The University of Jordan
Air Pollution

Midterm Exam **2nd Summer Semester 2016/2017**

Student's Name: [illegible] **Student's Number:** 0135754

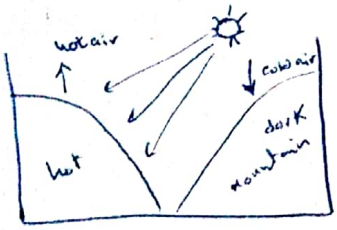
Question 1 (2 Marks)

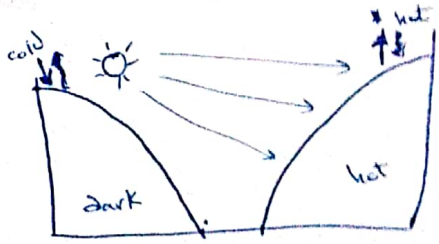
List the factors that influence the Insolation.

1. solar constant.
2. terpenancy of the atmosphere.
3. the angle between sun's rays & the earth.
4. effect of the effluence.

Question 2 (3 Marks)

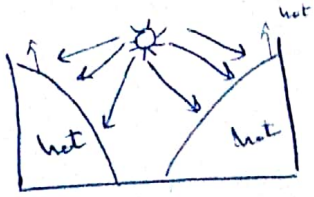
Discuss using drawings the role of sun's motion across the sky in the heating of mountain/valleys terrains.

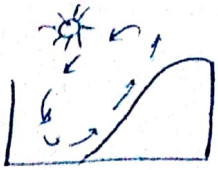




(At daytime).

* the surface which the sun rays drop on will be warmer than the other which the rays don't reach, so the air closest the hot will be more dense and move up then will be cooled and condensate (more dense). (As it is shown).





1

(At night time)

the surface (mountain/valleys) be cooler than morning → the air closest the surface will be denser Because it's heavy density. (As it shown above).

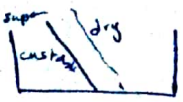
2.301

Question 3 (4 Marks)

Define the following: Wind rose, superadiabatic lapse rate, radiation inversion, and fumigation plume.

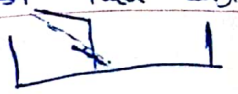
- wind rose: record the wind speed & wind direction at a particulate location & different period.

- superadiabatic lapse rate: it's called as unstable condition of the atmosphere which is below the dry adiabatic lapse rate and the rate is equal ≃ -6 C°/1000 m.



- radiation inversion: it's piece of stable condition, happen when the earth cools rapidly on early morning or late evening and the temperature will increase with altitude.

- fumigation plume: it's type of plumes, the stacke is above the inversion layer. firstly begin neutral then unstable.



Question 4 (3 Marks)

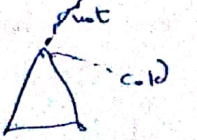
Explain how the dispersion of pollutants could be enhanced.

① dispersion OR Distription.

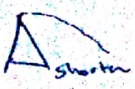
② *Down wash

Flow obstruction

② increasing temperature of the exit pollution → pollutants will more dense and more up away.



③ taller stack → pollutant, go away.



stack exit velocity

Question 5 (3 Marks)

Mention the particulate matter classifications, and the most harmful forms of it.

dust
fumes
Mists
smoke
spray

the most harmful is
spray & Mists.
the smallest size. less than 2.5 PM.

PM10

Question 6 (2 Marks)

Explain the mechanism by which ozone is depleted.

