Name: _____ Group: _____

THE PROBLEM

CKFL, QUÉBEC

News – 12:01 p.m. – 30 s

A disaster occurred in Gaspé yesterday when two freight trains collided head-on, resulting in an explosion that claimed the life of one person. A switching error appears to be the cause of the accident. According to observers, substances aboard the trains may have produced explosive gases.

This tragic accident is reminiscent of last year's event during which a maintenance worker died from poisoning.

The head of safety for the rail company has directed a team of chemists to examine whether this mix of substances could be harmful. The resulting recommendations will enable the company to adopt a new emergency measures plan.

TO: Test.inc. Chemical Laboratory
FROM: ABC Railways Inc.
CC: Minister of Public Safety
RE: Recommendations

Dear Sir or Madam,

The tragic accident in Gaspé has prompted us to review our emergency measures plan. We are requesting your firm to conduct tests to determine the nature of the gas produced by the mixture of certain substances transported on our trains. These mixtures produce gases that are potentially dangerous. As part of your mandate, please identify the nature of the gas produced by the following mixtures to determine whether they pose a fire hazard. Below is a list of the potentially dangerous mixtures:

- Hydrochloric acid (HCl) and solid magnesium (Mg)
- Hydrochloric acid (HCl) and solid calcium carbonate ($CaCO_3$)
- Hydrogen peroxide (H_2O_2) and solid manganese dioxide (MnO_2)

Please forward the results of these tests as soon as possible, as your recommendations will influence our new emergency measures plan.

Sincerely,

Hanna Corban
ABC Railways Inc.

In this simulation exercise, you are to assume the role of a lab chemist working at the firm Test.inc.

Choose one of the following mixtures to examine:

1. 25 mL of 36.5 g/L hydrochloric acid (HCl) solution with a 10-cm length of magnesium (Mg) tape
2. 25 mL of 1 mol/L hydrochloric acid (HCl) solution with 1.5 g of solid calcium carbonate ($CaCO_3$)
3. 25 mL of 3% hydrogen peroxide (H_2O_2) solution with 2 g of manganese dioxide (MnO_2)

Name: _____ Group: _____

CREATING THE CONTEXT

I ask myself questions

Name: _____ Group: _____

CREATING THE CONTEXT (*continued*)

I must

I think

Reflection

	Yes	No
Do I fully understand the scientific concepts involved in the problem?	☐	☐

Name: _____ Group: _____

PLANNING THE PROBLEM SOLVING

I plan

Materials

Procedures

Name: _____ Group: _____

PLANNING THE PROBLEM SOLVING (*continued*)

Table of results

Reflection

	Yes	No
Have I considered other possibilities?	☐	☐

Teacher's approval

Name: _____ Group: _____

INITIATING THE PROBLEM SOLVING

I experiment

Safety rules to follow

Reflection

	Yes	No
Did I record and justify all the modifications made to my plan of action?	☐	☐

Name: _____ Group: _____

ANALYZING RESULTS AND DRAWING CONCLUSIONS

I analyze my results

I draw my conclusions

Name: _____ Group: _____

MY EVALUATION

Use the evaluation grid on page 10 to do a self-evaluation. Write A, B, C, D or E in the appropriate space.

SSC 1 Seeks answers or solutions to scientific or technological problems				
Criteria*	**Observable indicators**	**Me**	**Teacher**	**Comments**
1	**Creating the context** Definition of the goal and formulation of a hypothesis		☐ With help	
2	**Planning the problem solving** Suitability of the elements in the plan of action: materials and procedures		☐ With help	
3	**Initiating the problem solving** Accuracy of results and respect for the safety rules		☐ With help	
4	**Analyzing results and drawing conclusions** Identification of the gas and development of appropriate recommendations		☐ With help	

*** Evaluation criteria**

1 Appropriate representation of the situation
2 Development of a suitable plan of action for the situation
3 Appropriate implementation of the plan of action
4 Development of relevant conclusions, explanations or solutions

Name: _____ Group: _____

MY EVALUATION (*continued*)

Use the evaluation grid on page 11 to do a self-evaluation. Write A, B, C, D or E in the appropriate space.

