

RECENT DEVELOPEMENT IN PHYSICS

PHYSICS - 2

UNIT - 11



NAME :
STANDARD : 12 SECTION :
SCHOOL :
EXAM NO :

செல்வத்துட் செல்வஞ் செவிச்செல்வம் அச்செல்வம்
செல்வத்து ளெல்லாம் தலை

செவியால் கேட்டுப் பெறும் செல்வமே சிறந்த செல்வம்.
இது பிற செல்வங்கள் எல்லாவற்றிலும் முதன்மையானது



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2 And 3 Mark Questions & Answers

1. Distinguish between Nanoscience and Nanotechnology.

Nanoscience :

- ✓ It is the science of objects with typical size 1 - 100 nm
- ✓ Nano means one - billionth of a metre. (i.e) $10^{-9} m$

Nanotechnology :

- ✓ It is a technology involving the design, production, characterization and application of nano structured materials

2. What is the difference between Nanomaterials and Bulk materials?

- ✓ If the particle of a solid is of size less than 100 nm, it is said to be a 'nano solid'. When the particle size exceeds 100 nm, it is a 'bulk solid'
- ✓ Though nano and bulk solids have same chemical composition, nano form of the material shows strikingly different properties when compared to its bulk counterpart.

3. Give the interdisciplinary nature of nano technology.

- ✓ Nano science and technology is the interdisciplinary area covering its applications in various fields. They are,
 - (1) Physics
 - (2) Chemistry
 - (3) Electrical & Mechanical Engineering
 - (4) Material science
 - (5) Molecular Biology
 - (6) Applied Mathematics & Computer science

4. Explain how nano structures are made in the laboratory?

Nano in laboratories :

- ✓ The nano structures made in the laboratory *mimic some of the nature's amazing nano structures.*
- ✓ There are two ways of preparing the nanomaterials. They are.
 - (1) Top - Down approach
 - (2) Bottom - Up approach

(1) Top - Down approach :

- ✓ Nano materials are synthesized by breaking down bulk solids into nano sizes. (e.g) Ball milling, sol-gel, lithography

(2) Bottom - up approach :

- ✓ Nano materials are synthesized by assembling the atoms or molecules together. Selectively atoms are added to create structures. (e.g.) plasma etching and chemical vapour deposition

5. List the applications of Nano technology.

- ✓ Energy storage
- ✓ Defence and security
- ✓ Metallurgy and materials
- ✓ Electronics
- ✓ Optical engineering and communication
- ✓ Biomedical and drug delivery
- ✓ Agriculture and food
- ✓ Cosmetics and paints
- ✓ Bio-technology
- ✓ Textiles

6. What is robotics?

- ✓ Robotics is an integrated study of mechanical engineering, electronic engineering, computer engineering and science.
- ✓ Robot is a mechanical device designed with electronic circuitry and programmed to perform a specific task.

7. What are the components of robotics?

- ✓ The robotic system mainly consists of
 - (1) Sensors
 - (2) Power supplies
 - (3) Control systems
 - (4) Manipulators
 - (5) Necessary softwares

8. Give the types of robots.

(1) Human robot :

- ✓ Certain robots are made to resemble humans in appearance and replicate the human activities like walking, lifting and sensing etc

(2) Industrial robots :

- ✓ Six main types of industrial robots are Cartesian, SCARA, Cylindrical, Delta, Polar and Vertically articulated.
- ✓ They are ideal for Arc welding, Spot welding, Material handling, machine tending and other applications.

9. What is artificial intelligence? What are its work?

- ✓ The aim of artificial intelligence is to bring in human like behaviour in robots.

- ✓ It works on,
 - (1) Face recognition
 - (2) Providing response to player's actions in computer games
 - (3) Taking decisions based on previous actions
 - (4) To regulate the traffic by analyzing the density of traffic on roads
 - (5) Translate words from one language to another

10. Give the applications of robot in various fields.

Applications of robot :

- ✓ Weaponry, packing, Lawn mowing, cutting, underwater, agriculture, pool cleaning
- ✓ Welding, cutting, assembling, litter robot, transport.
- ✓ Vacuum cleaners, hospitals, surgery, laboratory
- ✓ Exploring stars, planets etc., investigation of the mineralogy of the rocks and soils on Mars, analysis of elements found in rocks and soils

11. Write a note on nano robots.

Nano robots :

- ✓ The size of the nano robots is reduced to microscopic level to perform a task in very small spaces.
- ✓ In future nano robots are used in the medical fields.
- ✓ Nano robots in blood stream to perform small surgical procedures, to fight against bacteria, repairing individual cell in the body.
- ✓ It can travel into the body and once after the job is performed it can find its way out.

