Examination, Science of Environmental Change. FFR 166
Oct 23, 2008, 8.30-12.30 in V-buildings

Aids:
- -Pocket calculator of category a "Chalmers-approved calculator":
  Casio FX82, Texas TI30, Sharp EL531 (checked by teacher on duty).
- -Language dictionaries.
- -Physical and mathematical tables.

Teacher on duty: Sten Karlsson, extension: 3149.

Grading scale: 40, 60, 80 points (of total 100).
Maximum 14 points from hand-ins added for grades 4 and 5. (The points are weighted and rounded to nearest halfpoints.)

Write structured and if possible be concise. Use figures if they make your answers clearer. Your answers should prove *good understanding* of the subject.

Note! Always start on a *new paper* when you turn to the next question. Write your name on every paper.

Note! Your answers should be in *English*.

Evert Ljungström:

1 a/ Name the three kinds of elementary particles you need to put together a neutral atom of an element. (1)

b/ Give the oxidation state of sulphur in SO_4^{2-} and of carbon in CH_4 (2)

c/ You measure a pH of 3.2 in a solution. Which is the hydrogen ion concentration $[H^+]$ in the solution? (2)

2 a/ Write a balanced reaction for the process where slaked lime ($Ca(OH)_2$) reacts with SO_2 dissolved in water to form solid calcium sulphite. . (2)

b/ Based on the reaction you wrote in 2a, (the reaction being right or wrong does not matter for the grading of 2b) how much $Ca(OH)_2$ (mass/hour) would you consume in your flue gas scrubber if you completely absorb the sulphur dioxide given off by a coal fired power station emitting 3600 kg SO_2 /hour and how much product (mass/hour) would you have to handle?? (3)

3 a/ The reaction $MgO(s) + CO_2(g) \rightarrow MgCO_3(s)$ is spontaneous at room temperature. Considering the definition of Gibbs free energy and the character of the reaction above, suggest a way of making the reaction spontaneous in the other direction. Motivate your suggestion. (2)

b/ The change in Gibbs free energy for the reaction below is -394.4 kJ/mole. Calculate the Gibbs free energy of formation for $CO_2(g)$. (2)

$$O_2(g) + C(s) \rightarrow CO_2(g)$$

4/ Which are the main natural sources to the atmosphere sulphur, oxidised nitrogen and volatile organic compounds? (3)

5 a/ The concept of "smog" covers two phenomena. One is the "classical" smog and the other is "photochemical smog". Which similarities and which differences are there between these two pollution situations? (2)

b/ Describe briefly, with reaction formulas or words, how a water-insoluble hydrocarbon may be removed from the atmosphere. How is it related to the formation of ground level ozone? Assume slightly polluted conditions and sunshine. (5)

Sten Karlsson

6. a) Define the *turnover time* and *response time*, respectively, used when dealing with materials fluxes in the environment. (2p)

b) The response time for the adaptation of the atmospheric CO_2 concentration to a human disturbance by CO_2 emissions differs considerably from the relatively shorter turnover time. Why does it differ? (2p)

c) Earth is hit by incoming radiation and also emits radiation into space. Describe roughly how these two radiation fluxes differ. (in energy, frequency, temperature, space, time,…) (3p)

7. a) Give the energy quality (exergy units per energy unit) of the following four energy sources: crude oil, bioenergy in the form of forest residues, hydro power, and wind energy (2p)

b) The energy efficiency of a solar heater in Sweden, producing hot tap water with a temperature of 50 ^{o}C, is about 50 %. How large is the exergy efficiency of this device? Make if necessary reasonable assumptions of your own. (3p)

8 a) In atmospheric science, define the *potential temperature*, and explain the connection of this concept to atmospheric stability. (2p)

b) A balance of forces requires at least two forces (if not zero). In the free atmosphere, which are the two forces dominating the balance in the vertical and the horisontal, respectively. What are these balances called respectively? (3p)

c) Sketch qualitatively and explain the vertical profiles in the ocean of dissolved inorganic C, dissolved inorganic N, and O_2, respectively (3p)

9. Categorize nitrification and methanogenesis (biological production of methane from organic materials) along dissimilatory/assimilatory, oxic/anoxic, endoterm/exoterm, and reduction/oxidation of nitrogen/carbon respectively. Explain briefly. (4p)

