

NATIONAL UNIVERSITY OF SINGAPORE

ESE5001 - ENVIRONMENTAL PROCESSES

(Semester 2: AY2015/2016)

Time allowed: 2 hours

INSTRUCTIONS TO CANDIDATES

1. Please write your student number only. **Do not write your name.**
2. This assessment paper contains **THREE Parts: PART A - WASTE MANAGEMENT
PART B - AIR QUALITY
PART C - WATER QUALITY**
comprises **SEVEN** printed pages.
3. Answer **ALL** questions. All questions DO NOT carry equal marks.
4. This is a “CLOSED BOOK” assessment.
5. Please start each question on a new page in the answer booklets.
There are 3 answer booklets provided and please write your answer to the parts accordingly:
 - (i) **PART A - WASTE MANAGEMENT**
 - (ii) **PART B - AIR QUALITY**
 - (iii) **PART C - WATER QUALITY**

PART A – WASTE MANAGEMENT (30 Marks)**Question 1 [30 marks]**

In approximately 500 words, comment on the following statement by prominent environmental engineer Glenn Daigger of CH2M Hill:

“Environmental matters are on the front page today because we, the environmental industry, are not meeting people’s expectations. They’re telling us that accountability and quality are not open questions that ought to be considered. It’s sometimes difficult to grasp in the face of all the misinformation out there. Ultimately, we’re responsible for accommodating the public’s point of view, not the other way around.”

Do you agree with him? Give some examples related to solid waste management.

.../3

PART B – AIR QUALITY (30 marks)**Section I (15 marks)**

Indicate the letter of the correct answer in the answer booklet provided.

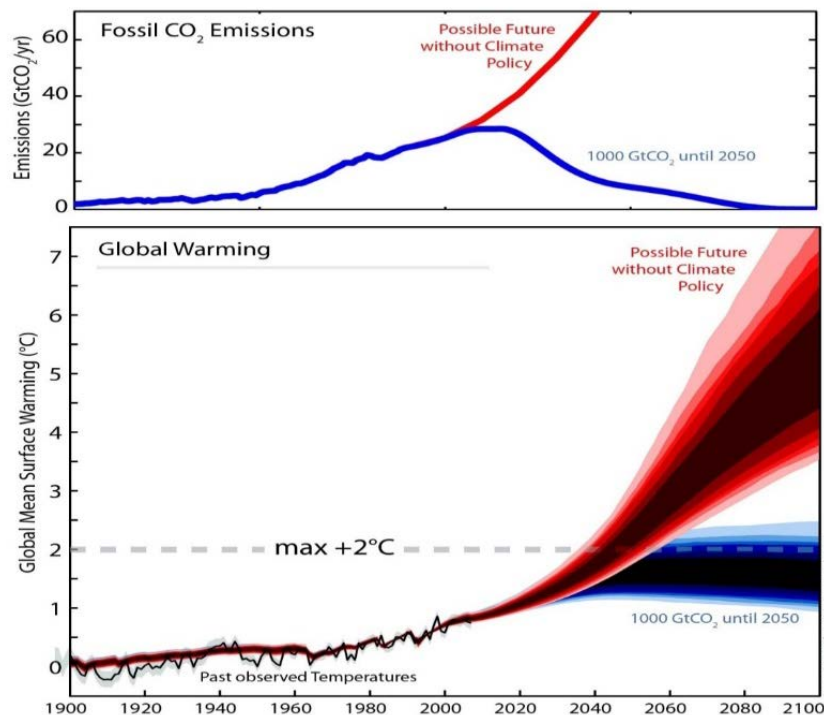
Each question = 1 mark

Question No.	Question	Answer
1	Ozone is beneficial in the stratosphere but harmful in the lower troposphere. Ironically, human activities are causing ozone to a. decrease in the stratosphere and increase in the lower troposphere b. increase in the stratosphere and decrease in the lower troposphere c. level out to equilibrium in both areas so there is no substantive difference between them d. Human activities are not causing any changes in ozone concentrations anywhere. e. bond with nitrous oxides to form acid rain	
2	Primary pollutants from burning coal include all of the following <i>except</i> a. droplets of sulfuric acid b. sulfur dioxide c. suspended solid particles d. Ozone e. None of the above	
3	Photochemical smog generally requires the presence of a. nitrogen oxides b. Sunlight c. volatile organic compounds d. Heat e. all of these answers	
4	Photochemical smog is a characteristic of urban areas with many vehicles and a climate that is a. cool, wet, and cloudy b. cool, dry, and sunny c. warm, dry, and sunny d. warm, wet, and cloudy e. warm, wet, and sunny	
5	Which of the following statements is <i>true</i> ? a. Temperature inversions occur when a layer of cold air prevents warm air from rising. b. Temperature inversions exacerbate pollution problems. c. Temperature inversions last only a few minutes to a few hours. d. Normally, cool air near Earth's surface expands and rises, carrying pollutants higher into the troposphere. e. Temperature inversions help prevent air pollution.	

