

The Open University of Sri Lanka
 B.Sc. Degree Programme 2012/2013



Environmental Chemistry – CMU 3129 – Level 5
 Continuous Assessment Test I (No book Test)

Date: 23.07.2013

Time: 4.00 pm. – 5.30 pm.

Registration No.:

Invigilator's signature.....

Question Number	Marks
1	
2	
3	
Total	
%	

Answer all the questions.

1.a. (i) Atmospheric pollutant are sometimes classified into two categories, primary pollutants and secondary pollutants. What do you understand by the following terms?

- primary pollutants

.....

- secondary pollutants

.....

(10 marks)

(ii) Identify the following as primary pollutant or secondary pollutant.

CO SO₂

NO..... NO₂.....

PAN (peroxyacetyl nitrate).....

(10 marks)

b. (i) Define the following terms as used in environmental chemistry.

Source

.....
.....
.....

Sinks

.....
.....
.....

(ii) Write the main source(s) and sink(s) for each of the following substances.

Substances	Source(s)	Sink(s)
CO ₂		
SO ₂		
O ₃		
CO		

(30 marks)

c. (i) What is meant by 'Residence time' of a substance?

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.....
.....

(ii) Calculate the residence time of Na^+ in the ocean given that the total amount of Na^+ is 6.08×10^{20} mol and the input rate of Na^+ by river is 1.18×10^{13} mol / year:

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(20 marks)

d. Write down the reaction of OH radical with

O_3

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CO

SO_2

.....

(30 marks)

2.a. (i) Tabulate the major regions of the atmosphere and their important characteristics.

Region	Altitude (km)	Temperature ($^{\circ}\text{C}$)	Major chemical species present.

(40 marks)

b. Ozone in the upper layer of atmosphere is regarded as beneficial to mankind and chlorofluoro carbons form a group of compounds responsible for depleting O₃ layer. For the first time in the history of mankind, the world acted fast to agree to phase out them completely. Alternative fluorocarbons were produced as good substituent for CFC.

i. Write the molecular formula of the compound with the code number CFC 12.

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(10 marks)

ii. Give the properties of CFCs which led to their original widespread used and now lead to their long term presence in the upper layer.

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(10 marks)

ii. Show by using chemical equations how CFCs catalyze destruction of O₃.

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(20 marks)

iii. What are the types of chemicals now being used as replacement for CFCs?

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(05 marks)

iv. Why don't they have such detrimental effect upon the O₃ layer?

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(10 marks)

v. Identify the protocol signed.

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(05 marks)

3. a. i. What is photochemical smog?

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(05 marks)

ii. List down the conditions necessary for the formation of photochemical smog.

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(05 marks)

iii. What are chemical pollutants present in photochemical smog?

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(10 marks)

iv. Briefly describe their effects on human health.

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(20 marks)

b. i. What is global warming?

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(05 marks)

ii. What are the consequences of global warming?

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(15 marks)

iii. What is meant by the term Global Warming Potential (GWP) of a greenhouse gas?

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.....

(10 marks)

c. i. What do you understand by 'Threshold Limit Values' (TLVs)?

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(10 marks)

ii. For NO₂, threshold value limit (TLV) is 3 mg m⁻³. Express its TLV in ppmv at 25° C.

[R = 8.314 JK⁻¹ mol⁻¹; 1 atm = 1x10⁵ Nm⁻²; Atomic weight (g mol⁻¹) N = 14; O = 16]

.....
.....
.....
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(20 marks)

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Answer guide for CAT 1

1.a. i. Refer page no. 3

- ii. CO – primary pollutant
- SO₂ – primary pollutant
- NO – primary pollutant
- NO₂ – secondary pollutant
- PAN – secondary pollutant

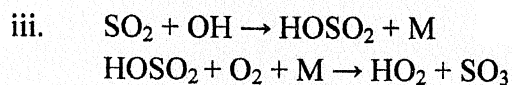
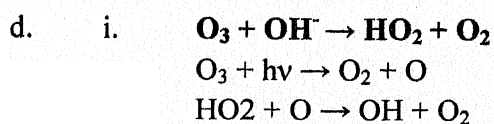
b. i. Refer page no. 2

ii.

Substance	Source	Sink
CO ₂	Respiration, Combustion, Decay etc	photosynthesis
SO ₂	Combustion of coal containing sulphur, Roasting of metal sulphide ores, volcanic eruptions	Ocean Acid rain.
O ₃	Photodissociation/ photolysis reaction of O ₂ Photochemical smog	CO
CO	Forest fire, volcanic eruptions, incomplete combustion of fossil fuel, burning of coal.	Soil organisms

c. i. Refer page no. 5

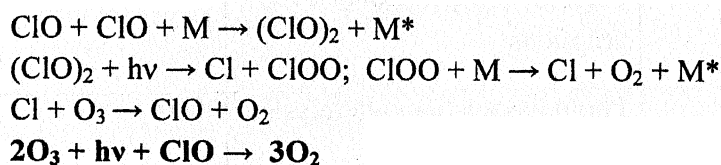
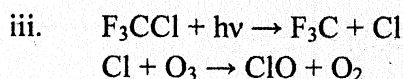
ii. 5.15×10^7 year



2.a. i. Refer page no. 87

b. i. CFC12
 Using 90 rule – $90 + 12 = 102$, Molecular formula CF_2Cl_2

ii. Properties of CFCs
 Chemical stability
 Inert character
 Non toxicity
 Non inflammability
 High residence time



iv. Hydrochlorofluorocarbons

v. OH radical present in troposphere preferably attack C-H bond rather than on C-Cl bond. Therefore the life time in the atmosphere is much shorter. Before reaching the stratosphere, a large fractions of HCIFCs are destroyed. So the possibility of generating Cl in the stratosphere is relatively reduced.
 $\text{CF}_3\text{CH}_2\text{F} + \text{OH} \rightarrow \text{H}_2\text{O} + \text{CF}_3\text{CHF}$

vi. Montreal protocol

- 3.a. i. Photochemical smog is a whitish yellow haze containing chemical species.
- ii. Refer page no.50
- iii. NO₂, Hydrocarbons, PAN, O₃ and aldehydes
- iv. Refer page 55
- b. i. Global warming: an increase in average temperature of the earth surface.
- ii. Refer page no. 71-72.
- iii. Refer page no. 70
- c. i. Refer page no. 75-76
- ii. 1.595×10^{-6} ppmv