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Special Materials For GS Mains 2012 Science and Technology



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CHAPTER - 1

SCIENCE AND TECHNOLOGY

1. What do you understand by the term Neutrinos? Bring out the position of India in Neutrino Physics. Bring out the application of Neutrino technology.

Neutrinos are elementary particles that are filling the Universe in abundance but are very elusive. Trillions of neutrinos are passing through our bodies every second without affecting us.

One of the most important discoveries of the last decade is that neutrinos have mass. Until this discovery, it was thought that neutrinos are massless particles like photons, the quanta of light.

This has led to active planning of many more neutrino laboratories round the world, especially considering that a considerable part of neutrino physics is yet to be discovered.

India is a pioneer in neutrino physics. The very first detection of cosmic-ray produced neutrinos was made in the Kolar Gold Fields (KGF) experiment in 1965. But the KGF laboratory was closed in the 1990s because the KGF mines were closed.

Now, the India-based Neutrino Observatory (INO) project has been conceived. It has been approved for funding by the Department of Atomic Energy and the Department of Science and Technology and included by the Planning Commission as a mega science project under the Eleventh Five-Year Plan.

A rock of at least a kilometre thickness is needed to filter all other cosmic-ray-produced particles to enable the detector to detect the elusive neutrinos. Hence we have to go inside a mountain.

Applications of neutrino technology

- 1) Since neutrinos are the most penetrating radiation known to mankind (a typical neutrino can travel a million Earth, diameters, of matter without getting stopped), neutrino beams will be the ultimate tools for the tomography of Earth.

- 2) A new window on geophysics opened a few years ago when a neutrino detector in Japan detected geoneutrinos emitted by radioactive uranium and thorium ore buried in the bowels of the Earth. This leads to the possibility of mapping the whole Earth as far as its radioactive content is concerned.

2. India-based Neutrino Observatory (INO) project

The INO Project is an underground facility with a huge detector and two man-made caves amidst a rock mass to study the properties of neutrinos through experiments and understand the various processes in the universe. Once started, this project is expected to take five years for execution.

Union Ministry of Environment and Forests (MoEF) accorded both environmental and forest clearance for locating the project in the Bodi West Hills (BWH) in then district, also in Tamil Nadu in October 2010.

A huge Science park, which will be open to the public, particularly for school and college students, has been included as one of the components of the India-based Neutrino Observatory (INO) project being established in Theni district.

3. What do you understand by HapMap Project? Why HapMap Project has been in news recently?

HapMap Project

The goal of the International HapMap Project is to develop a haplotype map of the human genome, the HapMap, which will describe the common patterns of human DNA sequence variation.

The HapMap is expected to be a key resource for researchers to use to find genes affecting health, disease, and responses to drugs and environmental factors. The information produced by the Project will be made freely available.

The Project is a collaboration among Scientists in Japan, the U.K., Canada, China, Nigeria, and the U.S. The Project officially started in 2002.

Most common diseases, such as diabetes, cancer, stroke, heart disease, depression, and asthma, are affected by many genes and environmental factors. .

Although any two unrelated people are the same at about 99.9% of their DNA sequences, the remaining 0.1% is important because it contains the genetic variants that influence how people differ in their risk of disease or their response to drugs.

Discovering the DNA sequence variants that contribute to common disease risk offers one of the best opportunities for understanding the complex causes of disease in humans.

Sites in the genome where the DNA sequences of many individuals differ by a single base are called single nucleotide polymorphisms (SNPs). For example some people may have a chromosome with an A at a particular site where others have a chromosome with a G. Each form is called an allele.

HapMap 3 project to include Indians in Houston

The Indian-American population in Houston, USA, with origins in Gujarat, is one of the seven population groups added to the third phase of the HapMap human genetic mapping project.

The new map is the third generation of what has been dubbed the HapMap (haplotype map) of the human genome.

It includes data from an additional seven global populations, bringing the total number to 11 populations, the National Human Genome Research Institute (NHGRI).

The increased number of samples allows detection of variants that are much rarer than could be found by the earlier HapMaps.

4. The first-ever Census of Marine Life (CoML)

The first-ever Census, of Marine Life (CoML), a mammoth decade-long exercise involving more than 2,700 scientists from over 80 countries, has been successfully completed.

The painstaking research has unearthed nearly 250,000 marine species of an estimated one million. About 6,000 new species have also been discovered.

The landmark exercise marks a remarkable beginning in identifying and mapping the diversity, distribution, and abundance of marine organisms.

While ten marine hotspots were identified, including one in the Indian Ocean, many biodiversity hotspots await detailed investigation.

This is because the oceans cover 75 per cent of the earth's surface, and investigating their surface and depths requires tremendous scientific expertise and huge investments.

5. Differentiate cruise missile from ballistic missile

Cruise missile

A cruise missile is a guided missile that carries an explosive payload and is propelled, usually by a jet engine, towards its target.

Cruise missiles are designed to deliver a large warhead over long distances with high accuracy. Modern cruise missiles can travel at supersonic or high subsonic speeds, are self-navigating, and can fly on a non-ballistic, extremely low altitude trajectory.

In a cruise missile, the warhead is integrated into the vehicle and the vehicle is always sacrificed in the mission. Cruise missile designs fundamentally derive from the German V-I of World War-II.

Ballistic missile

A ballistic missile is a missile that follows a sub-orbital ballistic flight path with the objective of delivering one or more warheads to a predetermined target. The missile is only guided during the relatively brief initial powered phase of flight and its course is subsequently governed by the laws of orbital mechanics and ballistics. To date, ballistic missiles have been propelled during powered flight by chemical rocket engines of various types.

Difference between cruise missile and ballistic missile

A cruise missile is a guided missile that carries an explosive payload and uses a lifting wing and a propulsion system, usually a jet engine, to allow sustained flight; it is essentially a flying bomb. Cruise missiles are generally designed to carry a large conventional or nuclear warhead many hundreds of miles with high accuracy.