6	Which of the following can be placed into a broad category called acid rain? a. acidic fog b. acidic snow c. wet deposition d. dry deposition e. all of these answers	
7	Acid deposition can affect forests by a. Leaching out essential plant nutrients b. Diminishing the supply of Oxygen available to the tree c. Releasing ions that are toxic to the trees d. A and B are correct e. A and C are correct	
8	Acid deposition is best classified as a a. local problem b. state problem c. regional problem d. national problem e. international problem	
9	Of the following strategies to reduce acid deposition, the <i>most</i> effective is probably a. using low-sulfur coal b. adding phosphate fertilizer to acidified lakes c. adding more topsoil to thin soil with little buffering capacity d. adding lime to neutralize the acids e. implementing prevention approaches that reduce or eliminate emissions	
10	The effectiveness of the pollution prevention approach is <i>best</i> illustrated by the significant drop in atmospheric a. ozone b. sulfur dioxide c. lead d. carbon monoxide e. nitrogen oxide	
11	Which statement is the most accurate? a. Climate is determined by average weather conditions. b. Weather is determined by average climate conditions. c. Climatologists examine data from one to a few years to estimate weather. d. A general rise or fall in temperature or precipitation over 25 to 30 years is a standard time period that climatologists will study. e. None of these answers are accurate.	

12	<p>Which of the following statements about the greenhouse effect is <i>false</i>?</p> <ul style="list-style-type: none">a. The amount of heat trapped in the troposphere depends on concentrations of greenhouse gases.b. The greenhouse effect is a new theory that explains the warming of the atmosphere.c. Heat trapped by greenhouse gases keeps the planet warm enough for life.d. The predominant greenhouse gases are water vapor, carbon dioxide, methane, and nitrous oxide.e. It has been confirmed by numerous lab experiments and measurements of atmospheric temperatures at different altitudes.	
13	<p>Increased levels of carbon dioxide in the atmosphere have been implicated in which of the following?</p> <ul style="list-style-type: none">a. increased global warmingb. increased seawater acidityc. decreased seawater temperaturesd. both increased global warming <i>and</i> increased seawater aciditye. both increased global warming <i>and</i> decreased seawater temperatures	
14	<p>The Kyoto treaty to reduce global warming</p> <ul style="list-style-type: none">a. does not require developing countries to make any cuts in their greenhouse gas emissionsb. requires participating countries to cut CO₂, CH₄, and N₂O emissionsc. went into effect in 2005d. was not supported by the U.S. after 2001e. all of these answers	
15	<p>Which of the following statements is <i>false</i>?</p> <ul style="list-style-type: none">a. Ozone in the lower stratosphere shields the earth from about 95% of the sun's harmful ultraviolet rays.b. CFCs are odorless and stable.c. CFCs are nonflammable, nontoxic, and noncorrosive.d. Fluorine atoms are most responsible for the breakdown of ozone to molecular oxygen.e. CFCs are cheap to produce.	

Section II: (15 marks)



The top panel shows fossil-fuel CO₂ emissions for two scenarios: one “business as usual” and the other with net emissions peaking before 2020 and then reducing rapidly to near zero emissions by 2100, with the cumulative emission between 2000 and 2050 capped at 1000 billion tons of CO₂. The bottom panel presents the median projections and uncertainties of global-mean surface air temperature based on these two emissions scenarios out to 2100. The darkest shaded range for each scenario indicates the most likely temperature rise.

Question 1:

Is the projected change of the surface temperature of the Earth worrisome? Why?

[6 marks]

Question 2:

What will be your recommendations to stabilize the global surface warming to +2°C? Briefly explain the rationale for your recommendations.

[9 marks]

PART C – WATER QUALITY (30 marks)**Question 1**

Propose suitable drinking water and wastewater treatment processes with your rationales for a lake water and a domestic wastewater.

[8 marks]

Question 2

List typical parameters for measuring solids and organics (three for each) present in wastewater and explain their relationships.

[8 marks]

Question 3

Describe briefly short- and long- term variation pattern of COD mass loading in a domestic wastewater. Develop sustained total COD peak and low mass loading for a wastewater treatment plant with a design flowrate of 2.5 m³/s for a period of one year. The long term daily average COD concentration is 150 g/m³. The following data are applicable.

[14 marks]

Length of sustained peak, d	Ratio of averaged sustained peak COD mass loading to average mass loading	Ratio of averaged sustained low COD mass loading to average mass loading
1	2.47	0.15
2	2.15	0.21
3	1.93	0.33
4	1.84	0.45
5	1.78	0.51
10	1.45	0.70
15	1.36	0.80
20	1.25	0.85
30	1.21	0.88
365	1.00	1.00

-END OF PAPER-