

**Question 1: Egg Freezing is generally done for medical reasons but some examples indicates its use for lifestyle reasons. Discuss the implications of this technology in India.**

Oocyte cryopreservation is aimed at three particular groups of women:

- Those diagnosed with cancer who have not yet begun chemotherapy or radiotherapy
- Those undergoing treatment with assisted reproductive technologies who do not consider embryo freezing an option
- Those who would like to preserve their future ability to have children, either because they do not yet have a partner, or for other personal or medical reasons.

**Pros:**

- A way to strike work life balance for Indian women in an increasingly fast-paced society. Traditional ideas of marriage and family are shifting: People are getting married late and having kids late.
  - Chemotherapy and radiotherapy are toxic for oocytes, leaving few, if any, viable eggs. Egg freezing offers women with cancer the chance to preserve their eggs so that they can have children in the future.
  - Option for individuals undergoing IVF who object, either for religious or ethical reasons, to the practice of freezing embryos.
  - Useful for women who, for the purpose of education, career or other reasons, desire to postpone childbearing.
- Women with a family history of early menopause have an interest in fertility preservation.

**Cons:**

- Could damage eggs and reduce a woman's chance of becoming a mother.
- Hayden's delivery has put a face to the technology and may get more Indian women to sign up for lifestyle reasons – moral issue involved.

**Question 2: Discuss properties of Neutrinos and their Key role in Science. Throw light on its research and development in India.**

A neutrino is an

- electrically neutral elementary particle
- with half-integer spin
- Chargeless
- Carry mass

**Significance:**

Neutrinos do not carry any electric charge, which means that they are not affected by the electromagnetic force that acts on charged particles, and are leptons, so they are not affected by the strong force that acts on particles inside atomic nuclei. Neutrinos are therefore affected only by the weak subatomic force and by gravity.

Neutrinos typically pass through normal matter unimpeded and undetected.

Neutrinos are very important for our scientific progress and technological growth for three reasons.

Have a role to play in nuclear non-proliferation through the remote monitoring of nuclear reactors.

Using appropriate neutrino detectors, the plutonium content can be monitored remotely and used to detect any pilferage.

Second, understanding neutrinos can help us detect mineral and oil deposits deep in the earth.

Third, neutrinos can pass right through the earth. They may open up a faster way to send data than the current 'around the earth' model, using towers, cables or satellites.

Neutrino are keys to explain existence of dark matter.

### **Question 3: India's Mars Mission has completed one and half year in its orbit. Analyze the performance of the mission till date.**

- ISRO extended the mission as the spacecraft has 37 kg (82 lb) of propellant remaining and all five of its scientific instruments are working properly. The orbiter can reportedly continue orbiting Mars for several years with its remaining propellant.
- The Orbiter's Mars Colour Camera had transmitted about 400 images of the red planet till date to the space agency's telemetry tracking and command network (Istrac)
- ISRO released its "Mars Atlas", a 120-page scientific atlas containing images and data from the Mars Orbiter Mission's first year in orbit.
- India's Mars Orbiter Mission survived a 15-day solar eclipse (June 8-22) and emitted signals back to earth.
- As a bonus of its extended life, it will be able to collect more data and information on the seasons on Mars and its images.

### **Question 4: ISRO has been in news for delivering multiple small satellites in orbits using single launch vehicle. What are benefits and possible impacts of small satellites?**

**Small satellites**, or **smallsats**, are **satellites** of low mass and size, usually under 500 kg (1,100 lb).

Benefits:

- One rationale for miniaturizing satellites is to reduce the cost: heavier satellites require larger rockets with greater thrust that also has greater cost to finance. In contrast, smaller and lighter satellites require smaller and cheaper launch vehicles and can sometimes be launched in multiples. They can also be launched 'piggyback', using excess capacity on larger launch vehicles. Miniaturized satellites allow for cheaper designs as well as ease of mass production,
- Another major reason for developing small satellites is the opportunity to enable missions that a larger satellite could not accomplish, such as:
  1. Constellations for low data rate communications
  2. Using formations to gather data from multiple points
  3. In-orbit inspection of larger satellites
  4. University-related research
- Large-satellite systems can be complemented by small satellites making specific measurements. A mission can be cost-effective and meet the needs without making all the measurements itself.
- Benefits for military due to short assembly and launch times.