12. Why steels are preferred to make robots?

- ✓ For robots, aluminum and steel are the most common metals.
- ✓ Aluminum is a softer metal and is therefore easier to work with it.
- ✓ But steel is several times stronger and because of the inherent strength of steel, robot bodies are made using sheet, bar, rod, channel and other shapes.

13. What is particle physics? Write down its recent development.

Particle physics and its development :

- ✓ The study of the theory of fundamental particles of nature is called particle physics.
- ✓ Initially it was thought that *atom* is the fundamental entity of matter. But in 1930, it was

established that atoms are made up of **electrons, protons and neutrons**

- ✓ In 1960, it was discovered that protons and neutrons were made up of **quarks**.
- ✓ Later it was found that quarks interact through **gluons**.
- ✓ Recently in 2013, famous **Higgs particles** also known as **God particles** were discovered which gives mass to many particles like protons, neutrons etc.,

14. Write a note on Cosmology.

- ✓ Cosmology is the branch that involves the origin and evolution of the universe.
- ✓ It deals with the formation of stars, galaxy etc.

15. What are called gravitational waves?

- ✓ The disturbances in the curvature of space-time is called gravitational waves. Its travels with speed of light.
- ✓ Any accelerated charge emits electromagnetic waves. Similarly any accelerated mass emits gravitational waves.
- ✓ But these gravitational waves are very weak even for masses like earth.
- ✓ The strongest source of gravitational waves are **black holes**.
- ✓ The recent discoveries of gravitational waves are emitted by two black holes when they merge to a single black hole.
- ✓ In 1915, **Albert Einstein** theoretically proposed the existence of gravitational waves. After 100 years, it is experimentally proved that his predictions are correct.

16. Write a note on black holes.

Black holes :

- ✓ Black holes are end stage of stars which are highly dense massive object.
- ✓ Its mass ranges 20 times mass of the sun to 1 million times mass of the sun.
- ✓ It has very strong gravitational force such that no particle or even light can escape from it.
- ✓ The existence of black hole is studied when the stars orbiting the black hole behave differently from the other stars.
- ✓ Every galaxy has black hole at its centre.
- ✓ **Sagittarius A*** is the black hole at the centre of the Milky Way galaxy.

5 Marks Questions & Answers

1. Explain Nano structure in nature with examples.

Nano in nature :

(1) Single strand DNA :

- ✓ It is the basic building block of all living things.
- ✓ It is about 3 nm wide

(2) Morpho butterfly :

- ✓ The scales of the wings of this butterfly contains nano structures.
- ✓ When light wave interact with this giving the wings brilliant metallic blue and green hues.

(3) Peacock feathers :

- ✓ They get their iridescent coloration from light interacting with 2 dimensional photonic crystal structures just tens of nanometers thick
- ✓ Similar nano structures are made in lab to glow in different colors

(4) Parrot fish :

- ✓ It crunches up coral all day.
- ✓ The source of powerful bite is the interwoven fibre nanostructure.
- ✓ Crystals of a mineral called **fluorapatite** are woven together in a chain mail-like arrangement. This structure gives parrot fish teeth incredible durability.
- ✓ It provides a blue print for creating ultradurable synthetic materials that could be useful for mechanical components in electronics and in other devices that undergo repetitive movement, abrasion and contact stress

(5) Lotus Leaf surface :

- ✓ Scanning electron micrograph (SEM) gives the nano structures on the surface of a leaf from a lotus plant.
- ✓ This is the reason for self cleaning process on lotus leaf.

