

EXAM GRADES: Each question was worth 3 points out of a possible 100, everyone got 1 point for signing their name. Letter grades were assigned on a curve. Scores ranged from 91 (A+) at the high end to around 50 at the low end. The mean (average) score was 65, and scores in this range (± 2) received a B. In general, there is at least one point separating each grading category (eg. B vs B+). Partial credit was given wherever possible. If you have issues with your grade please contact Kathy.

SIO 40 MID-TERM EXAM, Fall 2007

This mid-term consists of 33 multiple choice, matching, ranking and true/false questions. Each question is worth 3 points. **Multiple choice questions with potential for more than one correct answer are noted.** Please read each question carefully. You have one class period to complete the exam.

- 1) What are the three basic rock types?
- a) silicates, oxides, sulfates
 - b) stones, beetles, the who
 - c) sedimentary, igneous, metamorphic**
 - d) limestone, sandstone, shale

- 2) Which of these is not considered a greenhouse gas?
- a) water vapor
 - b) CO₂ (carbon dioxide)
 - c) CH₄ (methane)
 - d) SO₂**

- 3) The following pairs of elemental compounds may (or may not) differ in oxidation state for the element noted. Where there is a difference in oxidation state, circle the *more reduced* form of each element. If the oxidation states are the same, indicate that for your answer.

for carbon: CO₂ or **“CH₂O”**

for iron: Fe₂O₃ or **FeS₂**

for nitrogen: **NH₄⁺** or N₂

for carbon: H₂CO₃ or CO₂ **SAME**

for oxygen: **H₂O** or O₂

for sulfur: **H₂S** or H₂SO₄

4) In which of these locations is there a net **uptake** of atmospheric CO₂ by the surface ocean?

- a) the Indian Ocean
- b) off the coast of California
- c) the subtropical Atlantic
- b) the equatorial Pacific, near Galapagos
- c) the North Atlantic, near Greenland**

5) Which of the following gases is well-mixed (ie. uniformly distributed or nearly so) in the Earth's atmosphere?

- a) CO₂
- b) CH₄
- c) H₂O vapor
- d) O₂**

6) Which form of nitrogen is unavailable to any form of life on Earth?

- a) NO₃⁻
- b) NH₄⁺
- c) N₂
- d) NO₃
- e) none of the above**

7) At a given atmospheric pressure and amount of water vapor, increasing the air temperature will cause the relative humidity to:

- a) Increase
- b) Decrease**
- c) Stay the same

8) Which of the following reactions (as written) represents the largest sink (ie. uptake process) for atmospheric CO₂?

- a) $\text{Ca}^{2+} + 2\text{HCO}_3^- \rightarrow \text{CaCO}_3 + \text{H}_2\text{CO}_3$
- b) $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{CH}_2\text{O} + \text{O}_2$
- c) $\text{CaSiO}_3 + 2\text{H}_2\text{CO}_3 \rightarrow \text{Ca}^{2+} + 2\text{HCO}_3^- + \text{SiO}_2 + \text{H}_2\text{O}$**
- d) $\text{CaCO}_3 + \text{H}_2\text{CO}_3 \rightarrow \text{Ca}^{2+} + 2\text{HCO}_3^-$
- e) $\text{CO}_2 + \text{CO}_3^{2-} + \text{H}_2\text{O} \rightarrow 2\text{HCO}_3^-$

9) Quartz is a sedimentary rock.

- a) True
- b) False**

10) Consider the “plant in a box” model discussed in class. Which of the following terms describes the $\delta^{13}\text{C}$ of the plant in the box, relative to the $\delta^{13}\text{C}$ of the CO_2 in the box? (there could be more than one correct answer).

- a) heavier
- b) more negative**
- c) more positive
- d) lighter**
- e) the same

11) The age of the universe is:

- a) about 4,000 years
- b) 15 billion years**
- c) about 500 million years
- d) about 4.6 billion years

12) Which of the following statements about ozone are *true*? (there are several)

- a) Ozone absorbs high-energy UV radiation.**
- b) Ozone is a highly effective greenhouse gas.**
- c) The “ozone layer” is in the troposphere.
- d) The molecular formula of ozone is O_4 .
- e) Ozone is formed from reactions between O_2 and UV radiation in the atmosphere.**

13) In terms of net primary production on a global level (eg. grams carbon per year), the terrestrial biosphere is about twice as productive as the marine biosphere.