- Topographic mapping and disaster management: One could readily envision a small-satellite mission that was intended to provide some niche product, such as crop-yield forecasting, in a particular region.
- Low-Earth orbit systems enabling low-energy communication covering populated areas, and medium-Earth orbit systems for navigation in traffic, and search and rescue.

Possible impacts:

- In the future all large systems with a development time of more than fifteen years will probably be replaced by small satellites.
- Scope for commercialization of services offered by small satellites:
  1. Smaller countries want to involve local and small industry in the projects.
  2. Developing countries in particular use the possibilities of small satellites because of cost effectiveness.

**Question 5: Membership of MTCR would help India deal more effectively in critical high tech areas.**

**Elucidate.**

External benefits:

Selling BrahMos missile: India will be able to sell the Indo-Russian supersonic cruise missile BrahMos to Vietnam and other countries.

Getting Israel's Arrow II missile: India had for long eyed Israel's Arrow II missile defense interceptor to develop an indigenous ballistic missile system but couldn't do so because of MTCR's norms. Now, India will be able to defend itself against Chinese and Pakistani missiles.

Procuring surveillance drones: India will be able to buy surveillance drones from abroad like the American predator drones. The US may also provide UAVs, Reaper and Global Hawk that are used in counter-terrorism efforts.

Inching closer to NSG: India's admission in MTCR is a step closer to its membership to the 48-member NSG (Nuclear Suppliers Group) which has been blocked by China. It also gives India an opportunity to engage with other global non-proliferation players.

Internal benefits:

Boost to Make in India

Benefiting ISRO: During the Cold War era, Russia had denied the cryogenic technology to India. But now, with India getting a membership of the MTCR, its space agency will have access to high-end technologies for developing its cryogenic engines to enhance space exploration.

**Question 6: What is internet of things? Throw light on possible uses of the technology in different sectors in India?**

- The internet of things (IoT), is the internetworking of physical devices, vehicles, buildings and other items—embedded with electronics and network connectivity that enable these objects to collect and exchange data. The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the

physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit

- A thing, in the Internet of Things, can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low -- or any other natural or man-made object that can be assigned an IP address and provided with the ability to transfer data over a network.

Possible uses:

1. Metropolitan scale deployments

Development of smart cities with applications in areas such as water supply, electricity supply, traffic management etc.

2. Medical and healthcare

- IoT devices can be used to enable remote health monitoring and emergency notification systems. Will prove beneficial in rural areas.
- Specialized sensors can also be equipped within living spaces to monitor the health and general well-being of senior citizens.

3. Environmental monitoring

- monitoring air or water quality, atmospheric or soil conditions, and can even include areas like monitoring the movements of wildlife and their habitats.
- Earthquake or tsunami early-warning systems can also be used by emergency services to provide more effective aid.

4. Infrastructure management

Monitoring and controlling operations of urban and rural infrastructures like bridges, railway tracks, on- and offshore- wind-farms. The IoT infrastructure can be used for monitoring any events that can compromise safety and increase risk. It can also be used for scheduling repair and maintenance activities in an efficient manner, by coordinating tasks between different service providers and users of these facilities.

5. Manufacturing

- The IoT intelligent systems enable rapid manufacturing of new products, dynamic response to product demands, and real-time optimization of manufacturing production and supply chain networks.
- Digital control systems to automate and to optimize plant safety and security.
- Predictive maintenance and measurements to maximize reliability.

