THE UNIVERSITY OF ADELAIDE
DEPARTMENT OF MECHANICAL ENGINEERING

EXAMINATION FOR THE DEGREE OF B.E.

8682: ENGINEERING AND THE ENVIRONMENT

NOVEMBER, 1999

TIME: 3 HOURS

[In addition, candidates are allowed ten minutes before the exam begins, to read the paper.]

[The use of notes, textbooks and calculating devices is permitted in the examination room.]

Attempt **ALL NINE** questions

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1. You are responsible for a large factory containing many items of noisy equipment. You have been informed that some of your employees are suffering from severe hearing loss and you have also received threats of legal action from members of the surrounding community because of excessive noise made by your facility. List the steps (in order) that you would take to quantify and rectify the problem.

[10 marks]

2. What is the speed of sound in a gasoline engine cylinder just after combustion when the pressure is 200 times atmospheric pressure and the temperature is 1000°C? The ratio of specific heats of the gas mixture is 1.35 and the gas density is 1.4kg/m^2 at 0°C and atmospheric pressure.

[10 marks]

3. A barrier exists between a source and receiver and results in a sound pressure level at the receiver of 60dB(A). There are four sound wave paths over the top of the barrier with corresponding noise reductions of 8, 13, 13 and 8dB(A) respectively. There are two paths around each end of the barrier with noise reductions of 18 and 12dB(A) respectively. What would the receiver sound level be if the barrier were removed and if the noise reduction of a ground reflected wave is 5dB(A)?

[10 marks]

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4. Explain why the A-weighting network is used in evaluating noise levels and comment on its validity for evaluation of industrial noise exposure. Discuss the advantages and limitations of A-weighted sound levels for characterising noisy equipment and workplaces.

[10 marks]

5. Given the following octave band noise measurements in dB, calculate the overall level in dB(A) and in linear (dB).

Octave band Centre Frequency	63	125	250	500	1k	2k	4k
SPL (dB)	95	93	90	87	80	80	82

[10 marks]

6. A vibration isolator is used to reduce the force transmitted by a machine into a stiff foundation. If the isolator deflects 2mm when loaded by the machine, calculate the following

   (a) The resonance frequency of the system [5 marks]

   (b) The reduction transmitted force in decibels at a frequency of 100Hz. Assume a critical damping ratio for the isolator of 0.1.

[10 Marks]

7. You have been hired by a consulting company to carry out a finite element analysis on some large pressure vessels that are in the process of being constructed. As usual it is a rushed job and construction is proceeding on the assumption that everything will be OK. You complete your analysis just before the vessels (which cost $10,000,000 to build) are completed. Your results show that the design is marginal and the vessels are likely to fail eventually. You tell this to the person in the construction company that hired the company that hired you. You are told that under no circumstances are you to say anything to anyone about the problems you found with the design as it is too late now. You are also told that if you say anything, the company you work for will not be paid, will be black listed and will have trouble getting similar work, and you personally will be dismissed and will not get paid for the last 6 weeks of 12 hour days that you worked on the job. Relate the issues involved to the tenets of the IE Aust. Code of Ethics and discuss what you would do.

[15 marks]

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8. Given the vibration levels measured in a building in the table below, calculate (for an exposure time of 8 hours):

   (a) the estimated vibration dose value for each axis

   [5 marks]

   (b) the combined vibration dose value for all three axes

   [5 marks]

   (c) If these levels were measured in a workshop, would you expect any adverse comment?

   [2 marks]

1/3 octave band centre frequency (Hz)	2.5	3.15	4	5
a(m/s^2) z-direction	0.01	0.02	0.008	0.009
a(m/s^2) x-direction	0.008	0.03	0.02	0.04

Assume that acceleration values for frequencies or axes not listed in the table are zero.

9. Describe how you would minimise air pollution from an oil fired rotating kiln used in a cement manufacturing operation. [8 marks]