2. Discuss the applications of Nanomaterials in various fields.

Automotive industry :

- ✓ Lightweight construction
- ✓ Painting (fillers, base coat, clear coat)
- ✓ Catalysts
- ✓ Tires (fillers)

- ✓ Sensors
- ✓ Coatings for windscreen and car bodies

Chemical industry :

- ✓ Fillers for paint systems
- ✓ Coating systems based on nanocomposites
- ✓ Impregnation of papers
- ✓ Switchable adhesives
- ✓ Magnetic fluids

Engineering :

- ✓ Wear protection for tools and machines
- ✓ Lubricant-free bearings

Electronic industry :

- ✓ Data memory
- ✓ Displays
- ✓ Laser diodes
- ✓ Glass fibres
- ✓ Optical switches
- ✓ Filters (IR-blocking)
- ✓ Conductive, antistatic coatings

Construction :

- ✓ Construction materials
- ✓ Thermal insulation
- ✓ Flame retardants
- ✓ Surface-functionalised building materials for wood, floors, stone, facades, tiles, roof tiles, etc.
- ✓ Facade coatings
- ✓ Groove mortar

Medicine :

- ✓ Drug delivery systems
- ✓ Active agents
- ✓ Contrast medium
- ✓ Medical rapid tests
- ✓ Prostheses and implants
- ✓ Antimicrobial agents and coatings
- ✓ Agents in cancer therapy

Food and drinks :

- ✓ Package materials
- ✓ Storage life sensors
- ✓ Additives
- ✓ Clarification of fruit juices

Energy :

- ✓ Fuel cells
- ✓ Solar cells
- ✓ Batteries
- ✓ Capacitors

Textile/fabrics/non-wovens :

- ✓ Surface-processed textiles
- ✓ Smart clothes

Household :

- ✓ Ceramic coatings for irons
- ✓ Odors catalyst
- ✓ Cleaner for glass,
- ✓ ceramic, floor, windows

Cosmetics :

- ✓ Sun protection
- ✓ Lipsticks
- ✓ Skin creams
- ✓ Tooth paste

Sports/ outdoor :

- ✓ Ski wax
- ✓ Antifogging of glasses/goggles
- ✓ Antifouling coatings for ships/boats
- ✓ Reinforced tennis rackets and balls

3. What are the possible harmful effects of usage of Nanoparticles? Why?

Possible harmful effects of nano particles :

- ✓ The major concern here is that the nanoparticles have the dimensions same as that of the biological molecules such as proteins. They may easily get absorbed on to the surface of living organisms and they might enter the tissues and fluids of the body.
- ✓ The adsorbing nature depends on the surface of the nanoparticle. Indeed, it is possible to deliver a drug directly to a specific cell in the body by designing the surface of a nanoparticle so that it adsorbs specifically on to the surface of the target cell.
- ✓ The interaction with living systems is also affected by the dimensions of the nanoparticles.
- ✓ Nanoparticles can also cross cell membranes. It is also possible for the inhaled nanoparticles to reach the blood, to reach other sites such as the liver, heart or blood cells.
- ✓ Researchers are trying to understand the response of living organisms to the presence of nanoparticles of varying size, shape, chemical composition and surface characteristics.

4. Mention the advantages and disadvantages of Robotics.

Advantages of robotics :

- ✓ The robots are much cheaper than humans.
- ✓ Robots never get tired like humans. Hence absenteeism in work place can be reduced.
- ✓ Robots are more precise and error free in performing the task.
- ✓ Stronger and faster than humans.
- ✓ Robots can work in extreme environmental conditions: extreme hot or cold, space or underwater. In dangerous situations like bomb detection and bomb deactivation.
- ✓ In warfare, robots can save human lives.
- ✓ Robots are significantly used in handling materials in chemical industries especially in nuclear plants which can lead to health hazards in humans.

Disadvantages of robotics :

- ✓ Robots have no sense of emotions or conscience.
- ✓ They lack empathy and hence create an emotionless workplace.
- ✓ If ultimately robots would do all the work, and the humans will just sit and monitor them, health hazards will increase rapidly.
- ✓ Unemployment problem will increase.
- ✓ Robots can perform defined tasks and cannot handle unexpected situations
- ✓ The robots are well programmed to do a job and if a small thing goes wrong it ends up in a big loss to the company.
- ✓ If a robot malfunctions, it takes time to identify the problem, rectify it, and even reprogram if necessary. This process requires significant time.
- ✓ Humans cannot be replaced by robots in decision making.
- ✓ Till the robot reaches the level of human intelligence, the humans in work place will exit.