6. Energy management

- It is expected that IoT devices will be integrated into all forms of energy consuming devices (switches, power outlets, bulbs, televisions, etc.) and be able to communicate with the utility supply company in order to effectively balance power generation and energy usage.

- Such devices would also offer the opportunity for users to remotely control their devices.
- Besides home based energy management, the IoT is especially relevant to the Smart Grid to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity.

## 7. Transportation

The IoT can assist in integration of communications, control, and information processing across various transportation systems. Application of the IoT extends to all aspects of transportation systems (i.e. the vehicle, the infrastructure, and the driver or user). Dynamic interaction between these components of a transport system enables inter and intra vehicular communication, smart traffic control, smart parking, electronic toll collection systems, logistic and fleet management, vehicle control, and safety and road assistance.

## 8. Building and home automation

IoT devices can be used to monitor and control the mechanical, electrical and electronic systems used in various types of buildings (e.g., public and private, industrial, institutions, or residential) in home automation and building automation systems.

## 9. Consumer application

Examples of consumer applications include connected car, entertainment, residences and smart homes, wearable technology, connected health, and smart retail. Consumer IoT provides new opportunities for user experience and interfaces.

### **Question 7: World's first baby has been born using a “three person fertility technique”. What is three person fertility technique? Discuss possible ethical issues attached to it.**

Three parent baby is technique used to treat mitochondrial disorders. Boy's mother has a rare disease called Leigh's syndrome, a neurological disorder caused by faulty mitochondria, the cell's energy-producing structures. Mitochondria as energy producing units; when become dysfunctional causes organ failure; as it cease energy production leading to eventual death.

The baby was created via an IVF (in vitro fertilization) procedure that involved three people: the mother, the father and a woman who donated eggs.

So in three parent baby technique also called as mitochondrial donation; baby receives half genes from mother and fathers along with healthy mitochondrial DNA from donor mother thus it contains genes from 3 biological parents.

Bioethics is the study of the typically controversial ethical issues emerging from new situations and possibilities brought about by advances in biology and medicine.

Ethical issues involved –

- One of the first areas addressed by modern bioethicists was that of human experimentation. Is it ethical to do experiments on Human Beings?

“Three parent babies.” Run that phrase through your head. Doesn’t it sound a little wrong? If so, why? Because babies are supposed to be the product of one father and one mother alone? Any other arrangement is obviously artificial and feels ethically suspect.

Destruction of embryos – Many stem cell research therapies involve destruction of embryos. Some religions or people consider that life forms at the time of fertilization of Egg and thus destruction of embryo is as good as killing living human being.

**Issues with respect to Mitochondrial Disorders:**

Mitochondrial transfer passes on genetic changes from one generation to another. That raises ethical concerns because any unexpected problems caused by the procedure could affect people who are not yet born, and so cannot give their consent to have the treatment.

Mitochondria are not completely understood, and the DNA they hold might affect people’s traits in unknown ways. For that reason, some scientists believe mitochondria should be better understood before the procedures are legalized. We should also be careful in arguing that this is only about energy in cells. Scientists do not fully understand at this moment the importance of the mitochondrial genome for all sorts of human characteristics.

The Church of England says it is not opposed in principle, but wants to see more scientific research and debate on the ethics, safety and efficacy before the law is changed.

**Question 8: With examples explain big data and its characteristics? Throw light on challenges for harnessing big data technology in India?**

**Big data:**

Is a term that describes the large volume of data – both structured and unstructured – that inundates a business on a day-to-day basis. But it’s not the amount of data that’s important. It’s what organizations do with the data that matters. Big data can be analyzed for insights that lead to better decisions and strategic business moves.

**Characteristics of big data:**

**Big data is often characterized by 3Vs:**

**1. Extreme volume of data:**

Although big data doesn't equate to any specific volume of data, the term is often used to describe terabytes, petabytes and even exabytes of data captured over time.

Such voluminous data can come from myriad different sources, such as business sales records, the collected results of scientific experiments or real-time sensors used in the internet of things. Data may be raw or preprocessed using separate software tools before analytics are applied.

