1. What are the stages in the development of a vaccine? Why are the ongoing efforts to develop a vaccine for the Corona virus unprecedented? Discuss.

Demand of the question:
It expects students to give a clear account of the stages in the development of a vaccine. It also expects students to present a case for unprecedented efforts to develop a vaccine for the corona virus and finally arrive at a conclusion.

Introduction:
The outbreak of the novel coronavirus has triggered an international effort to develop a safe and effective vaccine against COVID-19, perhaps at breakneck speed. Several experimental vaccines have shown promising results in early trials, rising hopes that one will exist before the end of the year.

Body:
Stages in the development of a vaccine:
According to the Centres for Disease Control and Prevention (CDC), there are six stages of vaccine development: exploratory, pre-clinical, clinical development, regulatory review and approval, manufacturing and quality control.

- Exploratory: This is research-intensive phase of the vaccine development process which is designed to identify "natural or synthetic antigens that might help prevent or treat a disease."
- Pre-clinical: During this phase, researchers use tissue-culture or cell-culture systems and animal testing to determine whether the candidate vaccine will produce immunity or not.
- Clinical development: It is a three-phase process. During Phase I, small groups of people receive the trial vaccine. In Phase II, the clinical study is expanded and vaccine is given to people who have characteristics similar to those for whom the new vaccine is intended. In Phase III, the vaccine is given to thousands of people and tested for efficacy and safety.
- Regulatory review and approval: If a vaccine passes through all three phases of clinical development, the vaccine developer submits a Biologics License Application (BLA) to the licensing authority.
- Manufacturing: Major drug manufacturers provide the infrastructure, personnel and equipment necessary to create mass quantities of vaccines.
- Quality control: Stakeholders must adhere to procedures that allow them to track whether a vaccine is performing as anticipated.

With respect to COVID-19 vaccine development. The adenoviral vector-based vaccine is currently in the phase II trials. The vaccine is being developed by Russian military and government researchers. The ongoing efforts to develop a vaccine for the Corona virus are unprecedented due to the following reasons:

- The World Health Organisation listed 160 vaccines in development at various stages of research and development. This makes it the biggest vaccine development effort in the history of mankind while a pandemic is still on.

- The COVID-19 pandemic has had far-reaching consequences beyond the spread of the disease itself and efforts to quarantine it, including political, cultural, and social implications.
- The focus of manpower and resources on vaccine development for covid-19 is unparalleled because of no availability of any effective vaccine or medicine to fight the Coronavirus.
- Till today, Coronavirus has infected nearly 18 million people and took death toll of nearly 6,93,000 people worldwide. Hence, its sheer impact on the health of the people worldwide is disastrous.
- In the global economic sector lockdowns have resulted in disruption of supply chain leading to halt of the economic activities.
- According to a study by world bank, a severe pandemic can cause economic losses equal to nearly 5% of global GDP.
- The pandemic has affected educational systems worldwide, leading to the widespread closures of schools and universities. According to data released by UNESCO, school and university closures due to COVID-19 were implemented nationwide in 165 countries. Including localized closures, this affects over 1.5 billion students worldwide, accounting for 87% of enrolled learners.
- Low income groups are disproportionately hit by coronavirus cases. e.g. Migrant crisis in India.
- The pandemic has impacted religion in various ways, including the cancellation of the worship services of various faiths, as well as the cancellation of pilgrimages surrounding observances and festivals.
- The coronavirus pandemic has been followed by a concern for a potential spike in suicides, exacerbated by social isolation due to quarantine and social-distancing guidelines, fear, and unemployment and financial factors.
- Many countries have reported an increase in domestic violence and intimate partner violence attributed to lockdowns amid the COVID-19 pandemic. Financial insecurity, stress, and uncertainty have lead to increased aggression at home, with abusers able to control large amounts of their victims' daily life. Older people are particularly affected by COVID-19 as older age group has registered more number of deaths due to coronavirus infection.

Conclusion:
Hence, we can observe that coronavirus pandemic has impacted almost every sector and left a disastrous impact on the affected sector or groups. Due to this sheer scale of impact it becomes imperative to expedite the vaccine development to unprecedented level so that its impact will be minimised and a pre-covid-19 normalcy can be brought in to lives of people.