10. The oceanic uptake of carbon dioxide from the atmosphere is very important for the future possible build up of CO_2 concentration in the atmosphere. Describe shortly the processes controlling the future oceanic uptake and fluxes of CO_2 from the atmosphere. (4p)

11 a) Burning of fuels often involves conversion of nitrogen with possible environmental effects. Describe the nitrogen balance for burning of a fuel with air, especially the influence on the amount of reactive nitrogen forms in the environment. (4p)

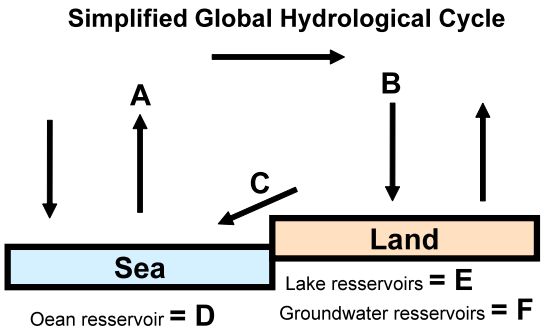
b) Describe shortly in which ways human sulfur dioxide emission to air can effect the radiation balance of the Earth. (4p)

12 a) Feedbacks are important for the understanding of the climate change. Describe the important feedbacks from various water phases in the climate system. (4p)

b) Define and explain the following concepts: c*limate sensitivity* and *global warming potential.* (4p)

Rod Stevens

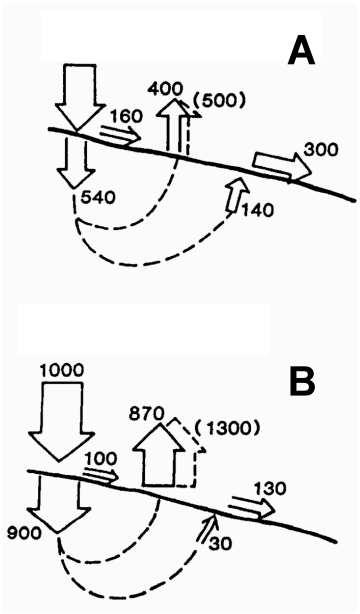
13 (3p) For the global hydrological cycle, match the correct (approximate) water fluxes and water reservoir volumes given below (1-8) with the indicated components in the figure (A-F). Note that that you are only to use 6 of the values below.



Water fluxes
1 – 50 10^3 km^3/yr
2 – 120 10^3 km^3/yr
3 – 40,000 10^3 km^3/yr
4 – 430,000 10^3 km^3/yr

Water reservoirs (storage)
5 – 175 10^3 km^3
6 – 23,400 10^3 km^3
7 – 1,300,000 10^3 km^3
8 - 5,500,000,000 10^3 km^3

14. (5p) Which two climate types are represented in the two water budgets shown (A & B)? For <u>one</u> of these, specify each of the components shown (the values are mm equivalents per year).



Stefan Wirsenius

15 a) What is a soil? Give a concise definition. (1 p)