$CFCl_3 + UV \rightarrow CFCl_2 + Cl$

$Cl + O_3 \rightarrow ClO + O_2$

$ClO + O \rightarrow Cl + O_2$

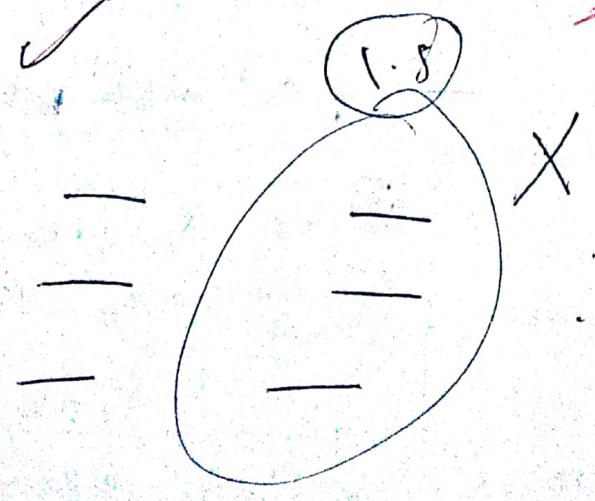
Question 7 (3 Marks)

What are the living organisms which can pollute indoors and explain its impact on human health?

cancer.

Mites
① Dust Mists.
② Micro animals..
③ Fungi

→ the effect on human health : Cancer !
Asmath



$M_w = 12+32 = 44$

Question 8 (3 Marks)

The concentration of carbon dioxide in the exhaust stack at 177 °C and 1.2 atm is 1.2 g/m³. Does this value exceed the concentration found in standard dry air (330 ppm).

2

$T = 177°C + 273 = 450\ K$

$R = 0.08208\ (atm.\ m^3)/(kmol \cdot K)$

$C = ppm = \frac{P\,M}{RT} * 10^3$

$1.2\ g/m^3 = ppm * \frac{1.2\ atm * 44}{(0.08208) * 450} * 10^3$

$ppm = 0.000839$

$ppm = 8.39 * 10^{-4} < 330.$

∴ NO! less than 330 ppm

Question 9 (7 Marks)

On an overcast day a stack with an effective height of 60 m is releasing sulfur dioxide. It has a mean concentration on the ground 500 m downwind and 50 m crosswind equal $6.37*10^{-8}$ kg/m³. The wind speed is 6 m/s. The stack is located in a rural area. Determine the emission rate of the stack and the maximum mean concentration (C_{max}) on ground level directly downwind at X_{max} equals 1.2 km.

7

D

H = 60 m

$C = 6.37 * 10^{-8}\ kg/m^3$

$z = 500\ m$ & $y = 50$

$u = 6\ m/s$

1) Q = ?

$\chi = \frac{Q}{\pi \bar{u} \sigma_y \sigma_z} \exp - \left[\frac{y^2}{2\sigma_y^2} + \frac{H^2}{2\sigma_z^2}\right]$

From table 5-2:

class D

$\sigma_y = 0.08 \times (1 + 0.0001 x)^{-1/2}$

$\sigma_y = 0.08 (6.37 * 10^{-8}) (1 + 0.0001 * 6.37 \times 10^{-8})^{-1/2}$ (1)

$\therefore \sigma_y = 5.1 \times 10^{-9}\ m$

$\sigma_z = 0.06 \times (1 + 0.0015 x)^{-1/2} \rightarrow = 0.06 (6.37 \times 10^{-8})(1 + 0.0015 * 6.37 \times 10^{-8})^{-1/2} \rightarrow \sigma_z = 3.82 \times 10^{-9}\ m$ (1)

$6.37 \times 10^{-8} = \frac{Q}{\pi * 6 * 5.1 \times 10^{-9} * 3.82 \times 10^{-9}} * \exp - \left(\frac{50^2}{2(5.1 \times 10^{-9})^2} + \frac{60^2}{2(3.82 \times 10^{-9})^2}\right)$

$6.37 * 10^{-8} = \frac{Q * 2.71}{\pi * 6 * 5.1 \times 10^{-9} * 3.82 \times 10^{-9}}$ (1.71)