Modern cruise missiles can travel at supersonic or high subsonic speeds, are self-

navigating, and fly on a non-ballistic very low altitude trajectory in order to avoid radar detection. In general (and for the purposes of this article), cruise missiles are distinct from unmanned aerial vehicles (UAV) in that they are used only as weapons and not for reconnaissance, the warhead is integrated into the vehicle, and the vehicle is always sacrificed in the mission.

6. What do you understand by the term breeder reactor? Assess the contributions made by the Fast Breeder Test Reactor at Indira Gandhi Centre for Atomic Research (IGCAR) in Kalpakkam. Bring out Homi Bhabha's vision for the country's nuclear electricity programme,

A breeder reactor

A breeder reactor is a nuclear reactor that generates more fissile material in fuel than it consumes. The term breeding refers to production of more fissile than consumed, in a reactor.

Nuclear transmutations take place in a reactor due to continual nuclear interactions and radioactive decays, leading to the production of a variety of new nuclei, not present in the initial feed of materials in the reactor.

Some of the newly produced nuclei are advantageous and some disadvantageous, but such new arrivals are inevitable.

The new arrivals include new fissile material and this becomes the most prominent among the materials newly produced in the transmutations.

The initial feed of the fuel is made of the fissile material (U-235, U-233 or Pu-239) and the fertile material (U-238 or Th-232) in a calculated proportion:

Fast Breeder Test Reactor

The Fast Breeder Test Reactor built at Indira Gandhi Centre for Atomic Research, Kalpakkam, is a fore-runner to the second stage of Indian nuclear power programme. The reactor design is based on the French reactor Rapsodie, with several modifications, which were made to suit India's requirement.

The reactor uses a unique plutonium-uranium carbide fuel developed indigenously as the driver fuel, and went critical on 18th October, 1985. Being a unique fuel of its kind without any irradiation data, it was decided to use the reactor itself as the test bed for this driver fuel.

The fuel has performed extremely well, with the peak burn-up reaching 155 GWd/t (about 17 atom %), without any fuel pin failure. This is a record for this type of fuel and one of the highest for any type of fast reactor driver fuels.

Though FBTR has been built as a fast reactor power station and has generated more than 5 million units of electricity, the main objective of FBTR is its deployment as a test bed for fast reactor fuels and structural materials.

The operating experience of FBTR has provided sufficient feed-back and confidence for India to launch upon the design and construction of a 500 MWe Prototype Fast Breeder reactor (PFBR) at Kalpakkam.

Nuclear electricity programme

Under the first stage, Pressurised Heavy Water Reactors (PHWRs) that use natural uranium as fuel are already operating in India.

The second stage envisages building a series of breeders that will use plutonium reprocessed from the PHWRs' spent fuel and their depleted uranium.

In the third stage, abundant thorium reserves in the country's and uranium-233 produced in the breeders will be used to generate electricity.

In Homi Bhabha's vision for the country's nuclear electricity programme the breeder reactors occupy the centre stage and form a bridge between the first and third stages.

7. Rustom 1

Rustom 1, a medium-altitude and long-endurance Unmanned Aerial Vehicle (UAV), developed by the Bangalore-based Aeronautical Development Establishment (ADE), was successfully test-flown in October 2010.

Rustom 1 followed the two other UAVs developed by the ADE — Lakshya and Nishant.

While Lakshya — a drone that is remotely piloted by a ground control station — provides aerial sub-targets for live-fire training, Nishant is a surveillance aircraft primarily tasked with intelligence gathering over enemy territory.

Rustom can be used as unmanned combat aerial vehicle and also to carry war-heads.

The UAV has an endurance of 12 to 15 hours and can carry payloads up to 75 kg.

It has an altitude ceiling of 25,000 feet. Such flights of UAVs remove the risk to human pilots when they have to fly them in hazardous zones.

8. What do you understand by In vitro fertilisation (IVF)?

In vitro fertilisation (IVF) is a process by which egg cells are fertilised by sperm outside the body, in vitro. IVF is a major treatment in infertility when other methods of assisted reproductive technology have failed.

The process involves hormonally controlling the ovulatory process, removing ova (eggs) from the woman's ovaries and letting sperm fertilise them in a fluid medium.

The fertilised egg (zygote) is then transferred to the patient's uterus with the intent to establish a successful pregnancy.

The first successful birth of a test tube baby", Louise Brown, occurred in 1978. Robert. G. Edwards, the doctor who developed the treatment, was awarded the Nobel Prize in Physiology for Medicine in 2010.

The term in vitro from the Latin root meaning within the glass is used because early biological experiments, involving cultivation of tissues outside the living organism from which they came, were carried out in glass containers such as beakers, test tubes, or petri dishes.

9. What is graphene Bring out the uses of grapheme

Graphene the new wonder material to come out of science laboratories is only one atom thick but is stronger than diamond and conducts electricity 100 times faster than the silicon in computer chips.

Just one atom thick, it is the world's thinnest and strongest nano-material, almost transparent and able to conduct electricity and heat.

Like diamond, graphene is pure carbon. It forms a six-sided mesh of atoms that, through an electron microscope, looks like a honeycomb or piece of chicken wire.

Despite its strength, its as flexible as plastic wrap and can be bent, folded or rolled up like a scroll.

Potential graphene applications include touch screens, solar cells, energy storage devices, mobiles and, eventually, high speed computer chips.

10. What are genetically modified (GM) organisms and GM foods? Do you think GM foods are safe? Bring out the arguments with reference to labeling of

GM foods. Bring out the operational issues associated with labeling of GM foods.

Genetically modified organisms

Genetically modified organisms (GMOs) can be defined as organisms in which the genetic material (DNA) has been altered in a way that does not occur naturally. The technology is often called "modern biotechnology" or "gene technology", sometimes also "recombinant DNA technology" or "genetic engineering". It allows selected individual genes to be transferred from one organism into another, also between non-related species.

Such methods are used to create GM plants — which are then used to grow GM food crops.

Are GM foods safe?

