Question 1: What are the benefits of electrifying every sector? What are the sectors which are harder to electrify in the present times?
Student Answer: The benefits of electrifying every sector are reducing the CO2 emissions upto an extent. There will be less polluting sectors if they are electrified. There will be reduction in the greenhouse gases that can be trapped in the atmosphere. This will also reduce the dependencies on the fossil fuel. It will enhance the energy efficiencies compared to the combustion based technologies. Furthermore, if it is integrated with renewable 2 energy like solar or wind then the air quality will also be improved as these are one of the non-polluting sources of renewable energy. Sectors that are harder to electrify are industries like steel, cement and any chemical production industries as they come under heavy industry categories as their energy requirement is very high.

Question 2: How will climate change impact crop yields and nutritional quality?
Student Answer:
1) Reduced Yields: - Increased temperatures, droughts, abnormal rainfalls pattern will disturb the crop growth

2) Increased Pests:- The hot temperatures will lead to the spread of pests and diseases leading to the damage of crops

3) Less Nutritional Qualities:- The high CO2 levels will disturb the levels of contents present in the crops like rice and wheat.

Question 3: Describe the carbon offset project and program.
Student Answer: Carbon offset projects are basically initiatives that compensate for carbon emissions by funding the project that reduce the greenhouse gases. Carbon offset programs are when the business are allowed to invest in projects like carbon offsetting, to be able to balance the carbon footprint.

Question 4: What is greenwashing and greenhushing?
Student Answer: Greenwashing is when the companies falsely claims to be an environment friendly to be able to get more customers. They may not be true to its values of completely being sustainable brand, but they still mention it out like that. Greenhushing is when the company intentionally under-report or hide their sustainability efforts to be able to avoid any allegations or escape accusations of the green washing.

Question 5: What are the four different types of solar PV solutions based on their application?
Student Answer: Solar PV solutions

On-grid - Connected to grid allowing the excess energy to be fed back into grid.
② Off-grid - Standalone system with battery
③ Hybrid - Combination of on and off grid

Integrated Photovoltaics - for rooftops and buildings-Building

Question 6: Describe doughnut economy and its purpose.
Student Answer: Doughnut economy is a model designed by an economist, Dr. Kate which tells about the balance between the human needs and the planetary limits. It is a socio-economic model that looks like a doughnut when drawn on paper. The inner circle represents the human well being and all the human needs like food, water, healthcare and education. The outer circle represents the planetary boundaries like biodiversity loss and climate change. The purpose of the doughnut economy model is to promote for a more balanced and rather sustainable economic growth. It is a framework provided for circular economy and responsible consumption.

Question 7: What is the greenhouse effect? How does it impact the earth system? Write any three examples of greenhouse gases and its present day concentration.
Student Answer: The greenhouse effect is when the process by which certain gases trap the heat in the atmosphere and warm up the planet. The more amount of greenhouse gases lead to global warming.

Impact on Earth:-
a) Rise in the global temperature
b) Extreme weather changes (too hot / heatwaves)
c) Ocean disruption
Examples of greenhouse gases: CO_2, N_2O, methane

Question 9: What are carbon sources, stocks and sinks? Explain with examples
Student Answer:
Carbon Source :- Emit carbon in the atmosphere (eg: burning of fossil fuels)
Carbon Stock: Where carbon is stored for sometime; (eg; forests, soil)
& Carbon Sinks: Absorb and store carbon, reducing the CO_2 levels. (eg:- ocean absorbing CO_2)

Question 10: Discuss at least 2 mental models in the context of climate change and solutions. Its strengths and weaknesses for each.
Student Answer: There are total of 4 mental models of which 2 are
Growth vs degrowth
Masculine vs. Feminine.

Question 11: What is the difference between carbon removal and carbon offset? What are two categories of carbon dioxide removal?
Student Answer: Carbon Removal is when you try to take out the carbon from the environment, Carbon offset is when you take initiatives to compensate for the carbon Emission.

Two categories of Carbon Dioxide Removal:
Natural method - Soil carbon sequestration, biochar.
Technological method - Direct air capture.

Carbon Dioxide removal is the subset of carbon removal that only focuses on CO2.

Question 12: What is climate sensitivity? What are the three common measures of climate sensitivity?
Student Answer: Climate sensitivity is measure of how much the Earth's temperature will rise with doubling of CO2.

Three common measures are:
Equilibrium Climate Sensitivity: When there is a long term temperature increase from ~1.5°C ~ ~4.5°C
Transient Climate Response: When there is near term temperature increase from ≈0.5°C - ~2.5°C
③ Effective Climate Sensitivity:

Question 13: Derive a simple energy balance model using Stefan's Boltzmann law and solar constant and calculate the average temperature of the Earth in Kelvin. Given that solar constant S = 1372 Wm-2 , σ = 5.67✕10 -8 Wm-2K -4 α = 0.3. Also write whether this temperature is too hot, cold or ambient.
Student Answer: T = 5 (1 - α)⁴ 1372 (1 - 0.7) = 5.67 X10⁻⁸ X 4 = (4.234567901.23)¼ = 255.095 K (= -18.05°C)

This temperature is too low than the actual average temperature.
α= Albedo
σ= Stefan's Boltzmann constant
S= Solar flux

Question 14: What is clean energy and what are the different types of clean electricity technologies? Explain any 3 with its pros and challenges.

Student Answer: Clean Energy is an energy that does not produce any greenhouse gas emissions. Type of clean energy technologies
① Solar Positive
- Renewable
- less costly
Negative
- Require external storage
- Use land for installation Space

② Wind Positive
- Renewable
- less emissions
Negative
- maybe harmful to birds
- Intermittent
- Operational at continuous wind speeds
③ Hydro power Positive
- Grid stability
- Reliable

Ngative
- environmental impact on the ecosystem

Question 15: Mention any three challenges of the carbon offset? What are its alternatives (mention at least 2)
Student Answer: Carbon offset Challenges:
1) Verification Issue - It is difficult to ensure the claimed offsets that can actually reduce the emissions.
2) Carbon Leakage - If we offset carbon for some particular area, there is a change of emission increasing in the other things. To balance it out at the same time can be difficult to manage.

Question 16: What are feedback loops in the climate system? Explain positive and negative feedback loops with 1 example each. Explain tipping points using two examples of tipping elements.
Student Answer: Feedback loops are the processes that amplify the climate change. Positive feedback loop is when it increases the warming. For example the ice - albedo effect. This basically is the melting of ice reduces the reflectivity, absorbing more heat and causes more melting. Negative feedback loop is when it reduces the warming. For example there is increased plant growth that will absorb the CO2 which will eventually reduce the atmospheric CO2 present.

Tipping points are referred to as irreversible climate shifts. Examples are Amazon rainforest where the deforestation and drought are turning the rainforest into savanna. Another example is the Greenland ice sheet melting where there is irreversible ice loss happening and it is leading to the sea-level rise.