SNC 1-DB Air Quality Name:

PART #1 Background Information

Taken From the Report by the World Health Organization (WHO): Health effects of transport related air pollution (2005)

Transport plays a fundamental role in the lives of societies and individuals: how people interact, work, play, organize production, develop cities, and get access to services, amenities and goods is inextricably linked with the development of mobility and the choices people make about it. In societies that rely heavily and increasingly on private motorized transport, vehicles are expected to become safer, more luxurious and powerful,and to be driven more frequently. These expectations, however, often do not take into account the ensuing consequences: increased fuel consumption, greater emissions of air pollutants and greater exposure of people to hazardous pollution that causes serious health problems.

The increased intensity of and reliance on transport also increase the risk of road-traffic injuries, exposure to noise and sedentary lifestyles. These risks are a disproportional threat to the most vulnerable groups in the population, such as children and the elderly, and they raise important questions about social inequalities.

An increasing body of evidence points to the magnitude of these adverse effects on health and to the need to identify solutions that both reduce risks to health and meet the requirement for mobility. This creates a major challenge to governments, public health organizations and environmental authorities, to urban and transport planners, and to all citizens.

Properly understanding the risks is a prerequisite to addressing them and to eliminating or reducing them.. The activities of populations, the planned use of spaces, individual behaviour and the choices available to transport users – all these affect people's exposure to pollution and the related health risks

<u>The Effect of Traffic on Air Quality</u>

Traffic contributes to a range of gaseous air pollutants and to suspended particulate matter (PM) of different sizes and composition. Tailpipe emissions of primary particles from road transport account for up to 30% of fine PM (less than 2.5 µm in diameter or PM2.5) in urban areas. Other emissions related to road transport (such as those from resuspended road dust, and wear of tires and brake linings) are the most important source of the coarse fraction of PM (2.5–10 µm in diameter or PM10–2.5). Road transport is also the main contributor to emissions of nitrogen dioxide and benzene in cities . Carbon dioxide, sulphur dioxide and ozone and also a by product of the combustion of fuels. In so-called street canyons (where pollutants are trapped) with heavy traffic, concentration levels of all transport-

related pollutants are much higher than in areas not affected directly by pollution sources Technological improvements and stricter emission standards will decrease vehicle specific emissions. Nevertheless, several factors – the growth of transport, an increased number of diesel cars on the market, the large number of short trips and traffic congestion – may offset the benefits derived from these improvements.

The present trends in transport patterns suggest the vehicle traffic will continue to rise. In the next decade, alternative vehicle technologies are unlikely to make important inroads in the market or to have a significant impact on air quality. Other factors are likely to contribute to inhibiting or preventing the reduction in people's exposure to transport-related air pollution; these include expansion of urban areas, increases in commuting time and greater traffic congestion. The trend in these contributing factors may also counteract the average improvement of air quality, particularly with respect to the levels of some gaseous pollutants.

Affect of poor Air quality on Human Health

Pollution intake is determined by emission levels, dispersion conditions (weather) as well as the number of people in polluted areas, how long they stay there and what they do. Time–activity patterns, particularly residence or work near busy roads (or both), and time spent in traffic are critical for population exposure. Travellers are often exposed to levels that are three times the background levels.
In-vehicle exposures are especially high for primary exhaust gases and particulate matter. Groups with high levels of exposure include people who live near busy roads or who ventilate their homes with air from roads with heavy traffic, road users (such as drivers, commuters and pedestrians) and people whose jobs require them to spend a long time on the roads.
Urban planning and development also strongly shape exposure; they determine not only patterns of residence and mobility but also the availability of public transport and non-motorized transport options.

Studies on Health Effects

A review of this evidence indicates that transport-related air pollution contributes to an increased risk of death, particularly from cardiopulmonary causes. It increases the risk of respiratory symptoms and diseases that are not related to allergies.
Laboratory studies indicate that transport-related air pollution may increase the risk of developing an allergy and can exacerbate symptoms, particularly in susceptible subgroups as well as an increase in heart attacks and inflammation disorders. A few studies suggest an increased incidence of lung cancer in people with long-term exposure to transport-related air pollution. Some studies suggest that it also causes adverse outcomes in pregnancy, such as premature birth and low birth weight.

Decreasing traffic exhaust exposure has been shown to reduce acute asthma attacks in children and the related medical care. Long-term decreases in air-pollution

levels are associated with declines in bronchial hyperreactivity, in the average annual trend in deaths from all causes, and in respiratory and cardiovascular diseases. Such decreases are also associated with gains in life expectancy.
Initial estimates show that tens of thousands of deaths per year are attributable to transport-related air pollution in North America, similar to the death toll from traffic accidents.