"Different GM organisms include different genes inserted in different ways. This means that individual GM foods and their safety should be assessed on a case-by-case basis and that it is not possible to make general statements on the safety of all GM foods.

Continuous use of risk assessments based on the Codex principles and, where appropriate, including post market monitoring, should form the basis for evaluating the, safety of GM foods.

Labeling of GM foods

Labeling of GM foods and food products is a contentious issue. On the whole agribusiness industries believe that labeling should be voluntary and influenced by the demands of the free market: If consumers show preference for labeled foods over non- labeled foods, then industry will have the incentive to regulate itself or risk alienating the customer. Consumer interest groups, on the other hand, are demanding mandatory labeling. People have the right to know what they are eating, argue the interest groups, and historically industry has proven itself to be unreliable at self-compliance with existing safety regulations. Without perfect information, the consumer is said to lack consumer sovereignty .and is unable to make 'rational consumption decisions.'

Issues associated with labeling

There are many questions that must be answered if labeling of GM foods becomes mandatory First, are consumers willing to absorb the cost of such an initiative? If the food production industry is required to label GM foods, factories will need to construct two separate processing streams and monitor the production lines accordingly.

Farmers must be able to keep GM crops and non-GM crops from mixing during planting, harvesting and shipping. It is almost assured that industry will pass along these additional costs to consumers in the form of higher prices.

11. Cloud seeding

Cloud seeding, a form of weather modification, is the attempt to change the amount or type of precipitation that falls from clouds, by dispersing substances into the air that serve as cloud condensation or ice nuclei, which alter the microphysical processes within the cloud. The usual intent is to increase precipitation (rain or snow), but hail and fog suppression are also widely practiced in airports.

The most common chemicals used for cloud seeding include silver iodide and dry ice (frozen carbon dioxide).

12. Bug

A software bug is the common term used to describe an error, flaw, mistake, failure, or fault in a computer program or system that produces an incorrect or unexpected result, or causes it to behave in unintended ways. Most bugs arise from mistakes and errors made by people in either a program's source code or its design, and a few are caused by compilers producing incorrect code. A program that contains a large number of bugs, and/or bugs that seriously interfere with its functionality is said to be buggy. Reports detailing bugs in a program are commonly known as bug reports, fault reports, problem reports, trouble reports, change requests, and so forth.

13. An aerostat

An aerostat is a system that remains aloft primarily through the use, of buoyant lighter than air gases to give a vehicle with nearly the same overall density as air.

Aerostats include free balloons, airships, and moored balloons.

An aerostat's main structural component is its envelope, a lightweight skin containing a lifting gas to provide buoyancy, to which other components are attached.

Aerostats are so named because they use "aerostatic" lift which is a buoyant force that does not require movement through the surrounding air mass. This contrasts with aerodynes that primarily use aerodynamic lift which requires the

movement of at least some part of the aircraft through the surrounding air mass.

14. Agni-II Prime

The two-stage, surface-to-surface missile has a range of about 2,500 km. The 17-tonne missile is 20 metres long, capable of carrying nuclear warheads of one tonne. The DRDO had built Agni-II Prime, earlier called Agni-II+, to fill the gap in the range between Agni-II and Agni-III.

While Agni-II has a range of more than 2,000 km, Agni-III can target places more than 3,000 km away. All the three were strategic missiles, capable of carrying nuclear warheads. Agni-II Prime was an improved version of Agni-II, boasting several new technologies.

Agni-II Prime also had a better stage separation system, efficient propulsion, high-energy propellants, more efficient batteries to provide, 'better power' supply and sophisticated retro rockets. It had a good configuration which meant the user (the Army) could move it around easily.

The maiden launch of the Agni-II Prime missile from the Wheeler Island, off the Orissa coast, failed in December 2010.

15. What is Cryogenics? Bring out the uses of cryogenics.

Cryogenics is the study of the production of very low temperature (below - 150°C, -238°F or 12 K) and the behavior of materials at those temperatures.

The scientists have chosen to consider the field of cryogenics as that involving temperatures below -180° C. (93.15 K). This is a logical dividing line, since the normal boiling points of the so-called permanent gases (such as helium, hydrogen, neon, nitrogen, oxygen, and normal air) lie below - 180°C.

Liquefied gases, such as liquid nitrogen and liquid helium, are used in many cryogenic applications. Liquid nitrogen is the most commonly used element in cryogenics and is legally purchasable around the world, Liquid helium is also commonly used and allows for the lowest attainable temperatures to be reached,

Another use of cryogenics is cryogenic fuels. Cryogenic fuels, mainly liquid hydrogen, have been used as rocket fuels.

Cryogenic fuels are fuels that require storage at extremely low temperatures in order to maintain them in a liquid state.

Cryogenic fuels most often constitute liquefied gases such as liquid helium, liquid hydrogen, liquid nitrogen, and liquid oxygen,

India developed the technology in 2008 for use in their GSLV rockets.

16. FOSS

Free software, software libre or libre software is software that can be used, studied, and modified without restriction, and which can be confidence redistributed in modified or unmodified form either without restriction, or with minimal restrictions only to ensure that further recipients can also do these things and that manufacturers of consumer-facing hardware allow user modifications to their hardware.

Free software is generally available without charge, but can have a fee, such as in the form of charging for CDs or other distribution medium among other ways.

In practice for software to be distributed as free software, the human-readable form of the program (the source code) must be made available to the recipient along with a notice granting the above permissions.

The free software movement was conceived in 1983 by Richard Stallman to satisfy the need for and to give the benefit of software freedom to computer users.

Stallman founded the Free Software Foundation in 1985 to provide the organizational structure to advance his Free Software ideas.

From 1998 onward, alternative terms for free software came into use. The most common are software libre, free and open source software (FOSS) and free, libre and open source software (FLOSS).

The Software Freedom Law Center was founded in 2005 to protect and advance FLOSS.

17. Middleware

Middleware is computer software that connects software components or some people and their applications.