2. What are the different types of vaccines for the Coronavirus being tested in different parts of the world? Explain.

Demand of the question:
It expects students to explain different types of vaccines and for the Coronavirus being tested in different parts of the world.

Introduction:
As per WHO more than 160 vaccines are in development stage against coronavirus by research teams in companies and universities across the world. Researchers are trialling different technologies, some of which haven't been used in a licensed vaccine before. At least six groups have already begun injecting formulations into volunteers in safety trials; others have started testing in animals.

Body:
All vaccines aim to expose the body to an antigen that won't cause disease, but will provoke an immune response that can block or kill the virus if a person becomes infected. There are at least seven types being tried against the coronavirus, and they rely on different viruses or viral parts.

- Inactivated vaccine — The whole virus is killed with a chemical and used to make the vaccine. This is the same approach that is used to make the inactivated polio (shot), hepatitis A and rabies vaccines. e.g. Sinovac Biotech in Beijing has started to test an inactivated version of SARS-CoV-2 in humans.
- Subunit vaccine — A piece of the virus that is important for immunity, like the spike protein of COVID-19, is used to make the vaccine. This is the same approach that is used to make the hepatitis and human papillomavirus vaccines.
- Weakened, live viral vaccine — The virus is grown in the lab in cells different from those it infects in people. As the virus gets better at growing in the lab, it becomes less capable of reproducing in people. The weakened virus is then used to make the vaccine. When the weakened virus is given to people, it can reproduce enough to generate an immune response, but not enough to make the person sick. This is the same approach that is used to make the measles, mumps, rubella, chickenpox and one of the rotavirus vaccines. e.g. Oxford University vaccine, also referred to as AZD1222.
- Replicating viral vector vaccine — In this case, scientists take a virus that doesn't cause disease in people (called a vector virus) and add a gene that codes for, in this case, the coronavirus spike protein. Genes are blueprints that tell cells how to make proteins. The spike protein of COVID-19 is important because it attaches the virus to cells. When the vaccine is given, the vector virus reproduces in cells and the immune system makes antibodies against its proteins, which now includes the COVID-19 spike protein. As a result, the antibodies directed against the spike protein will prevent COVID-19 from binding to cells, and, therefore, prevent infection. This is the same approach that was used to make the Ebola virus vaccine.

- Non-replicating viral vector vaccine — Similar to replicating viral vector vaccines, a gene is inserted into a vector virus, but the vector virus does not reproduce in the vaccine recipient. Although the virus can't make all of the proteins it needs to reproduce itself, it can make some proteins, including the COVID-19 spike protein. No currently licensed vaccines use this approach.
- DNA vaccine : The gene that codes for the COVID-19 spike protein is inserted into a small, circular piece of DNA, called a plasmid. The plasmids are then injected as the vaccine. No currently licensed vaccines use this approach.
- mRNA vaccine:In this approach, the vaccine contains messenger RNA, called mRNA. mRNA is processed in cells to make proteins. Once the proteins are produced, the immune system will make a response against them to create immunity. In this case, the protein produced is the COVID-19 spike protein. No currently licensed vaccines use this approach. The US governments partially funded Moderna's vaccine is based on mRNA approach.

It is likely that COVID-19 vaccines could have different levels of effectiveness in various subgroups of people. Because the elderly generally do not respond as well to vaccines, one or more COVID-19 vaccines may not work well for them. At present, three vaccine candidates are at the final stage of their trials. Among them, Oxford's COVID-19 vaccine has shown a positive result in its initial trial.

Conclusion:

Keeping in mind the pandemic situation, many of these research institutes and universities are working at a breakneck speed to develop vaccine. Though the they have adopted different approaches to develop the vaccine, in the end what matters is how effective the vaccine is; so that whole humanity can be saved from the disastrous impact of this global pandemic.

3. How do mobile apps pose a threat to internal security? Examine.

Demand of the question:
It expects students to put forth view of how mobile apps pose a threat to internal security and what needs to be done to tackle this threat to internal security.

Introduction:
The Ministry of Information Technology, invoking it's power under section 69A of the Information Technology Act, in view of the emergent nature of threats has decided to block 47 more Chinese apps in addition to 59 apps. The reasons cited in view of information available that they are engaged in activities which is prejudicial to sovereignty and integrity of India, defence of India, security of state and public order.