5. Comment on the recent advancement in medical diagnosis and therapy.

(1) Virtual reality :

- ✓ Medical virtual reality is effectively used to stop the brain from processing pain and cure soreness in the hospitalized patients.
- ✓ It helps in the treatment of Autism, Memory loss, and Mental illness.

(2) Precision medicine :

- ✓ Precision medicine is an emerging approach for disease treatment and prevention that takes into account individual variability in genes, environment, and lifestyle for each person.

(3) Health wearables :

- ✓ A health wearable is a device used for tracking a wearer's vital signs or health and fitness related data, location, etc.
- ✓ Medical wearables with artificial intelligence and big data provide an added value to healthcare with a focus on diagnosis, treatment, patient monitoring and prevention.

(4) Artificial organs :

- ✓ An artificial organ is an engineered device or tissue that is implanted or integrated into a human.
- ✓ It is possible to interface it with living tissue or to replace a natural organ. It duplicates or augments a specific function or functions of human organs so that the patient may return to a normal life as soon as possible.

(5) 3D printing :

- ✓ Advanced 3D printer systems and materials assist physicians in a range of operations in the medical field from audiology, dentistry, orthopedics and other applications.

(6) Wireless brain sensors :

- ✓ Wireless brain sensors monitor intracranial pressure and temperature and then are absorbed by the body. Hence there is no need for surgery to remove these devices.

(7) Robotic surgery :

- ✓ Robotic surgery is a type of surgical procedure that is done using robotic systems.
- ✓ Robotically-assisted surgery helps to overcome the limitations of pre-existing minimally-invasive surgical procedures and to enhance the capabilities of surgeons performing open surgery.

(8) Smart inhalers :

- ✓ Inhalers are the main treatment option for asthma. Smart inhalers are designed with health systems and patients in mind so that they can offer maximum benefit.

- ✓ Smart inhalers use Bluetooth technology to detect inhaler use, remind patients when to take their medication and gather data to help guide care.

6. Discuss the functions of key components in Robots?

Functions of key components of Robots :

- ✓ Most robots are composed of 3 main parts:
 - (1) Controller
 - (2) Mechanical parts
 - (3) Sensors

Controller :

- ✓ It is also known as the "brain" which is run by a computer program.
- ✓ It gives commands for the moving parts to perform the job.

Mechanical parts :

- ✓ It consists motors, pistons, grippers, wheels, and gears that make the robot move, grab, turn, and lift.

Sensors :

- ✓ It tells the robot about its surroundings. It helps to determine the sizes and shapes of the objects around, distance between the objects, and directions as well.

7. Explain the various components of robotics.

Power conversion unit:

- ✓ Robots are powered by batteries, solar power, and hydraulics.

Actuators:

- ✓ Converts energy into movement. The majority of the actuators produce rotational or linear motion.

Electric motors:

- ✓ They are used to actuate the parts of the robots like wheels, arms, fingers, legs, sensors, camera, weapon systems etc.
- ✓ Different types of electric motors are used. The most often used ones are AC motor, Brushed DC motor, Brushless DC motor, Geared DC motor, etc.

Pneumatic Air Muscles:

- ✓ They are devices that can contract and expand when air is pumped inside.
- ✓ It can replicate the function of a human muscle. They contract almost 40% when the air is sucked inside them.

Muscle wires:

- ✓ They are thin strands of wire made of shape memory alloys. They can contract by 5% when electric current is passed through them.

Piezo Motors and Ultrasonic Motors:

- ✓ Basically, we use it for industrial robots.

Sensors:

- ✓ Generally used in task environments as it provides information of real-time knowledge.

Robot locomotion:

- ✓ Provides the types of movements to a robot.
- ✓ The different types are
 - (a) Legged
 - (b) Wheeled
 - (c) Combination of Legged and Wheeled Locomotion
 - (d) Tracked slip/skid