Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	AIR POLLUTION AND NOISE
COURSE CODE	:	BNA 30803
PROGRAMME	:	3 BNA
EXAMINATION DATE	:	DECEMBER 2019/JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) Analyze the natural and anthropogenic origin of the six criteria air pollutants and identify the likely mechanisms for their removal from the atmosphere.

(6 marks)

(b) Construction activities have the potential to generate a substantial amount of air pollution. In some cases, the emissions from construction represent the largest air quality impact associated with a project. As an Environmental Consultant, you need to complete an EIA report. Prepare the report by analyzing the expected air pollutants emission generated including the mitigation measures to reduce the impacts on environment.

(9 marks)

(c) You as a postgraduate student conducting a research and dealing with many chemicals in the lab. Few of them emit toxic and dangerous fumes that can cause severe health effects in short and long-term duration. Plan your work based on the hierarchy of hazard control.

(10 marks)

Q2 (a) Explain how a sea breeze adversely affects the dispersion of pollutants.

(3 marks)

(b) Determine the atmospheric stability with the following temperature profiles as tabulated in **Table Q2(b)**. Then, predict the pollution dispersion based on their atmospheric stability. For each condition, give **ONE (1)** example of plume behavior associated with its atmospheric stability.

(5 marks)

Table Q2(b)

Case	Z (m)	T (°C)
1	10	6.00
	201	3.09
2	18	14.03
	286	16.71

(c) One pulp and paper industry in Johor produces 1000 mg/m^3 of particulate matter with density of 700 kg/m^3 from its recovery furnaces is using venturi scrubber as one of their air pollution control (APC) device. With the following particle size distribution as described in **Table Q2(c)** and based on Environmental Quality (Clean Air) Regulations 2014 for industry pulp and paper industry, evaluate the overall mass efficiency removal by this APC and its compliance to the stated regulations.

Given, the venture characteristics are as follows:
Throat area = 1.0 m^2
Gas flow rate = 94.40 m^3/s
Gas temperature = 150°C
Liquid flow rate = 0.13 m^3/s
Coefficient κ = 200
Droplet diameter = 100 μm
Liquid flow rate = 0.13/94.40 m^3/m^3 of gas
Dynamic viscosity of the gas at 150°C = 25.2 μPa.s

Table Q2(c)

Average diameter, μm	% of total mass
2.5	25
7.5	20
15.0	15
25.0	15
35.0	10
50.0	15

(17 marks)

Q3 (a) Define the following based on interpretaion given by Environmental Quality Act 1974, Clean Air Regulations (2014).
(i) Fuel burning equipment
(ii) Performance monitoring
(iii) Best Available Techniques Economically Achieveable

(6 marks)

(b) Cement dust is characterized by very fine particulates. The exhaust gas temperatures from a cement kiln are very hot. From the list given, propose the most appropriate air pollution control device and explain the reasoning of the selection. Briefly explain the basic principle of selected device.
(i) Venturi Scrubber
(ii) Baghouse
(iii) Electrostatic Precipitator

(6 marks)

(c) Construct the graph of cyclone efficiency as a function of particle diameter for the particles having a density of 1,000 kg/m^3 and radii of 1, 5, 10 and 25 μm. In this case, standard reverse cyclone as in **Figure Q3(c)** is used with specifications and the gas conditions are as follows:

Cyclone barrel diameter = 0.50 m
Gas flow rate = 4.0 m^3/s
Gas temperature = 25°C

(13 marks)

Q4 (a) Differentiate between steady state (continuous) and impulse (impact) noise by giving **ONE (1)** example for each.

(3 marks)

(b) By referring to **Figure Q4(b)**,

(i) Determine the sum of 68, 82, 76, 68, 74 and 81 dB by sketching the diagram of decibel addition.

(5 marks)

(ii) A motorcyclist is warming up his racing cycle at a race tract approximately 200 m from a sound level meter. The meter reading is 56 dBA. Expect the meter reading if 15 of the motorcyclist's friends having exactly the same sound emission characteristics join him for racing cycle.

(5 marks)

(c) Point out **FOUR (4)** engineering noise control and describe its application.

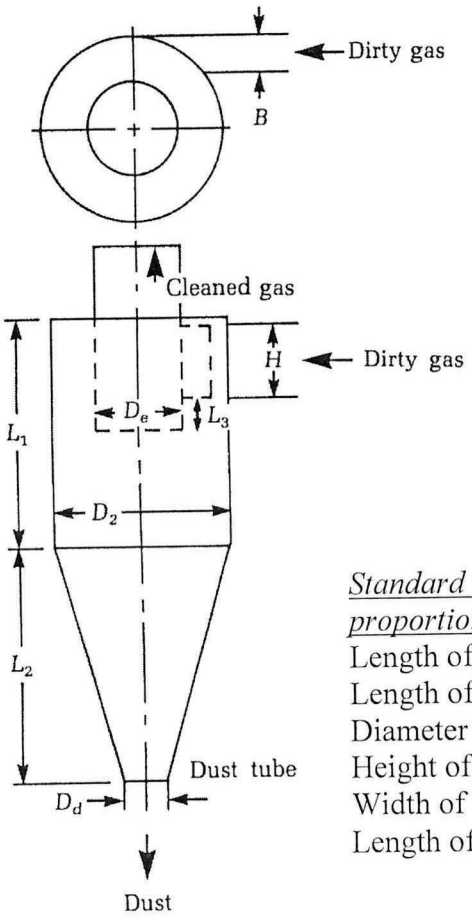
(12 marks)