Body:
Mobile users are generally unaware of the importance of internal security and often assume mobile apps are safe for download. Such lax mindsets, as well as the low cost and ease in developing mobile malware, mean apps are now the main source of mobile threats to internal security. Following kind of cyber attacks or stealing of information can be done through mobile apps:

- Malware, short for malicious software refers to any kind of software that is designed to cause damage to a single computer, server, or computer network. Ransomware, Spy ware, Worms, viruses, and Trojans are all varieties of malware.
- For instance, WannaCry, it was a ransomware attack that spread rapidly in May, 2017. The ransomware locked users' devices and prevented them from accessing data and software until a certain ransom was paid to the criminals. Top five cities in India (Kolkata, Delhi, Bhubaneswar, Pune and Mumbai) got impacted due to it.
- Phishing: It is the method of trying to gather personal information using deceptive e-mails and websites. It occurs when an attacker, masquerading as a trusted entity, dupes a victim into opening an email, instant message, or text message. It is often used to steal user data, including login credentials and credit card numbers. e.g. A malware attack on Kudankulam power plant.
- Denial of Service attacks: A Denial-of-Service (DoS) attack is an attack meant to shut down a machine or network, making it inaccessible to its intended users. DoS attacks accomplish this by flooding the target with traffic, or sending it information that triggers a crash.
- For instance, six banks were attacked in the USA in 2012. If denial of service attack is initiated on the banking system in India, it would lead to structural collapse of the system and will result in creating chaos.
- A local, state or central government maintains huge amount of confidential data related to country (geographical, military strategic assets etc.) and citizens. Unauthorized access to the data can lead to serious threats on a country. e.g. Aadhar data breach.

- Photos, videos and other personal information shared by an individual on social networking sites can be inappropriately used by others, leading to serious and even life-threatening incidents. So it is also harmful for the citizens of India. e.g. Honey trapping incidences with respect to defence personnel.
- Company employees have a lot of data and information on their mobiles. A cyber attack or stealing of information through mobile apps may lead to loss of competitive information (such as patents or original work), loss of employees/customers private data resulting into complete loss of public trust on the integrity of the organization.
- Many of the public personnel also store important relevant data on mobile. Their mobile microphone or camera can be turned on through distant communication, resulting in breach of security.
- India's push towards cashless payments accelerated in 2019, as card and mobile payments as a percentage of GDP rose to 20%. Since most of the times payments are done through mobile phones, a malicious app can steal the sensitive information of the user and pose a financial security threat to the user.

Hence, due to the evolutionary nature of the mobile apps they pose a grave threat to the internal security of country. Following are the government initiatives and necessary steps which will help to tackle this internal security threat.

- Budapest Convention on Cybercrime: It is an international treaty that seeks to address Internet and computer crime (cybercrime) by harmonizing national laws, improving investigative techniques, and increasing cooperation among nations.
- As most of the mobile apps market is dominated by China there is need to give impetus to develop indigenous apps which will in turn help to have a secure use of important apps. e.g. AatmaNirbhar bharat app innovation challenge.
- Cyber Surakshit Bharat Initiative: It was launched in 2018 with an aim to spread awareness about cybercrime and building capacity for safety measures for Chief Information Security Officers (CISOs) and frontline IT staff across all government departments. The mandate of this initiative also needs to be expanded to include mobile app based threats too.
- International cooperation: Looking forward to becoming a secure mobile ecosystem, India needs to join hands with several developed countries like the United States, Singapore, Japan, etc. These agreements will help India to challenge even more sophisticated mobile app based cyber threats.
- Also individual level strategy needs to be adopted to secure the data such as, lock the phone with a intricate pass code, encrypting storage, learning to remotely wipe the cell phone, etc.

Conclusion:
India today accounts for nearly 420 million mobile phone users. A single mobile data breach can pose a bigger threat of national internal security in front of any country.

Hence, it becomes imperative to be well prepared to tackle any of these kind of challenges if arises in future. Which will ensure a safety of the confidential as well as personal information of users in turn helping to secure country's internal security.