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Mains Practice Questions

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Q. What is nanotechnology? Discuss the recent developments in applications of nanotechnology in India. (150 words)

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Approach

- In the introduction, explain what nanotechnology is and mention a few examples of its application
- Briefly explain the growing scope of nanotechnology along with recent developments taking place in the country.
- Summarize in the end and write a way forward suggesting what more needs to be done to exploit this technology efficiently.

Introduction

Nanotechnology is the use and the developments of techniques to study physical phenomena and develop new material and devices structures in the physical size range from 1 to 100 nanometres (nm). Nanotechnology influences almost all areas of our lives, including manufacturing, electronics, computers and information technologies, medicine, the environment and energy storage, chemical and biological technologies and agriculture.

Body

Some of the recent developments in the application of nanotechnology in India are listed below:

- **Medical and Healthcare applications-**
 - Nanotechnology is already broadening itself in the areas of medical tools, knowledge, and therapies currently available to clinicians.
 - **Nanomedicine**, the application of nanotechnology in medicine, draws on the natural scale of biological phenomena to produce precise solutions for disease prevention, diagnosis, and treatment.
 - For example, better imaging and diagnostic tools enabled by nanotechnology are paving the way for earlier diagnosis, more individualized treatment options, and better therapeutic success rates.
- **Electronics and IT Applications-**

Nanotechnology has greatly contributed to major advances in computing and electronics, leading to faster, smaller, and more portable systems that can manage and store larger and larger amounts of information.

- **Energy Applications-**

Nanotechnology is finding application in traditional energy sources and is greatly enhancing alternative energy approaches to help meet the world's increasing energy demands.

For example, Nanotechnology is improving the efficiency of fuel production from raw petroleum materials through better catalysis. It is also enabling reduced fuel consumption in vehicles and power plants through higher-efficiency combustion and decreased friction

- **Environment remediation-**

In addition to the ways that nanotechnology can help improve energy efficiency, there are also many ways that it can help detect and clean up environmental contaminants

For example, Nanotechnology could help meet the need for affordable, clean drinking water through rapid, low-cost detection and treatment of impurities in water.

- **Future Transportation Benefits-**

Nanotechnology offers the promise of developing multifunctional materials that will contribute to building and maintaining lighter, safer, smarter, and more efficient vehicles, aircraft, spacecraft, and ships. In addition, nanotechnology offers various means to improve the transportation infrastructure

- **Everyday Materials and Processes-**

- Nanoscale additives to or surface treatments of fabrics can provide lightweight ballistic energy deflection in personal body armor, or can help them resist wrinkling, staining, and bacterial growth.
- Clear nanoscale films on eyeglasses, computer and camera displays, windows, and other surfaces can make them water- and residue-repellent, anti-reflective, self-cleaning, resistant to ultraviolet or infrared light, anti-fog, antimicrobial, scratch-resistant, or electrically conductive.

Nanotechnology In India

- The emergence of nanotechnology in India has witnessed the engagement of a diverse set of players, each with their own agenda and role.
- Presently nanotechnology in India is mostly government-led initiative. Industry participation has very recently originated.
- Nanotechnology R&D barring a few exceptions is largely being ensued at public-funded universities as well as research institutes.
- Scientific experts from all over the country came together at the National Conference - **Nano India 2019** to discuss ways of using nanotechnology for the development of products and processes for national development, especially in areas of national relevance like safe drinking water, materials development, sensors development, and drug delivery.

Conclusion

Nanotechnology is helping to considerably improve technology in sectors like information technology, homeland security, medicine, transportation, energy, food safety, and environmental science.

Because of their small size, much concern has been expressed about the potential for adverse health effects arising from the ability of nanoparticles to penetrate cell walls and the blood-brain barrier. These concerns also include possible detrimental health effects during manufacturing and transportation. Therefore, there is a need to identify key gaps in knowledge and areas where further research may be targeted in order to efficiently exploit the technology.