-END OF QUESTIONS-

FINAL EXAMINATION

SEMESTER / SESI	: SEM I / 2019/2020	PROGRAM	: 3 BNA
COURSE NAME	: AIR POLLUTION AND NOISE	COURSE CODE	: BNA 30803

LIST OF FIGURE



Standard reverse flow cyclone proportion.
Length of cylinder, $L_1 = 2D_2$
Length of cone, $L_2 = 2D_2$
Diameter of exit, $D_e = 0.5D_2$
Height of entrance, $H = 0.5D_2$
Width of entrance, $B = 0.25D_2$
Length of exit duct, $L_3 = 0.125D_2$

Figure Q3(c)

FINAL XAMINATION

SEMESTER / SESI	: SEM I / 2019/2020	PROGRAM	: 3 BNA
COURSE NAME	: AIR POLLUTION AND NOISE	COURSE CODE	: BNA 30803

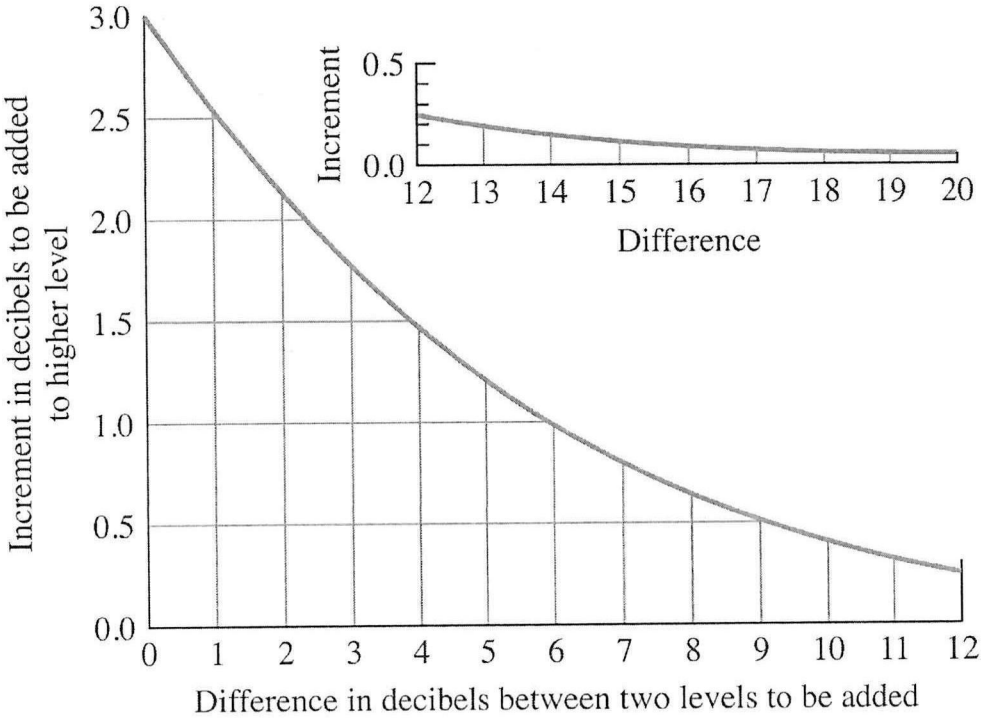


Figure Q4(b)

FINAL EXAMINATION

SEMESTER / SESI : SEM I / 2019/2020
COURSE NAME : AIR POLLUTION AND NOISE
PROGRAM : 3 BNA
COURSE CODE : BNA 30803

APPENDICES

Table A1: Environmental Quality Act 1974 Environmental Quality (Clean Air) Regulations 2014, Table H: Pulp and Paper Industry Including Paper Recycling Facilities In All Sizes

Source	Pollutant	Limit value	Monitoring
Recovery furnaces	PM	150 mg/m^3	Periodic
	Sum of NO and NO_2 expressed as NO_2	2 kg/t Air Dried Pulp (ADP)	Periodic
Lime kilns	Hydrogen sulfide (H_2S)	15 mg/m^3	Periodic
	Sum of NO and NO_2 expressed as NO_2	2 kg/t Air Dried Pulp (ADP)	Periodic
Sulfite mills	Total sulfur	1.5 kg/t Air Dried Pulp (ADP)	Periodic
Kraft and others	Total sulfur	1.0 kg/t Air Dried Pulp (ADP)	Periodic

FINAL EXAMINATION

SEMESTER / SESI	: SEM I / 2019/2020	PROGRAM	: 3 BNA
COURSE NAME	: AIR POLLUTION AND NOISE	COURSE CODE	: BNA 30803

LIST OF FORMULA

(a). $\psi = \frac{C\rho_p v_g (d_p)^2}{18 d_d \mu}$

(b). $C = 1 + \frac{6.21\ x\ 10^{-4}(T)}{d_p}$

(c). $\eta = 1 - \exp(-\kappa R\sqrt{\psi})$

(d). $\mathrm{d}_{0.5} = \left[\frac{9\mu B^2}{\rho_p Q_g}\ \frac{H}{\theta}\right]^2$

(e). $\theta = \frac{\pi}{H}(2L_1 + L_2)$