions, gravitational effects on nearby stars, and gravitational waves. The first ever Black Hole was captured by the Event Horizon Telescope in M87 galaxy.

Date: _____

TYPES OF BLACK HOLE

- Stellar
- Supermassive
- Primordial Black Holes.

FORMATION OF BLACK HOLES

A black hole is formed when a massive star collapses under its own gravity after exhausting its nuclear fuel. This leads to a supernova explosion and the creation of a dense core known as the singularity. The singularity is surrounded by an event horizon.

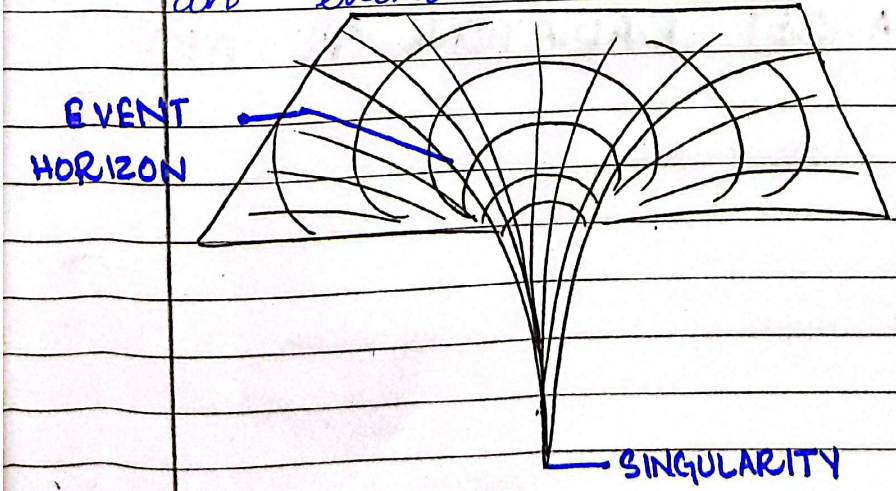


figure: formation of a black hole.

Date:

(c) Write two applications of each of the following electromagnetic radiations:

(i) Ultraviolet (ii) Infra-red
(iii) Microwaves (iv) Radio waves
(v) X-rays.

APPLICATIONS OF ELECTROMAGNETIC RADIATIONS:

Electromagnetic radiations are the waves of energy that travel through space or a medium at the speed of light, consisting of oscillating electric and magnetic fields that are perpendicular to each other and to the direction of wave propagation.

1 ULTRAVIOLET RADIATIONS (UV-RAYS)

The ultraviolet radiations are used for:

i- sterilization and disinfection of medical equipment and water

Date:

ii. forensic analysis and detecting forged documents (fluorescence).

2 INFRARED RADIATIONS

Infrared radiations are used for;

i. Remote controls and thermal imaging cameras.

ii. Heat therapies in medicine and night-vision devices.

3 MICROWAVES

Microwaves are used;

i- in microwave ovens for heating food.

ii- in radar systems and satellite communications.

4 RADIOWAVES

Radiowaves are used in;

i. radio and television broadcasting.

ii. wireless communication systems (wifi).

Date:

5 X-RAYS

X-rays are used in;

i- medical imaging to detect bone fractures and diseases.

ii- security scanning at airports and malls.

(d) What is Wildfire? Explain its types, causes, spread and prevention.

WILDFIRE

"A wildfire is an uncontrollable fire that spreads rapidly through forests, grasslands, or other vegetation, fueled by dry conditions, wind and heat. It destroys ecosystems, wildlife habitats, and human settlements."

TYPES OF WILDFIRE

- Surface fire
- Crown fire
- Ground fire.

Date:

Surface fire:

It is the type of wildfire that burns the surface litter, grass, and small plants. It is the most common type of wildfire and the easiest to cool.

Crown fire:

It is the type of wildfire that spreads through the tops of trees and can move rapidly. It is extremely dangerous and destructive.

