Carbon Capture, Utilization, and Storage
(이산화탄소 포집, 활용 및 저장) (38535)

- 2022 Midterm Examination -

Student ID: **Name:**

Notice

- Fill your name below:

  "I, _____, swear I solve all problems by myself in this midterm examination. I will take any disadvantages if any dishonesty such as cheating is acted on my solution."

  5 points will be deducted from your total score if you do not fill in your name above.

- **You MUST solve each problem by hand.**
- Submission Deadline: 12:30~13:45 PM, April 18, 2022.

Problem 1.

Provide the full name of each acronym:

1-1. CCUS [2 pts.]
1-2. IPCC [2 pts.]
1-3. IEA [2 pts.]
1-4. BAU [2 pts.]
1-5. WAG [2 pts.]
1-6. GWP [2 pts.]
1-7. COP26 [2 pts.]

Problem 2.

Fill in the two blanks with correct years. [6 pts.]

"*In the* (①) *Paris Agreement on climate change, nearly every country on Earth pledged to keeping global temperatures "well below" 2 °C above pre-industrial levels and to "pursue efforts to limit the temperature increase even further to 1.5 °C". However, at the time, scientists had only modelled energy system and carbon mitigation pathways to achieve the 2 °C target. Few studies had examined how the world might limit warming to 1.5 °C. Now a paper in Nature Climate Change presents the results from a new modelling exercise using six different "integrated assessment models" (IAMs) to limit global temperatures in* (②) *to below 1.5C.*"

Problem 3.

Answer the following problems based on the IPCC 2nd, 4th, and 5th assessment reports.

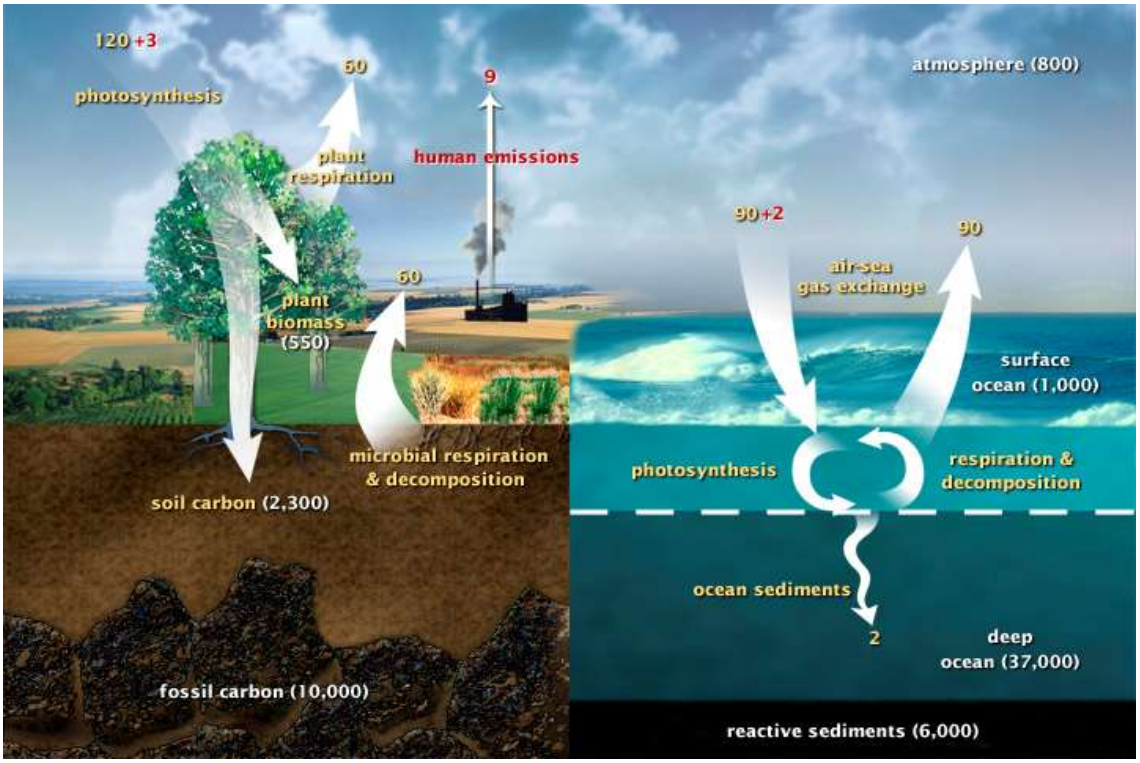
3-1. List up the six greenhouse gases below in the ascending order of their estimated global warming potential values. [5 pts.]

3-2. List up the six greenhouse gases below in the ascending order of their estimated half-lives. [5 pts.]

(A) Methane (CH_4)
(B) Nitrous Oxide (N_2O)
(C) HFC-23 (CHF_3)
(D) PFC-14 (CF_4)
(E) Sulfur Hexafluoride (SF_6)
(F) Nitrogen Trifluoride (NF_3)

Problem 4.