**2. Wide variety of data:**

Data may also exist in a wide variety of file types. Further, big data may involve multiple, simultaneous data sources, which may not otherwise be integrated. For example, a big data analytics project may attempt to gauge a product's success and future sales by correlating past sales data, return data and online buyer review data for that product.

**3. Types and the velocity at which the data must be processed.**

Finally, velocity refers to the speed at which big data must be analyzed. This means human analysts must have a detailed understanding of the available data and possess some sense of what answer they're looking for. Velocity is also meaningful, as big data analysis expands into fields like machine learning and artificial intelligence, where analytical processes mimic perception by finding and using patterns in the collected data.

**Example of usage of big data:** ways that retailers can use the right data to drive consumer experience:

Social media has emerged as a platform where people reveal a lot about their personal tastes, preferences, likes and dislikes, whether they know it or not. The pages they like, or the posts they share, lead to a better understanding of a buyer's persona. Companies use this information and cookie-based ad retargeting to put products or service recommendations into social feed and in front of the eyes of individual consumers most likely to buy.

Big data allows companies to spot and address common or recurring customer complaints by collecting and analyzing numerous posts and tweets over a period of time. For example, Delta Air Lines learned that lost luggage was one of their customers' biggest complaints. By digging through its data, Delta offered a solution to its passengers with the "Track My Bag" feature on its application. This clever use of social data put Delta ahead of its competitors.

**Challenges for Big data Analytics in India**

**1. The IT Challenge: Storage and computational power**

The need for big data velocity imposes unique demands on the underlying compute infrastructure. The computing power required to quickly process huge volumes and varieties of data can overwhelm a single server or server cluster. Organizations must apply adequate compute power to big data tasks to achieve the desired velocity. This can potentially demand hundreds or thousands of servers that can distribute the work and operate collaboratively.

Achieving such velocity in a cost-effective manner is also a headache. However, public cloud computing can be used as primary vehicle for hosting big data analytics projects.

2. Lack of talent pool - Ultimately, the value and effectiveness of big data depends on the human operators tasked with understanding the data and formulating the proper queries to direct big data projects. Some big data tools meet specialized niches and allow less technical users to make various predictions from everyday business data. But these tools only address limited use cases. Many other big data tasks, such as determining the effectiveness of a new drug, can require substantial scientific and computational expertise from the analytical staff. There is currently a shortage of data scientists and other analysts who have experience working with big data in a distributed, open source environment.
3. Past and current data is required to make the application of big data analytics really useful, and there is a scarcity of this in public and private sectors in India. Healthcare, economic, and

statistical data, in both private and public sectors in India, is yet to be computerised. The main reason for this is the late adoption of IT in India. Unlike in the West, most industries in India made the transition from manual records to computerised information systems only during the last decade.

4. **Big data in India is not structured.** Most transactional data in the healthcare and retail segments are stored purely for book-keeping purposes. They have very limited appropriate information of the kind that can help big data analytics map enterprise-generated transactional data with public information.
5. Public social media information that is available for most individuals from **India lacks quality information about users themselves.** Random facts and figures in individual profiles, sharing of spam content, and fake social media accounts that are created for bots are very common in India.
6. Given the **extensive cultural and linguistic variation** across India, any insight generated for a consumer based out of Chandigarh, for example, will not be directly applicable to a consumer based in Chennai. This problem is made worse by the fact that a lot of local data lives in regional publications, in different languages, and has very limited online visibility.
7. Even though smart phones are driving the new handset market in India, feature phones still dominate everyday usage. Most connections in India are pre-paid and fewer than 10% of users have access to 3G networks. To add to it, **internet connection speeds are amongst the lowest** in Asia. As a result, consumer data, especially retail enterprise data, is limited.
8. **Big data is in its infancy stage at present in India,** mostly we are dealing in data warehousing. Most companies are still learning to store the data collected.