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## NATIONAL EXAMS MAY 2011

### 07-Bld-B7, Indoor Air Quality

**3 hours duration**

#### NOTES

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is a Closed Book Exam with a candidate prepared  $8\frac{1}{2}$ " x 11" double sided Aid-Sheet allowed.
3. Candidates may use one of two calculators, the Casio or Sharp approved models. Write the name and model designation of the calculator on the first inside left hand sheet of the exam work book.
4. Any five (5) questions constitute a complete paper. Only the first five (5) answers as they appear in your work book(s), will be marked.
5. Each question is worth a total of 20 marks with the section marks indicated in brackets ( ) at the left margin of the question. The complete Marking Scheme is also provided on the final page. A completed exam consists of five (5) answered questions with a possible maximum score of 100 marks.

### Problem 1

Compare and contrast the following pairs of terms as they relate to *elements of indoor air quality*. In your answers briefly discuss the key differences or similarities of importance.

- (5) (i) Source control and ventilation
- (5) (ii) Indoor pollutant levels and weatherizing your home
- (5) (iii) VOCs and household products
- (5) (iv) Concentration-based standards and compliance testing for indoor air quality

### Problem 2

Provide answers to the following questions related to indoor *physical and chemical characteristics of contaminants*. For each type of contaminants below provide: (1) examples of contaminants; (2) a description or values of their physical, chemical or biological characteristics and (3) one method that may be used to minimize or eliminate related adverse impacts (a unique method for each type of contaminant):

- (5) (i) Inorganic
- (5) (ii) Organic
- (5) (iii) Biological
- (5) (iv) Radioactive

### Problem 3

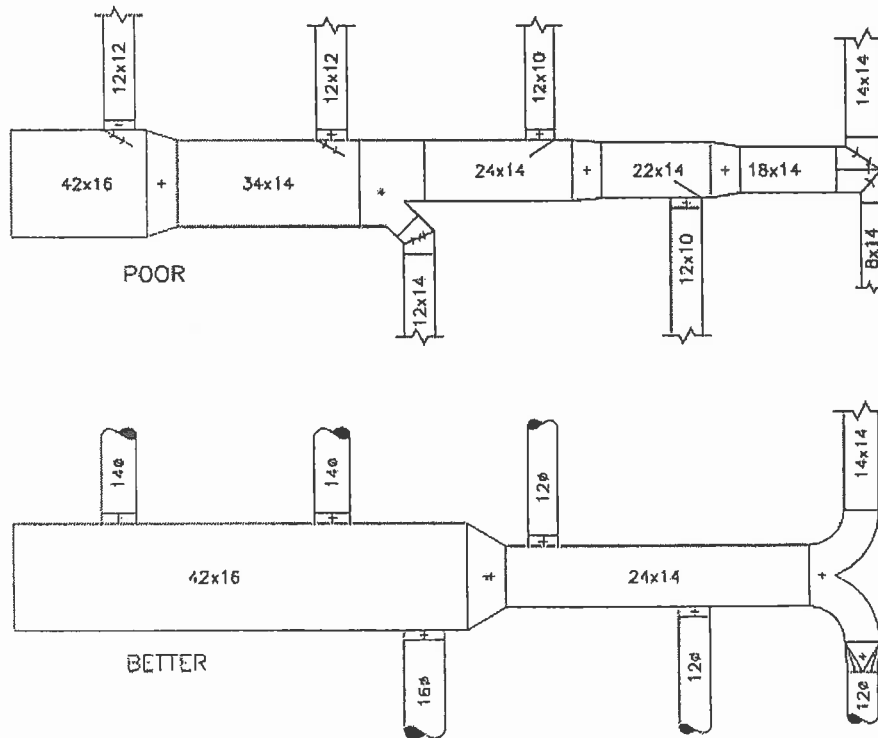
Provide answers to the following questions related to *health effects and indoor product standard requirements*. For each contaminant, briefly explain a potential health effect and how product or building standards may reduce or eliminate the critical concentration levels that may be found indoors. In your answer consider the indoor building environmental conditions, the kinetics and metabolism of the contaminant as well as potential chronic or acute health related issues.

- (6) (i) Radon
- (7) (ii) Formaldehyde
- (7) (iii) Benzene

### Problem 4

Provide answers to the following questions related to *design of ventilation systems for pollutant control*. It has been reported that about 50% of indoor air quality problems are caused by inadequate ventilation systems.

- (6) (i) Briefly explain how ventilation systems are designed to balance the exhaust, outside, return and supply air quantities to maintain good indoor air quality. Consider using schematics, figures and equations to supplement your explanation.
- (6) (ii) Identify three (3) important fan selection or design criteria and explain how they can assist with pollutant control within a building.
- (8) (iii) Briefly explain three (3) reasons why the “better” design is an improvement to the “poor” duct design given below. In your explanation suggest two (2) additional pollution control adaptations to the “better” system design.



### Problem 5

Provide answers to the following questions related to *air pollution due to outdoor air supply through ventilation systems*.

- (7) (i) In general, increasing the rate at which outdoor air is supplied to the building decreases indoor air pollution. Identify three (3) design methods in the ventilation system design, related to air supply, to promote improved indoor air quality.
- (6) (ii) Briefly explain how outdoor air supply through ventilation systems may alleviate indoor air pollution associated with (1) Intermittent air flow and (2) Poor distribution of air.
- (7) (iii) To dilute and eventually remove indoor contaminants, HVAC systems must bring in adequate amounts of outdoor air. Identify three (3) potential health problems associated with insufficient amount of outdoor air.

### Problem 6

Provide answers to the following questions related to and *effect of outdoor air pollution on indoor air quality*. It has been reported that about 10% of indoor air quality problems are associated with outdoor air pollution.

- (7) (i) Identify and briefly explain how three (3) major outdoor sources or outdoor activities result in poor indoor air quality.
- (6) (ii) Outdoor air pollution may cause poor indoor air quality that results in intermediate or long-term health effects. Briefly compare and contrast these effects as related to indoor air quality.
- (7) (iii) Define and explain the role of *air exchange rate* in influencing indoor air pollutant levels.

### Problem 7

Provide answers to the following questions related to *estimation of levels of indoor air contaminants in buildings*.

- (8) (i) Explain three (3) different methods commonly used to estimate the levels of indoor air contaminants in buildings. For each method give one (1) advantage and one (1) disadvantage of each.
- (7) (ii) Buildings in which more than 20 percent of its occupants report building-related illness have been associated with a “sick building syndrome”. Briefly explain how having a good estimation of contaminant levels will help to identify corrective measures in the building.
- (5) (iii) Explain the role of contaminant *standards* and risks associated with different levels of contaminant exposures to determine corrective measures are necessary.

## Marking Scheme

1. (i) 5, (ii) 5, (iii) 5, (iv) 5, 20 marks total
2. (i) 5, (ii) 5, (iii) 5, (iv) 5, 20 marks total
3. (i) 6, (ii) 7, (iii) 7, 20 marks total
4. (i) 6, (ii) 6, (iii) 8, 20 marks total
5. (i) 7, (ii) 6, (iii) 7, 20 marks total
6. (i) 7, (ii) 6, (iii) 7, (iv) 5, 20 marks total
7. (i) 8, (ii) 7, (iii) 5, 20 marks total