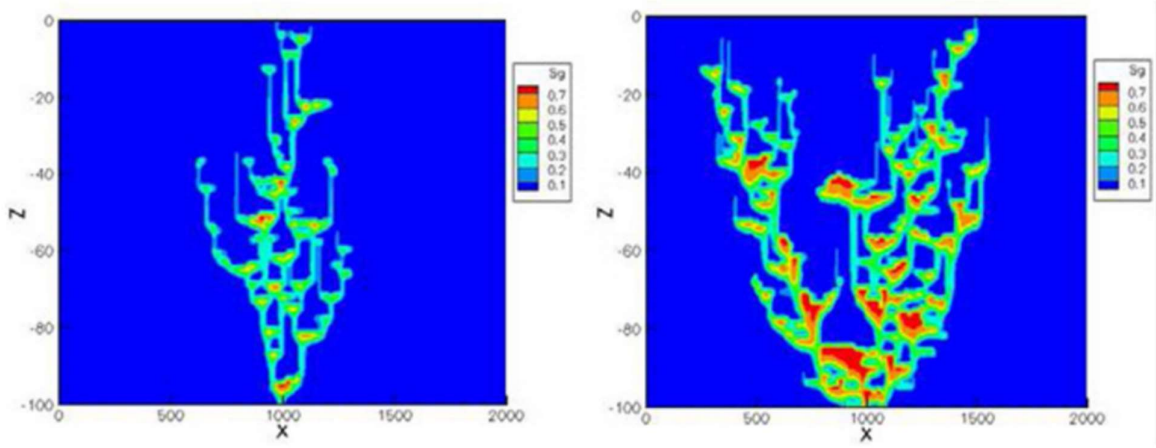
Below is the schematic of fast carbon cycle. Explain why the atmosphere is called "Grand Central Station" in the fast carbon cycle, in brief. [5 pts.]



Problem 5.

Below two figures show the CO_2 plume migration. Let's assume that both figures have the same reservoir properties. Based on your knowledge, fill in the two blanks in the following sentence [6 pts.]:

"The two figures show the impact of ( ) *and* ( ) *on the vertical spread of CO_2 injected at the bottom of the reservoir."*



0.001 kg/s per meter of thickness

0.01 kg/s per meter of thickness

Problem 6.

6-1. Draw a phase diagram of pure CO_2 with its critical point. [3 pts.]

6-2. How much are critical pressure and temperature of pure CO_2? [3 pts.]

6-3. Explain dense phase fluid. [3 pts.]

6-4. Explain supercritical fluid. [3 pts.]

6-5. What happens to the phase diagram if impurities are added to the pure CO_2? [3 pts.].

Problem 7.

Below table shows greenhouse gas emissions from "A" company in 2020.

CO_2 (ton)	CH_4 (kg)	N_2O (kg)	HFCs (kg)	PFCs (kg)	SF_6 (kg)	GWP (CO2)	GWP (CH4)	GWP (N2O)	GWP (HFCs)	GWP (PFCs)	GWP (SF6)
20,000	380	35	.	.	.	1	21	310	-	-	23,900

7-1. How much is the CO_2 emissions of this company? [3 pts.]

7-2. How much is the CO_2-eq emissions of this company? Round off your answer to the nearest hundredth (당신의 답을 소수점 둘째자리에서 반올림하시오). [3 pts.]

7-3. How much is the carbon (C) emissions of this company? Round off your answer to the nearest hundredth. [4 pts.]

Problem 8.

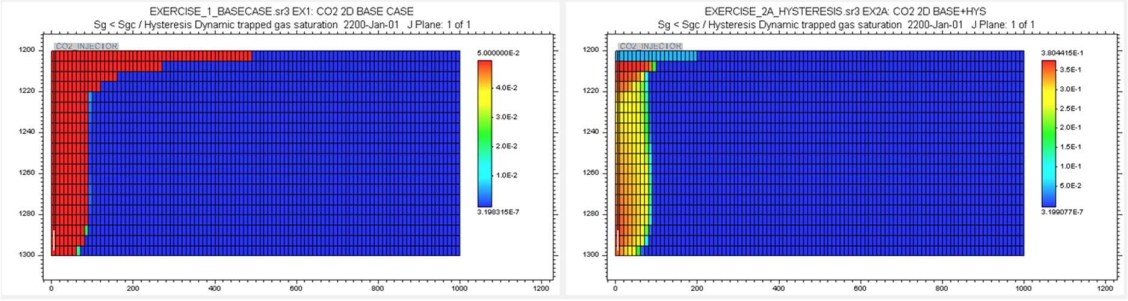
List six conventional options for storing CO_2 in deep underground geological formations for CO_2. [12 pts.]

Problem 9.

Draw a graph to compare four primary CO_2 trapping mechanisms of in terms of time since cessation of injection (years) and trapping contribution (%) [12 pts.].

Problem 10.

Below figures compare simulation results of structural trapping (left) and hysteresis trapping (right) where CO_2 has been injected for 1 year and migrated for the subsequent 200 years. Analyze the simulation results based on your engineering knowledge [10 pts].



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