ORDRE DES INGÉNIEURS DU QUÉBEC

MAY 2018 SESSION

Open-book examination Calculators : only authorized models Duration : 3 hours

14-BA-B3 BUILDING AIR QUALITY

1: The occupants in a converted warehouse were not happy with their workplace. Although an expensive ventilation and air conditioning system had been installed, their offices were always too cold in winter and too hot in summer, and they were frequently bothered by exhaust fumes that they blamed on a moving and storage company in the same building. However, they could not make up their minds whether the fumes came from forklift units used in the storage warehouse on the left their area, the moving truck parking lot at the front of the building, or the truck service bays on the right side of the offices. Why the fumes are entering the building? And, how would you go about finding where the fumes come from? **(30%)**

2: The threshold limit for acetone in occupied space is 1000 parts per million at 25 C. Convert this limit to milligram per liter. **(10%)**

3: A tube containing 10 cm^3 of a toxic gas broke in a room. The dimension of the room is 10-m by 15-m by 2.5-m, and its air change rate is 0.5 hr^{-1}. How long would it take for the concentration of gas to be reduced by 50%? Assume that the gas and air are well mixed. State your assumption(s). **(20%)**

4: If we wanted to set the fresh air damper on a constant volume system for 15% outdoor air, what would be the mixed air temperature if the outdoor air was 30 ^oC and the return air was 70 ^oC? **(10%)**

5: A fan pressurization test was conducted to assess the leakage characteristics of a residential house in Montreal. The climate conditions, building parameters, and the measurement data are given below.

Building parameters	L=10 m,	W=10 m, and	H=4 m
Indoor temperature	23 C		
Outdoor Temperature	10 C		
Wind Speed at 10 m	5 m/s		

Measured data:

Pressure Difference (Pascal)	Airflow Rate (m^3/s)
11.97	0.0937
13.85	0.1026
17.24	0.1201
22.08	0.1410
26.47	0.1609
31.92	0.1849
38.39	0.2079
44.79	0.2294
51.84	0.2502
58.83	0.2673
65.08	0.2819
70.28	0.2943

i) Calculate the leakage characteristics for the given data,

ii) Calculate the equivalent area and the normalized leakage area at a reference pressure difference of 50 Pa, and

iii) Discuss the effect of the climate conditions (indoor/outdoor temperature and wind speed) on the accuracy of the assessment.

(30%)