$1.71 = Q * 2.71$

$Q = 2.32 \times 10^{-16}\ kg/s$

Good Luck

2) $X_{max} = 1.2\ Km = 1200\ m.$

From table → $\sigma_z = 43\ m.$

Class D

$\sigma_y = 90.4\ m$ →

According to Gaussian dispersion model, the ground-level pollution concentration due to an elevated source (z=0, H), and the maximum ground level concentration at the center line, could be calculated according to the following formulas, respectively:

$$q(x,y,0) = \frac{Q}{\pi \bar{u} \sigma_y \sigma_z} \exp - \left[\frac{y^2}{2\sigma_y^2} + \frac{H^2}{2\sigma_z^2} \right] \quad \text{.... (1)}$$

$$(C)_{max} = \frac{2Q_m}{e\pi u H_1^2} \left(\frac{\sigma_z}{\sigma_y} \right). \quad \text{.... (2)}$$

at the distance x_{max} for which $\sigma_z = \frac{H}{\sqrt{2}}$

Table 5-2 Recommended Equations for Pasquill-Gifford Dispersion Coefficients for Plume Dispersion[1,2] (the downwind distance x has units of meters)

Pasquill-Gifford stability class	σ_y (m)	σ_z (m)
Rural conditions		
A	$0.22x(1 + 0.0001x)^{-1/2}$	$0.20x$
B	$0.16x(1 + 0.0001x)^{-1/2}$	$0.12x$
C	$0.11x(1 + 0.0001x)^{-1/2}$	$0.08x(1 + 0.0002x)^{-1/2}$
D	$0.08x(1 + 0.0001x)^{-1/2}$	$0.06x(1 + 0.0015x)^{-1/2}$
E	$0.06x(1 + 0.0001x)^{-1/2}$	$0.03x(1 + 0.0003x)^{-1}$
F	$0.04x(1 + 0.0001x)^{-1/2}$	$0.016x(1 + 0.0003x)^{-1}$
Urban conditions		
A–B	$0.32x(1 + 0.0004x)^{-1/2}$	$0.24x(1 + 0.0001x)^{+1/2}$
D	$0.22x(1 + 0.0004x)^{-1/2}$	$0.20x$
D	$0.16x(1 + 0.0004x)^{-1/2}$	$0.14x(1 + 0.0003x)^{-1/2}$
E–F	$0.11x(1 + 0.0004x)^{-1/2}$	$0.08x(1 + 0.0015x)^{-1/2}$

A–F are defined in Table 5-1.

cont.

$\therefore \sigma_z = \frac{H}{\sqrt{2}} \Rightarrow 43 * \sigma_z = H$

$H = 60.85\ m.$

$Q_m \rightarrow$ $z = 0$

$x_{max} = \frac{Q_m}{\pi u \sigma_y \sigma_z} * 2.71 - \left(\frac{y^2}{2\sigma_y^2} + 0 \right)$

$1200 = \frac{Q_m * 2.71}{\pi * 6 * 90.4 * 43} - \left(\frac{50^2}{2(90.4)^2} \right)$

0.152

$Q_m = 3.3 \times 10^7\ kg/s$

$C_{max} = \frac{2 * Q_m}{e \pi u H_1^2} \left(\frac{\sigma_z}{\sigma_y} \right)$

$C_{max} = \frac{2 * 3.3 * 10^7}{2.71 * \pi * 6 * (60.85)^2} \left(\frac{43}{90.4} \right)$

$\therefore C_{max} = 165.43\ kg/m^3$

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Quiz 3 **2nd Summer Semester 2016/2017**

Student's Name: سروى أبو رزق **Student's Number:** 24

Question 1 (4 Marks)

Explain the mechanism by which ozone prevents ultraviolet radiation from reaching earth's surface.

$O_2 \xrightarrow{h\nu} O + O$

$O_2 + O \rightarrow O_3$

then $O_3 \xrightarrow{h\nu} O_2 + O$

4

Question 2 (6 Marks)

What are the living organisms which can pollute indoors, and explain its impact on the human health?

2

① Fungi ⟶ problems of dispersion.

② as this →

③ Micro organisms.

Good Luck

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Quiz 5 **2nd Summer Semester 2016/2017**

Student's Name: [illegible] **Student's Number:** 24

6

Question 1 (5 Marks)

List the steps of the control strategy required for an industrial environmental impact.