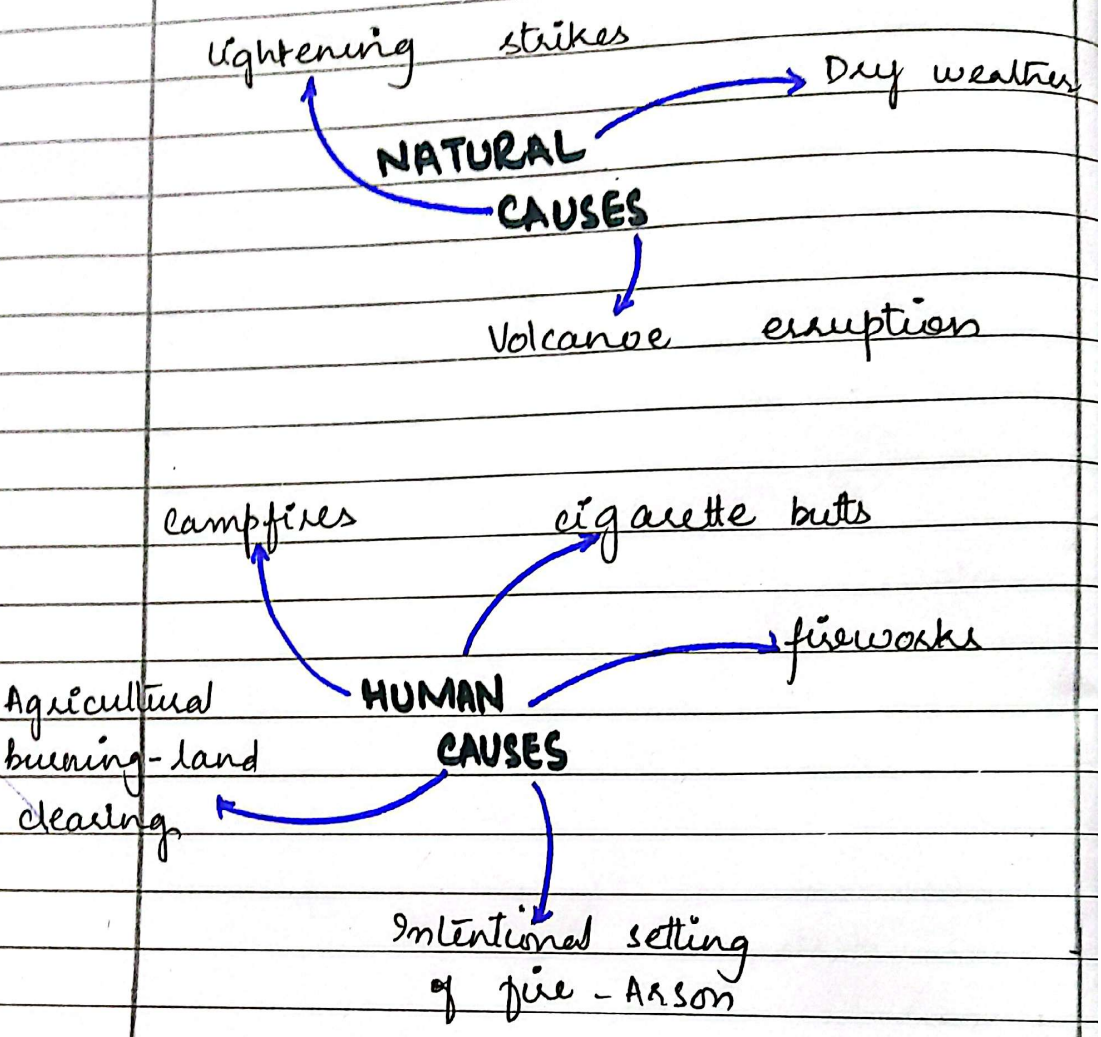
Ground fire:

This type of wildfire burns underground organic matter like peat and roots. It is difficult to detect and extinguish.

CAUSES OF WILDFIRE

Wildfire can occur either due to natural causes or human causes.

Date:



SPREAD OF WILDFIRE

Numerous natural and human-made factors cause and spread wildfire. They include:

→ Winds carrying embers and flames from one place to another.

→ Low humidity and heat increase flammability.

Date:

PREVENTION AND CONTROL OF WILDFIRES

1- Controlled (prescribed) burning to remove excess dry fuel.

2- Creating gaps in vegetation to stop spread.

3- Developing early detection systems using satellites and drones for monitoring.

4- Educating public about fire safety.

5- Implementing strict laws to regulate campfires and deforestation activities.