The software consists of a set of services that allows multiple processes running on one or more machines to interact.

This technology evolved to provide for interoperability in support of the move to coherent distributed architectures, which are most often used to support and simplify complex distributed applications.

It includes web servers, application servers, and similar tools that support application development and delivery.

Middleware is especially integral to modern information technology based on XML, SOAP, Web services, and service-oriented architecture.

Middleware sits “in the middle” between application software that may be working on different operating systems.

18. What do you understand by 3G or 3rd generation mobile telecommunications? When it was introduced in India?

3G

3G or 3rd generation mobile telecommunications, is a generation of standards for mobile phones and mobile telecommunication services fulfilling the International Mobile Telecommunications-2000 (IMT-2000) specifications by the International Telecommunication Union.

Application services include wide-area wireless voice telephone, mobile Internet access, video calls and mobile TV, all in a mobile environment. To meet the IMT-2000 standards, a system is required to provide peak data rates of at least 200 kbit/s.

3G networks are expected to provide wireless telecommunications to mobile devices over a wide area, such as mobile phones. These networks are digital and in addition to telephone and video calls they may provide content in a similar format to any other wired internet connection, via TCP/IP protocol.

A new generation of cellular standards has appeared approximately every tenth year since 1G systems were introduced in 1981/1982 and it is expected that 4G compliant will be released within the next 2-3 years.

Each generation is characterized by new frequency bands, higher data rates and non backwards compatible transmission technology.

In 2008, India entered the 3G arena with the launch of 3G enabled Mobile and Data services by Government owned Bharat Sanchar Nigam Ltd. (BSNL). Later, MTNL launched 3G in Delhi and Mumbai. Nationwide auction of 3G wireless spectrum was announced in April 2010.

The 3G mobile services, already available from BSNL and set to be rolled out by private operators, will take a long time to gain large-scale adoption,

says a study conducted by Nielsen, an international marketing and advertising research firm.

19. Dragon capsule

SpaceX, a private enterprise has launched Dragon capsule in December 2010, a historic first for the future of space travel.

Never before has a private enterprise attempted to launch its own spacecraft to orbit the Earth and splash back down intact, and SpaceX pulled off the operation perfectly, said NASA and company officials.

The demonstration launch invigorated the U.S. space agency and boosted confidence in the prospect of using commercial vendors to carry astronauts into space and to supply the International Space Station.

The Dragon spacecraft blasted off from Cape Canaveral, Florida atop the massive Falcon 9 rocket.

The bullet-shaped capsule entered orbit about 10 minutes later, then circled the Earth twice before re-entering the atmosphere from low orbit, and splash-landed into the Pacific Ocean.

The next step is for a fly-by of the ISS as part of a five-day mission in which the Dragon will approach the orbiting station within 11 km.

Later, an actual cargo and crew mission to the ISS is planned. Both are scheduled to take place in 2011.

The US space agency NASA signed a \$1.6-billion contract with SpaceX in December 2008 under the Commercial Orbital Transportation Services (COTS) programme to provide 12 spacecraft with cargo capacity of at least 20 tonnes to resupply the International Space Station (ISS) through 2016.

20. Mycoplasma laboratorium or Creation of first self-replicating synthetic life

In May 2010, researchers from the J. Craig Venter Institute (JCVI), a not-for-profit, genomic-focused basic research organization, reported the successful construction of a first self-replicating, synthetic bacterial cell. They copied and modified an entire genome of a small bacterial cell, inserted it into a living cell of another species, and by doing so created a new, synthetic organism.

"This is the first self-replicating species that we've had on the planet whose parent is a computer," U.S. scientist Craig Venter who led the

team said. "It also is the first species to have its own website encoded in its genetic code."

Scientists hope to patent the organism called Mycoplasma laboratorium and engineer it to manufacture cheap biofuels, medicines and other useful compounds.

However, critics angle the move will stifle future science relying on an artificial microbes. U.S. President Obama has asked the Presidential Commission for the Study of Bioethical Issues to study the implications of synthetic biology after proponent.

21. 'Rosetta Stone' For T-dwarf Stars

An international team of astronomers has discovered a unique star system comprised of a very cool, methane-rich dwarf star and a white dwarf star in orbit around each other, the European Southern Observatory (ESO) said on November 2010.

The system, which is the first of its type to be found, is a "Rosetta Stone" for such dwarf stars and gives scientists a way of finding the mass and age of the methane dwarf, known as a T-dwarf star.

22. TERC gene

It is a gene associated with aging. The TERC gene is known to produce an enzyme called telomerase, which helps regulate the length of telomeres — caps at the end of chromosomes similar to the plastic tips at the ends of shoelaces. Every time a cell divides, telomeres shorten, leading to a chromosomal fraying associated with aging.

23. Anchor Babies

The US state of Arizona passed its controversial immigration bill. The debate was still raging when usage of the loaded term "anchor babies multiplied after some Republican hardliners argued that children born in the U.S. to illegal immigrants — supposedly for the purpose of binding undocumented family members to the country — should not receive automatic citizenship. Discussion of a new anchor babies law wasn't limited to Arizona. U.S. Senator Lindsey Graham, Republican from South Carolina, announced he was considering introducing a new amendment to repeal the section of the 14th Amendment of the Constitution — the part that states all people born in the U.S. are Americans — and soon other senators said they were open to hearings on the issue.

24. Truvada

Antiretroviral drugs have turned the AIDS epidemic around, by thwarting the virus in HIV-positive patients. But new research suggests that this powerful treatment may have another benefit — as a weapon against infection in healthy individuals.

In a trial involving nearly 2500 HIV-negative, but high risk, gay men in six countries, researchers found that a combination antiretroviral pill called Truvada reduced the risk of HIV infection by 44%, compared with placebo. When scientists looked more carefully at the study volunteers who took the medication most faithfully, on a daily basis, they found that the risk of contracting HIV was even lower — 73% lower than the placebo group.