Traffic management is one of the instruments that can significantly reduce the exposure of residents of urban areas. In addition, the integration of environmental and health considerations into urban planning can be improved. In particular, urban planning may aim at integrative measures that lower emission rates, such as the promotion of highly efficient, service-oriented and clean public transport and improvements in the flow of traffic.

Several technologies show promise in lowering emission levels from conventional vehicles, and their development should be promoted, along with effective control mechanisms (such as mandatory car inspections) for eliminating gross polluters and badly maintained vehicles. Finally, alternative vehicle technologies and fuel substitutes could lead to substantial future reductions in emissions of hazardous air pollutant

PART #2 – A Question to Investigate

How does the volume of transportation (as measure by the number of vehicles/hour) affect the air quality (as measured by ozone, sulfur dioxide, carbon dioxide levels, and particulate matter) ?

PART #3 – The Hypothesis

What are the variables going to be in your investigation? (5)

- Independent Variable(s):

- Dependent Variable(s):

- Control Variable(s): Identify at least 3 variables

State your hypothesis. (3 marks)

PART #4 (a) – Planning your Investigation

Use this planner to "sketch" out your experiment. Each box is one step of your experiment. Use words, pictures or both.

Step 1:	Step 2:	Step 3:
Step 4:	Step 5:	Step 6:
Step 7:	Step 8:	Step 9:

PART #4 (b) – Writing your Procedure [12 marks] As you will be conducting your experiment in the field, it is very important that you make sure that you have collected all necessary equipment before you leave for your test site.

MATERIALS: List all the equipment and materials you would use to conduct your lab (4)	SAFETY: What safety rules must be remembered and followed in this experiment (2)

Procedure. What was the method you used to investigate your question? (6)

Step 1:
Step 2:
Step 3:
Step 4:
Step 5:
Step 6:
Step 7:
Step 8:
Step 9:
Step 10
Step 11

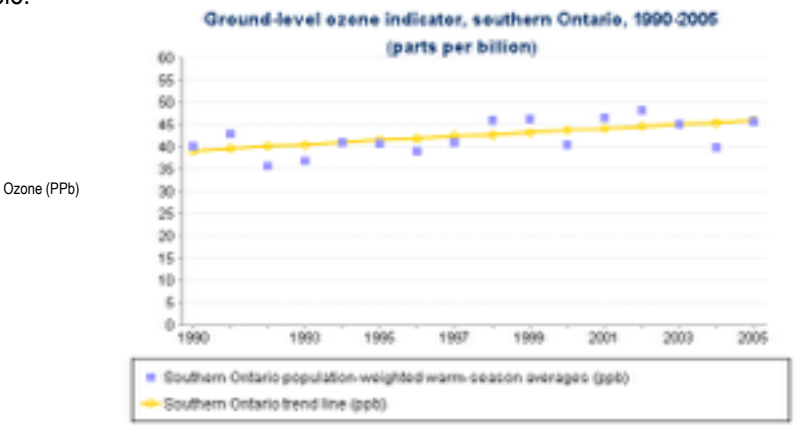
PART #5 – Conducting Your Investigation – OBSERVATIONS [15 marks]

a) Construct a table(s) of observations including units and appropriate headings.

b) Include a photograph of your test sites, as well as your map

c) Complete a graph if appropriate. You may want to use the classes data to ensure that you have enough trials.

Example:



PART #6 – Conclusion [11 marks]

Make a conclusion from the investigation you performed. Be sure you refer to the question asked **in the investigation you performed**. Tie your conclusion back to the observations you made, the given question, and the hypothesis you formulated at the beginning of the period.

PART #7 What are the sources of error? (4)

List 2 possible sources of error in the experiment. Explain how each source of error could be improved upon in your experiment. Make sure you make a distinction between human error and experimental error that was out of your control.

Source of error	How could you improve the experiment

Part #8 Questions (25 Marks)

1. How does your data compare with the standard air quality guidelines set by the Ontario government?

2. What is smog?

3. How does vegetation impact air quality and vice versa?

4. How might high traffic volumes affect water quality of streams and lakes in the vicinity of the roads?

5. What is an air quality health index and why is it useful?

6. Why would ozone levels be expected to be higher in the summer?

7. The Drive Clean emissions testing program was implemented to reduce emissions caused by poorly maintained vehicles. Has this been a successful program? Support your answer.

8. Canada's smog 'hot spot' is Southwestern Ontario which experiences high levels of pollutants because of many sources of domestic and transboundary air pollution. It is estimated that more than half of all smog forming pollutants come from the United States; from industries in Ohio, Illinois and Michigan and the rest by use of cars and electricity during hot summer days. How has Ontario tried to reduce the amount of transboundary pollution coming into Ontario? Can you suggest any other means to reduce this Made In America Smog?