- a) True
- b) False**

14) Changes in atmospheric CO_2 and Earth surface temperature do not appear to have been correlated over glacial/interglacial timescales.

- a) True
- b) False**

15) In polar regions, the amount of incoming shortwave solar radiation (in Watts/m^2) is _____ the amount of the outgoing longwave radiation (in Watts/m^2).

- a) greater than
- b) less than**
- c) the same as

16) Identify the redox reactions among the following (there are several):

- a) dissolving CO_2 in water
- b) aerobic respiration of organic matter**
- c) carbonate weathering
- d) photosynthesis**
- e) weathering of pyrite**

- 17) The residence time of water in the atmosphere is approximately:
- a) 8 years
 - b) 4000 years
 - c) 9 days**
 - d) 5 years
 - e) 1-2 months
- 18) Which of the following gases was *not* a constituent of the “primitive atmosphere” used in Stanley Miller’s origin of life experiment?
- a) methane
 - b) ammonia
 - c) oxygen**
 - d) water vapor
 - e) hydrogen
- 19) The Antarctic continent and the Sahara desert are both terrestrial areas with high:
- a) surface temperatures
 - b) biomass
 - c) albedo**
 - d) relative humidity
- 20) What is the characteristic turnover (ie. replacement) time for marine primary producers?
- a) weekly**
 - b) daily
 - c) decadal
 - d) hourly
 - e) annual
- 21) Earth’s early atmosphere was derived primarily from volcanic outgassing.
- a) True
 - b) False**
- 22) In terms of grams carbon per square meter, net ecosystem production is _____ net primary production.
- a) greater than
 - b) less than**
 - c) equal to
- 23) Chemical weathering reactions are an important long-term control on the atmospheric concentration of O₂, but not the atmospheric concentration of CO₂.
- a) True
 - b) False**

24) Which of the following is an important class of biomarker compounds for eukaryotes in ancient sedimentary deposits?

- a) amino acids
- b) 2 α -methyl hopanes
- c) steroids
- d) steranes**
- e) ribosomal RNA

25) Which of the following mineral phases is important in the inorganic carbon cycle?

- a) limestone**
- b) pyrite
- c) apatite
- d) kaolinite
- e) olivine

26) The influence of Coriolis force causes winds and currents to move to the right in the southern hemisphere, relative to a fixed point on the surface of the Earth.

- a) True
- b) False**

27) Earth's Moon is thought to have been formed via:

- a) co-accretion with the Earth
- b) a giant impact on Earth**
- c) gravitational capture of a smaller body by Earth
- d) splitting apart of a rapidly rotating early Earth

28) Significant gradients in which of the following properties exist between the surface and deep ocean?

- a) oxygen
- b) temperature
- c) salinity
- d) density
- e) all of the above**
- f) none of the above

29) Latent heat describes the heat produced when:

- a) Liquid water evaporates
- b) Water vapor condenses**
- c) CO₂ dissolves in water
- d) Frozen water melts

30) Which term describes the east coast of the United States?

- a) convergent margin
- b) passive continental margin**
- c) transform margin
- d) divergent margin

31) Rank the following hydrologic reservoirs in terms of size, starting with the largest as #1:

- 2** Ice caps and glaciers
- 3** Groundwater
- 1** Ocean
- 5** Atmosphere
- 4** Lakes, streams, and rivers

32) Match the following processes in the global carbon cycle with their characteristic timescale:

Atmosphere/upper ocean exchange 1-10yrs	annual
Terrestrial forest/atmosphere exchange annual	>100 yrs
Deep ocean/surface ocean exchange >100 yrs	10-100 yrs
Terrestrial soil/atmosphere exchange 10-100 yrs	1-10 yrs

33) Various lines of evidence indicate that molecular oxygen (O₂) first achieved appreciable levels in Earth's atmosphere around:

- a) 1.9 million years ago
- b) 4.6 billion years ago
- c) 2.7 billion years ago
- d) 2.3 billion years ago**
- e) none of the above