① elimination of problem sources.
② Modification of sources.
③ Application control technologys.
④ Change plant operations.

4

Question 2 (5 Marks)

What are the five categories of evaporative volatile organic compounds emissions from motor vehicle fuel systems?

① process operations { distillation systems. / Vacuum system.
② surface Area operation.

2

Good Luck

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Quiz 3" **2nd Summer Semester 2016/2017**

Student's Name: [illegible] **Student's Number:** (24)

Question 1 (4 Marks)

Explain the mechanism by which ozone is depleted in the stratosphere.

$O_2 + h\nu \longrightarrow O + O$ hv damage O_3.

$O + O_2 \longrightarrow O_3$

$O_3 + h\nu \longrightarrow O_2 + O$

Question 2 (6 Marks)

Give three examples of the volatile organic compounds which can pollute indoors, its sources, and explain its chronic impact on the human health.

1. [illegible]
2. [illegible]
3. [illegible]

[illegible]

① Benzene some paints.

② ethyle benzene ⟶ paints.

③ Chloroform ⟶ Chemical RXN.

Good Luck

* Chronic impact → [illegible] + Cancer + [illegible]

9/10

4

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Quiz 2 — **2nd Summer Semester 2016/2017**

(24) **Student's Name:** [illegible] **Student's Number:** 0135754 (24)

Question 1 (4 marks)

Discus the impact of the topographical features on the atmosphere.

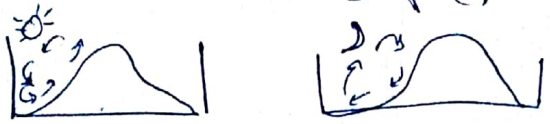
① Thermally → B caused by difference in surface temperature
the air closest the hot surface being warm and rises upward then the cold air with high density down ward.

② Mechanically so

↓

caused by difference in the shape (mountains, river, valley, ... etc). → ?!

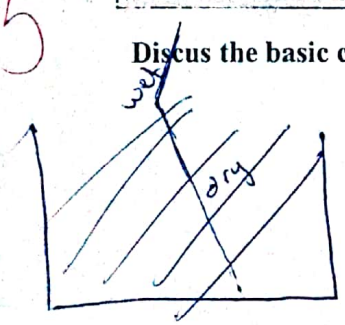
as this →

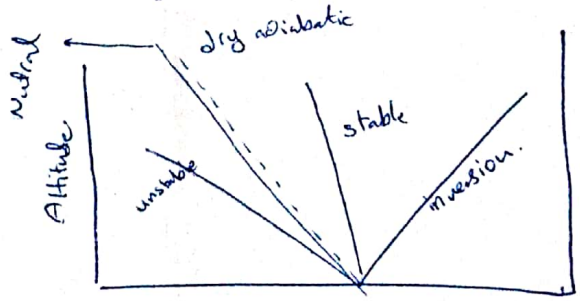


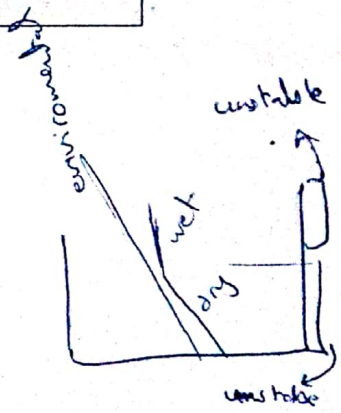
5

Question 2 (6 marks)

Discus the basic conditions of the atmosphere using a drawing.







$\frac{\partial T}{\partial t} = -1\,C^\circ/100\,m$

if $\frac{\partial T}{\partial t} = -9.8\,C^\circ/100\,m$ → it's dry adiabatic.

Good Luck

if $\frac{\partial T}{\partial t} > -9.8$ → it's [illegible] stable.

& inversion is type include stable condition.

$\frac{\partial T}{\partial t}$ → ⊖ if T decrease with height.

$\frac{\partial T}{\partial t}$ → ⊕ if (T) increase with height.