

SEMESTER I EXAMINATIONS 2002-2003

Unit EP328- Physics of the Environment I
Unit CE432- Airborne Pollution

Prof. E. Kennedy
Prof. S.G. Jennings
Dr. M. Byrne
Dr. K. McNamara
Prof. W. Powrie
Prof. P. O Donoghue

Time allowed: ONE AND A HALF hours.

Answer THREE questions, at least one from
Section A and one from Section B

Section A

- Q.1 What atmospheric property is measured with (i) a hair hygrometer (ii) a globe thermometer. [2 marks]
Briefly explain how the relative humidity of air may be altered without changing the air's water vapour content. [2 marks]
If the surface temperature of the Sun is 6000 K, at what wavelength does it emit its maximum radiation intensity? Wien's constant = $2.898 \times 10^{-3} \text{ m K}$. [2 marks]
Outline the principles of operation of (i) a hot-wire anemometer (ii) a pitot tube. [4 marks]
- Q.2 With reference to indoor airborne particulate pollution, give an example of (i) a pathogen (ii) a carcinogen (iii) an allergen. [3 marks]
What do you understand by the terms *Class 100 clean room*, *MMMF*, *resuspension*? [3 marks]
Given a source of tracer aerosol particles, a cylinder of sulphur hexafluoride tracer gas, and appropriate gas and particle detection equipment, outline how you would make a measurement of the aerosol deposition velocity in a room. [4 marks]

Q.3 Explain what is meant by the following terms:
aerosol, isometric particle, equivalent surface diameter, Martin’s diameter, PM₁₀. [5 marks]

The concentration of NO₂ at a particular site is 20 ppb. If the temperature and pressure at the time is 20 °C and 985 mb, what is the NO₂ concentration in units of µg m⁻³ ?

Molecular mass of NO₂ =46 g mole⁻¹
 Standard temperature = 273.15 K
 Standard atmospheric pressure = 1013 mb
 One mole of an ideal gas occupies 22.41 x 10⁻³ m³ at standard temperature and pressure.
 [3½ marks]
 Describe a method for the measurement of the mass concentration of ambient air.[1½ marks]

Section B

Q.4 A worker is exposed to a noise level of 91dB(A) for seven hours. In an adjacent room, a second worker is exposed to a noise level of 94dB(A). For how long must the second worker be present in the adjacent room to receive the same noise exposure as the first ? [3 marks]

According to the UK Noise at Work Regulations (1989), what is an employer’s obligation when his/her employee’s daily noise exposure is likely to reach (i) 85 dB(A) and (ii) 90dB(A). [2 marks]

Write a short note on how atmospheric stability affects the dispersion of a gaseous pollutant in the atmosphere. Assume the pollutant source is a chimney. [3 marks]

Using the ‘Key to Stability Categories’ given, determine the atmospheric stability for the following conditions:

- a) Clear Summer afternoon at 2:00pm; wind speed 2.7m/s
- b) Clear Winter night at 2:00am; wind speed 2.7m/s and
- c) Clear Summer morning at 10:30am; wind speed 6.2 m/s. [2 marks]

KEY TO STABILITY

Wind speed m/s	Day			Thin overcast or >4/8 low cloud	Night ≤3/8 Cloudiness
	Incoming Strong	solar radiation Moderate	Slight		
<2	A	A-B	B	-	-
2-3	A-B	B	C	E	F
3-4	B	B-C	C	D	E
4-6	C	C-D	D	D	D
>6	C	D	D	D	D

Q 5 A power plant burns coal at an average rate of 1.5kg per second throughout the year. The coal used contains 2% by weight of sulphur. Long term records indicate that 4% of the sulphur ends up in the ash. Estimate the SO₂ emission in kilograms per year. The gram molecular weight of sulphur is 32 and that of oxygen is 16. [7 marks]

List the parameters that affect plume rise from a chimney and comment on their effects on plume rise. [3 marks]