SSC3 Communicates in the languages used in science and technology				
Criteria*	**Observable indicators**	**Me**	**Teacher**	**Comments**
1	**Creating the context and planning the problem solving** Definition of the hypothesis, identification of the variables and formulation of a protocol		☐ With help	
2	**Planning the problem solving** Use of appropriate scientific rules and terminology when establishing the list of necessary materials and protocol		☐ With help	
3	**Analyzing results and drawing conclusions** Analysis of results and drawing of conclusions		☐ With help	

*** Evaluation criteria**

1 Accurate interpretation of scientific and technological messages
2 Appropriate production or sharing of scientific and technological messages
3 Use of appropriate scientific and technological terminology, rules and conventions

EVALUATION GRIDS

Name: _____ Group: _____

SSC 1 Seeks answers or solutions to scientific or technological problems

Criteria*	Observable indicators	A	B	C	D	E
1	**CREATING THE CONTEXT** Definition of the goal and formulation of a hypothesis	The goal respects the objective of the problem to solve and the hypothesis is plausible and justified.	The goal somewhat respects the objective of the problem to solve or the hypothesis is somewhat plausible or not fully justified.	The goal somewhat respects the objective of the problem to solve and the hypothesis is somewhat plausible and not fully justified.	The goal does not respect the objective of the problem to solve and the hypothesis is implausible and unjustified.	The work needs to be redone.
2	**PLANNING THE PROBLEM SOLVING** Suitability of the elements in the plan of action: materials and procedures	The list of materials is complete. The procedures are very clearly stated and appropriate.	The list of materials is almost complete. The procedures are clearly stated and appropriate.	There are several elements missing from the list of materials OR the procedure are more or less clearly stated and appropriate.	There are several elements missing from the list of materials AND the manipulations are more or less clearly stated and appropriate.	The work needs to be redone.
3	**INITIATING THE PROBLEM SOLVING** Accuracy of results and respect for the safety rules	The experiment is conducted in a safe manner. All the results are correctly noted.	The experiment is conducted in a safe manner. Most of the results are correctly noted.	The experiment is conducted in a safe manner AND some results are correctly noted.	The experiment is not conducted in a safe manner.	The work needs to be redone.
4	**ANALYZING RESULTS AND DRAWING CONCLUSIONS** Identification of the gas and development of appropriate recommendations	The gas is correctly identified and the recommendation is very clearly stated and appropriate.	The gas is correctly identified and the recommendation is clearly stated and appropriate.	The gas is correctly identified AND the recommendation is more or less appropriate.	The gas is not correctly identified OR the recommendation is not appropriate.	The work needs to be redone.

* Evaluation criteria

1 Appropriate representation of the situation
2 Development of a suitable plan of action for the situation
3 Appropriate implementation of the plan of action
4 Development of relevant conclusions, explanations or solutions

Name: _____

Group: _____

EVALUATION GRIDS (*continued*)

SSC 3 Communicates in the languages used in science and technology

Criteria*	Observable indicators	A	B	C	D	E
1	**CREATING THE CONTEXT AND PLANNING THE PROBLEM SOLVING** Definition of the hypothesis, identification of the variables and formulation of a protocol	The hypothesis and variables are clearly linked to the problem to solve and the protocol allows the problem to be answered correctly.	The hypothesis and variables are linked to the problem to solve and the protocol allows the problem to be answered, although it contains a few minor errors.	The hypothesis and variables are more or less linked to the problem to solve OR the protocol contains several errors.	The hypothesis and variables are more or less linked to the problem to solve AND the protocol contains several errors.	The work needs to be redone.
2	**PLANNING THE PROBLEM SOLVING** Use of appropriate scientific rules and terminology when establishing the list of necessary materials and protocol	All the specified materials and protocol respect scientific rules and terminology.	The specified materials and protocol respect scientific rules and terminology, but contain some minor errors.	The specified materials or the protocol have little respect for scientific rules and terminology.	The specified materials and the protocol do not respect scientific rules and terminology.	The work needs to be redone.
3	**ANALYZING RESULTS AND DRAWING CONCLUSIONS** Analysis of results and drawing of conclusions	The analysis of the results and the conclusion are very clearly stated and linked to the goal of the problem to solve.	The analysis of the results and the conclusion are clearly stated and linked to the goal of the problem to solve.	The analysis of the results and the conclusion are more or less clearly stated OR are more or less linked to the goal of the problem to solve.	The analysis of results and the conclusion are more or less clearly stated AND are more or less linked to the goal of the problem to solve.	The work needs to be redone.

* Evaluation criteria

1 Accurate interpretation of scientific and technological messages
2 Appropriate production or sharing of scientific and technological messages
3 Use of appropriate scientific and technological terminology, rules and conventions