More studies will need to confirm the benefit of antiretrovirals in the prevention of HIV, and public health experts warn that even if the results hold up, it would not replace the best method of prophylaxis: safe sex and consistent use of condoms. That's because the way so-called pre-exposure prophylaxis, or PrEP, works is to load up high-risk people with HIV-disabling antiretroviral drugs before exposure to the virus, which allows the medication to hit HIV as early as possible. But the drugs do not work as a vaccine would, by priming the immune system to actually prevent infection.

25. Avandia

Eleven years after it hit the market and became a worldwide blockbuster, the diabetes medication Avandia (rosiglitazone) was slapped with the FDA's most stringent drug restrictions yet. Now, the medication that helps control blood sugar in patients with Type 2 diabetes can be prescribed only by physicians who are part of a registry certifying that they are aware of the increased risk of heart attack associated with the drug. These doctors may dispense Avandia only if their patients have exhausted all other treatment options and patients must sign off on these risks as well.

26. Ununseptium

Lead, iron and uranium are nothing compared to ununseptium, the temporary name for element 117, an extremely heavy combination of berkelium and calcium isotopes created in a particle accelerator in Dubna, Russia. The new element existed for only the tiniest fraction of a second before vanishing again — and it must be

independently created elsewhere before it earns a permanent spot on the periodic table of the elements — but the fact that it remained stable for even the fleeting instant it did is promising.

27. Looxcie

Looxcie, a camera worn over the ear, ups the ante invented by a parent who found himself fumbling with video cameras while trying to record children's parties, Looxcie can capture everything the user sees for up to five hours, hands-free. And with the press of a button, a clip of the last 30 seconds of film can be sent to a Facebook page, YouTube or a preset e-mail address — making Looxcie the perfect device for the age of audio-video oversharing.

28. Enter Square

Enter Square, a payment platform created by Twitter co-founder Jack Dorsey. With the aid of a tiny magnetic card reader that attaches to a smart phone Square lets anyone process credit cards. It might not do away with paper entirely — plenty of people still prefer cash — but you certainly don't need to wait for a receipt: tap on the screen and Square sends a copy straight to e-mail.

29. Google's new Prius

Google's new Prius — tricked out with radar sensors, video cameras and a laser range finder — has driven itself (Driverless technology) 140,000 miles without an accident.

Driverless technology is logical and efficient, and in the near future, it could transform our commute into stress-free transport on a motorized sofa.

30. Martin Jetpack

The Martin Jetpack is an experimental aircraft that can carry one person. Its trade name calls it a "jet pack, but it is not jet- or rocket-powered. It was developed by the Martin Aircraft Company of New Zealand. Unlike earlier devices called "jetpacks", the Martin Jetpack is the first to be considered a practical device. It has been under development for over 27 years and uses a gasoline (premium) engine with two ducted fans to provide lift. Theoretically it can reach a speed of 60 miles per hour, an altitude of 8,000 feet, and fly for about 30 minutes on a full fuel tank.

31. Edison2

It is a newly designed Very Light Car — light weight and low aerodynamic drag. The designers

of the Edison2 concept vehicle have taken auto dieting to the extreme. The car — as aerodynamic as it is anorexic — weighs less than 800 lb., which helps it get 102.5 m.p.g. The car has super-fuel-efficient.

32. Trace the origin of World Wide Web

The World Wide Web, abbreviated as WWW or W3 and commonly known as the Web, is a system of interlinked hypertext documents accessed via the Internet.

With a web browser, one can view web pages that may contain text, images, videos, and other multimedia and navigate between them via hyperlinks.

Using concepts from earlier hypertext systems, English engineer and computer scientist Sir Tim Berners-Lee, now the Director of the World Wide Web Consortium, wrote a proposal in March 1989 for what would eventually become the World Wide Web.

At CERN in Geneva, Switzerland, Berners-Lee and Belgian computer Scientist Robert Cailliau proposed in 1990 to use "Hyper Text" to link and access information of various kinds as a web of nodes in which the user can browse at will, and publicly introduced the project.

33. Resourcesat-2

RESOURCESAT-2 is a follow on mission to RESOURCESAT-1 and the eighteenth Remote Sensing satellite built by ISRO. RESOURCESAT-2 is intended to continue the remote sensing data services to global users provided by RESOURCESAT-1, and to provide data with enhanced multispectral and spatial coverage as well.

An important change in RESOURCESAT-2 compared to RESOURCESAT-1 is: Enhancement of Linear Imaging and Self Scanning Sensor (LISS-4) multispectral swath from 23 km to 70 km.

RESOURCESAT-2 also carries an additional payload known as AIS (Automatic Identification System) from COMDEV, Canada as an experimental payload for ship surveillance in VHF band to derive position, speed and other information about ships.

RESOURCESAT-2 carries two Solid State Recorders with a capacity of 200 Giga Bytes each to store the images taken by its cameras which can be read out later to ground stations.

34. What is S band spectrum? Bring out the importance of S band spectrum.

The S band is defined by an IEEE standard for radio waves with frequencies that range from 2 to 4 GHz, crossing the conventional boundary between UHF and SHF at 3.0 GHz. It is part of the microwave band of the electromagnetic spectrum. The S band is used by weather radar, surface ship radar, and some communications satellites, especially those used by NASA to communicate with the Space Shuttle and the International Space Station.

The S-band spectrum is extremely valuable for mobile broadband services, in terms of usage as well as money. The frequency, also known as 2.5 GHz band, is globally used for providing mobile broadband services using fourth generation technologies such as WiMax and Long Term Evolution (LTE).

This frequency band is unique because it has a substantial amount of spectrum (190 MHz) that can be put to use for mobile services. All other spectrum bands below 3.5 GHz include significantly smaller amounts of spectrum for terrestrial mobile communication, or are not available.

35. What do you understand by the term Geospatial Technology? Bring out the details regarding National Geospatial Data Authority.

Geospatial Technology, commonly known as geomatics, refers to technology used for visualization measurement, and analysis of features or phenomena that occur on the earth. This terminology has become common in the United States, and is synonymous with Spatial Information Technology.