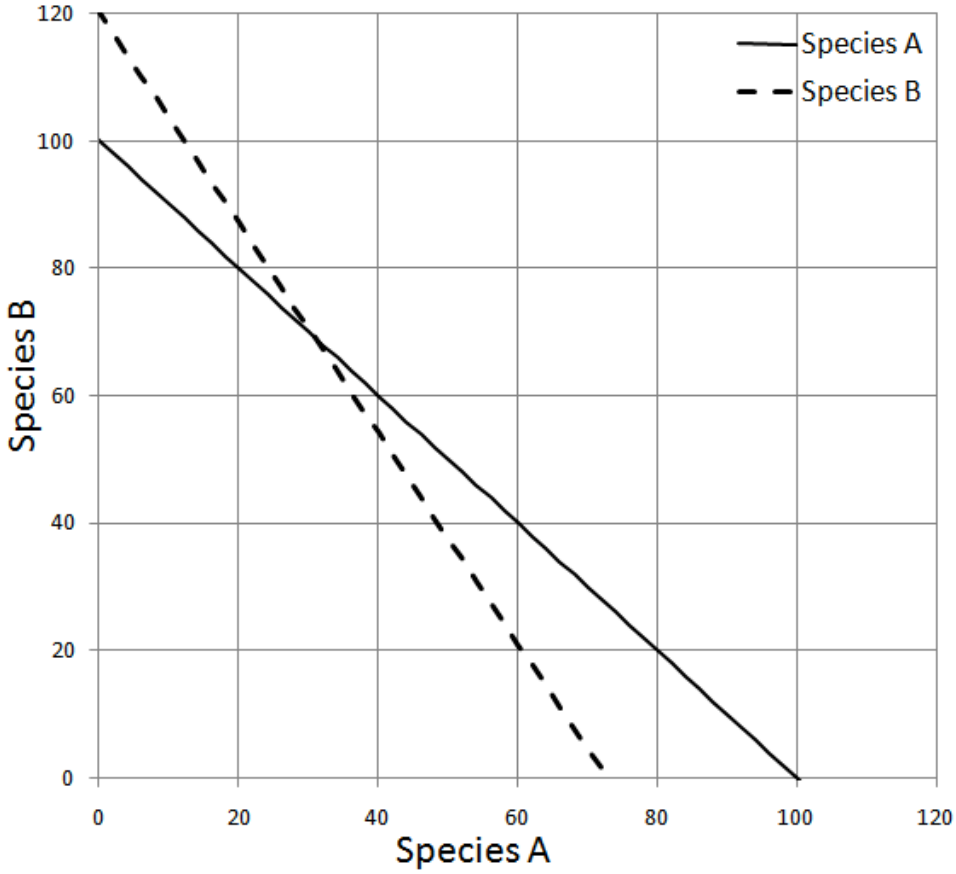
b) Identify and describe the three major processes that form soils. (3 p)

c) Explain the mechanisms of natural and anthropogenic *soil* acidification, respectively. Describe briefly for each case relevant processes in the soil-plant profile. (4p)

Kjell Wallin

16: The time dynamic of biological populations are determined by four processes, some of them global and some local. Which are these processes and what are their spatial belongings? (4p)

17: When two species compete over a common resource they have negative impact on each other's growth rate. The simplest model for such an interaction is a linear relationship. Such a situation is described in the figure showing the equilibrium population of species A, given the density of species B (solid line) and vice versa (broken line). In the long run, will these species co-exist or will one or the other go extinct? What are the equilibrium densities for the two species? Make a graphic solution (use the graph below) when you give answers! (4p)



Thomas Backhaus

18. Describe the process and which data is needed to perform an environmental risk assessment of a chemical compound. (8p)

PERIODIC TABLE OF THE ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 1.0079																	2 He 4.0026
3 Li 6.941	4 Be 9.0122											5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.305											13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.64	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 - 71 La-Lu	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 -103 Ac-Lr	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (281)	111 Uuu (272)	112 Uub (285)		114 Uuq (289)				

PSE.Menu

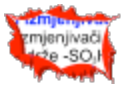
Lanthanide	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
Actinide	89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

ENIG. HOME

SOLID LIQUID GAS 100 °C 101 kPa SYNTHETIC ELEMENT

Relative atomic mass is shown with five significant figures. For the precise value of the atomic mass you must click on an element symbol in periodic table. For elements have no stable nuclides, the value enclosed in brackets indicates the mass number of the longest-lived isotope of the element. However three such elements (Th, Pa and U) do have a characteristic terrestrial isotopic composition, and for these an atomic weight is tabulated. (*Atomic Weights of the Elements 1999*, Pure Appl. Chem., Vol. **73**, No. 4 (2001) 667-683)

CONTENT:



Glossary of chemical terms

Glossary of chemical terms contain a brief definitions of selected terms of importance in chemistry and related fields of science. Individual chemical compounds are not included. It is composed of two parts:

- appendixes
- dictionary

A | B | C | D | E | F | G | H | I | J | K | L
M | N | O | P | R | S | T | U | V | X | Z

Periodic table of the elements contains the basic data about the elements in five languages:

- English (Editors: Aditya Vardhan, Eni Generalic)
- French (Editor: Michel Ditria)
- Croatian (Editors: Eni Generalic, Marija Bralic, Slobodan Brinic)
- German (Editor: Marc Hens)
- Italian (Editor: *editors wanted*)