Geospatial technology includes three different technologies that are all related to mapping features on the surface of the earth. These three technology systems are GPS (global positioning systems), GIS (geographical information systems), and RS (remote sensing).

The Global Positioning System (GPS)

The Global Positioning System (GPS) is a space-based global navigation satellite system (GNSS) that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible by anyone with a GPS receiver with some technical limitations which are only removed for military users.

GPS was created and realized by the U.S. Department of Defense (USDOD) and was originally run with 24 satellites. It became fully operational in 1994.

In addition to GPS, other systems are in use or under development. The Russian Global Navigation Satellite System (GLONASS) was in use by only the Russian military, until it was made fully available to civilians in 2007. There are also the planned Chinese Compass navigation system and the European Union's Galileo positioning system.

'A Geographic Information System (GIS)

A geographic information system (GIS), geographical information system, or geospatial information system is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographically referenced data. In the simplest terms, GIS is the merging of cartography, statistical analysis, and database technology.

A GIS can be thought of as a system — it digitally creates and 'manipulates spatial areas that may be jurisdictional, purpose or application-oriented for which a specific GIS is developed. Hence, a GIS developed for an application, jurisdiction, enterprise or purpose may not be necessarily interoperable or compatible with a GIS that has been developed for some other application, jurisdiction, enterprise, or purpose. What goes beyond a GIS is a spatial data infrastructure (SDI), a Concept that has no such restrictive boundaries.

Therefore, in a general sense, the term describes any information system that integrates, stores, edits, analyzes, shares and displays geographic information for informing decision making. GIS applications are tools that allow users to create interactive queries (user-created searches), analyze spatial information, edit data, maps, and present the results of all these operations. Geographic information science is the science underlying the geographic concepts, applications and systems.

Remote sensing

Remote sensing is the acquisition of information about an object or phenomenon, without making physical contact with the object. In modern usage, the term generally refers to the use of aerial sensor technologies 'to detect and classify objects on Earth (both on the surface, and in the atmosphere and oceans) by means of propagated signals (e.g. electromagnetic radiation emitted from aircraft or satellites).

National Geospatial Data Authority

A bill to establish a National Geospatial Data Authority would be introduced in the budget session of Parliament, Union Minister of Science and Technology Kapil Sibal announced.

Mr. Sibal said the proposed Authority would facilitate the setting up of an independent regulator for issuing licenses and regulating the activities of the geospatial sector.

The Survey of India had embarked on a project of creating a national topographic database on a 1: 10,000 scale for rural areas. Simultaneously, the project would generate 1:2,000 scale maps for 800 cities and 1: 1,000 scale maps for metros.

36. India's third power reactor spent fuel reprocessing plant

In January 2011, the Prime Minister commissioned the country's third power reactor spent fuel reprocessing plant at the Bhabha Atomic Research Centre (BARC) at Tarapur, about 100 km from Mumbai. He activated a switch which, in turn, started chopping the first spent fuel bundle in the new facility.

Construction on the new plant began five years ago. With a 100-tonne annual capacity, it will reprocess spent fuel from indigenous nuclear power plants to be used for fast breeder reactors.

The first reprocessing plant of spent fuel in India was commissioned in 1974 at Trombay. The second reprocessing plant of spent fuel in India is located in Kalpakkam. Another reprocessing plant, under construction at Kalpakkam, was expected to be commissioned in 2013. Also there was a programme of making large-sized reprocessing plants, the first of which would be located at Tarapur itself, and the site selection was already approved.

37. Transgenesis

Transgenesis is the process of introducing an exogenous gene — called a transgene — into a living organism so that the organism will exhibit a new property and transmit that property to its offspring. Transgenesis can be facilitated by liposomes, plasmid vectors, viral vectors, pronuclear injection, protoplast fusion, and ballistic DNA injection.

Transgenic organisms are able to express foreign genes because the genetic code is similar for all organisms. This means that a specific DNA sequence will code for the same protein in all organisms.

38. What do you understand by Pulsars?

Pulsars are highly magnetized, rotating neutron stars that emit a beam of electromagnetic radiation. The radiation can only be observed when the beam of emission is pointing towards the Earth.

This is called the lighthouse effect and gives rise to the pulsed nature that gives pulsars their name. Because neutron stars are very dense objects, the rotation period and thus the interval between observed pulses is very regular. For some pulsars, the regularity of pulsation is as precise as an atomic clock.

The observed periods of their pulses range from 1.4 milliseconds to 8.5 seconds.

39. Euclid

European dark-energy mission known is known as Euclid.

40. What do you understand by Dark energy?

In physical cosmology, astronomy and costal mechanics, dark energy is a hypothetical form of energy that permeates all of space and tends to increase the rate of expansion of the universe.

Dark energy is the most accepted theory to explain recent observations and experiments that the universe appears to be expanding at an accelerating rate.

In the standard model of cosmology, dark energy currently accounts for 73% of the total mass-energy of the universe.

Dark energy certainly counts as frontier science. The discovery a decade ago that the universe is speeding up, in defiance of common sense or cosmic gravity, has thrown into doubt notions about the fate of the universe and of life within it, not to mention gravity and even the nature of the laws of physics. It is as if, when you dropped your car keys, they shot up to the ceiling.

Physicists have one ready-made explanation for this behaviour, but it is a cure that many of them think is worse than the disease: a fudge factor invented by Einstein in 1917 called the cosmological constant. He suggested, and quantum theory has subsequently confirmed, that empty space could exert a repulsive force, blowing things apart. But the best calculations predict an effect 10 to the exponent of 120 times greater than what astronomers have measured, causing physicists to metaphorically tear their hair out and mutter about multiple universes.

41. The James Webb Space Telescope

The James Webb Space Telescope (JWST) is a planned infrared space observatory and is the scientific successor to the Hubble Space Telescope. The JWST or Webb Telescopes main scientific goal is to observe the most distant objects in. the universe beyond the reach of either ground-based Instruments or the Hubble. The JWST is a project of the National Aeronautics and Space Administration, the United States space agency, with international collaboration from the European Space Agency and the Canadian Space Agency, including contributions from fifteen nations.

Originally called the Next Generation Space Telescope (NGST), it was renamed in 2002 after NASA's second administrator James E. Webb.

42. The Mars 500 experiment

The Mars500 experiment is being conducted by the Moscow-based Russian Institute for Biomedical Problems (IBMP), the European Space Agency and China's space training centre.

In an effort to reproduce the conditions of space travel, with exception of weightlessness, the crew has living quarters the size of a bus connected with several other modules for experiments and exercise. A separate built-in imitator of the Red Planet's surface is attached for the mock landing.

After 233 days in a lacked steel capsule, six researchers on a 520-day mock flight to Mars are all feeling strong and ready to land" on the Red Planet, the mission director said on January 21.

The all-male crew, of three Russians, a Chinese, a Frenchman and an Italian-Colombian, has been inside windowless capsules at a Moscow research centre since June 2010. Their mission aims to help real space crews in the future cope with the confinement and stress of interplanetary travel: The researchers communicate with the outside world via e-mails and video messages occasionally delayed to give them the feel of being farther than a few yards (meters) away from mission control. The crew members eat canned food similar to that eaten on the International Space Station and shower only once a week.

The six men are due to "land" on Mars on February 12, 2011 and spend two days researching the planet. They then being the months-long return flight to Earth, expected to be the most challenging part of the mission. (The end of the 520-day study, with the crew landing on Earth is on November 5, 2011.)

A real Mars mission is decades away — there are huge costs, major technological challenges and the task of creating a compact shield to protect crew from deadly space radiation.

43. DNA profiling

DNA profiling (also called DNA testing, DNA typing, or genetic fingerprinting) is a technique employed by forensic scientists to assist in the identification of individuals by their respective DNA profiles. DNA profiles are encrypted sets of numbers that reflect a person's DNA makeup, which can also be used as the person's identifier. It is used in, for example, parental testing and criminal investigation.

Although 99.9% of human DNA sequences are the same in every person, enough of the DNA is different to distinguish one individual from another, unless they are monozygotic twins.

The DNA profiling technique was first reported in 1984 by Sir Alec Jeffreys at the University of Leicester in England, and is now the basis of several national DNA databases.

44. Phishing

Phishing is a way of attempting to acquire sensitive information such as usernames, passwords and credit card details by masquerading as a trustworthy entity in an electronic communication.

45. What is a nuclear submarine? Bring out the performance advantages of nuclear submarines over “conventional” (typically diesel-electric) submarines. How far India has developed this technology?

Nuclear submarine

A nuclear submarine is a submarine powered by a nuclear reactor.

Performance advantages

The performance advantages of nuclear submarines over ‘conventional (typically diesel-electric) submarines are considerable. Nuclear propulsion, being completely independent of air, frees the submarine from the need to surface frequently, as is necessary for conventional submarines.

The large amount of power generated by a nuclear reactor allows nuclear submarines to operate at high speed for long durations and the long interval between refuellings grants a range limited only by consumables such as food.

Current generations of nuclear submarines never need to be refueled throughout their 25-year lifespans. Conversely, the limited power stored in electric batteries means that even the most advanced conventional submarine can only remain submerged for a few days at slow speed, and only a few hours at top speed.

India's position

India briefly used a nuclear submarine leased by Russia from 1988 to 1991. Since then it has been trying to build one of its own. It has signed an agreement for the transfer of a couple of nuclear-powered Russian Akula class submarines, one of which is likely to be inducted by the Indian Navy soon.

India's first indigenous nuclear powered submarine was launched at Vishakapatnam for trial on July 26, 2009. The submarine is named INS Arihant (destroyer of enemies). The submarine is already fitted with a miniaturised nuclear-powered reactor developed by BARC at Kalpakkam. Highly enriched uranium will power the reactor which has a capacity of 80 MWe.

46. What do you understand, by the term “Cloud computing”. Bring out the uses of Cloud computing.

Cloud Computing is Internet-based computing, whereby shared resources, software, and information are provided to computers and other devices on demand, like the electricity grid. Cloud computing uses the internet and central remote servers to maintain data and applications.

Cloud computing allows consumers and businesses to use applications without installation and access their personal files at any computer with internet access.

This technology allows for much more efficient computing by centralizing storage, memory, processing and bandwidth.

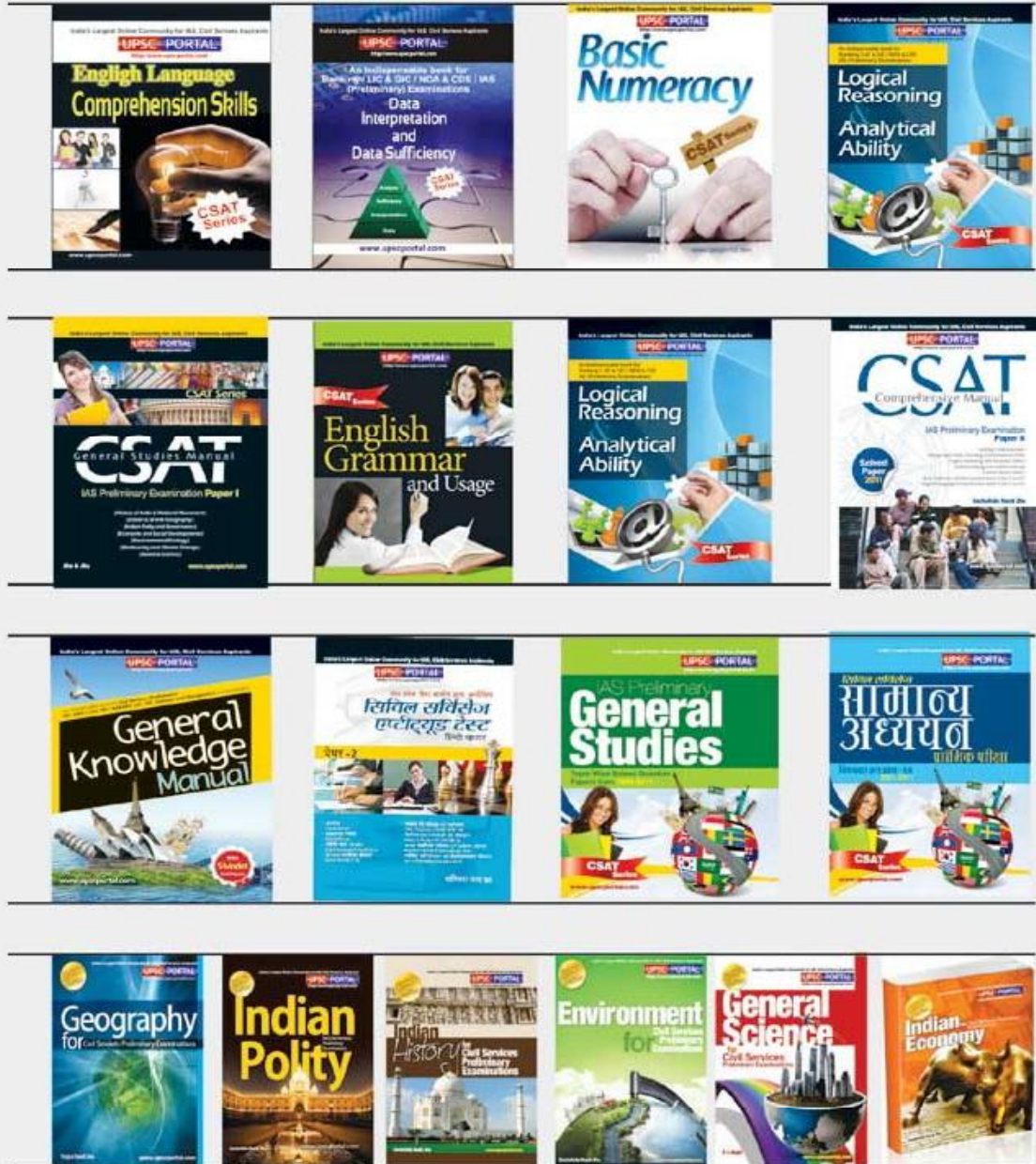
Uses

Cloud computing customers do not own the physical infrastructure. So it avoids capital expenditure by renting usage from a third-party provider. They consume resources as a service and pay only for resources that they use. Cost is claimed to be reduced and capital expenditure is converted to operational expenditure. This ostensibly lowers barriers to entry.

Device and location independence enable users to access systems using a web browser

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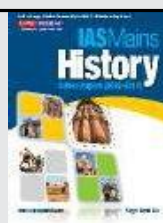
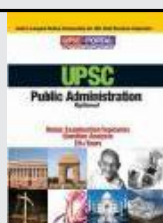
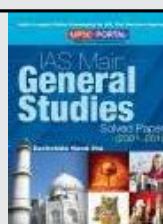
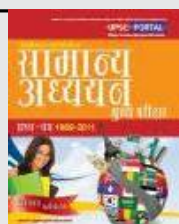
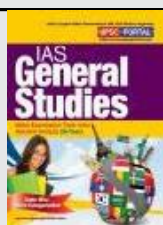
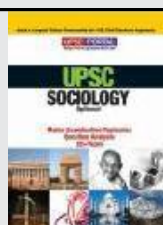
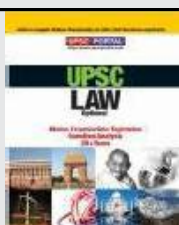
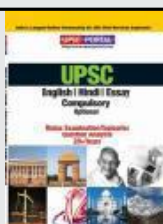
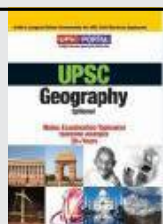
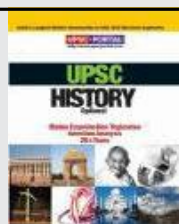
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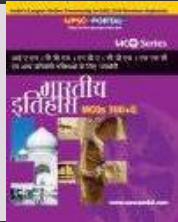
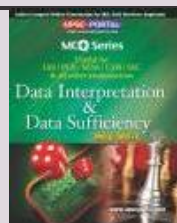
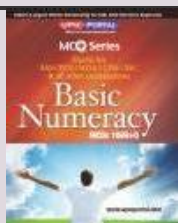
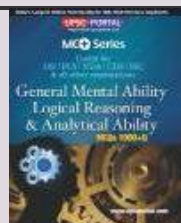
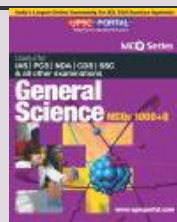
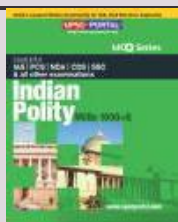
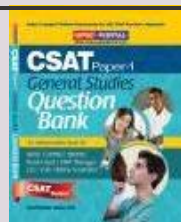
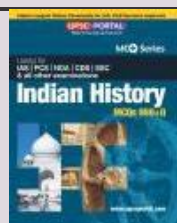
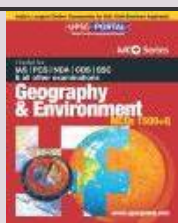
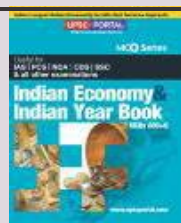
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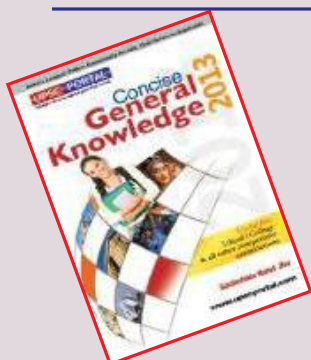
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