Name_____Date_____Class_____

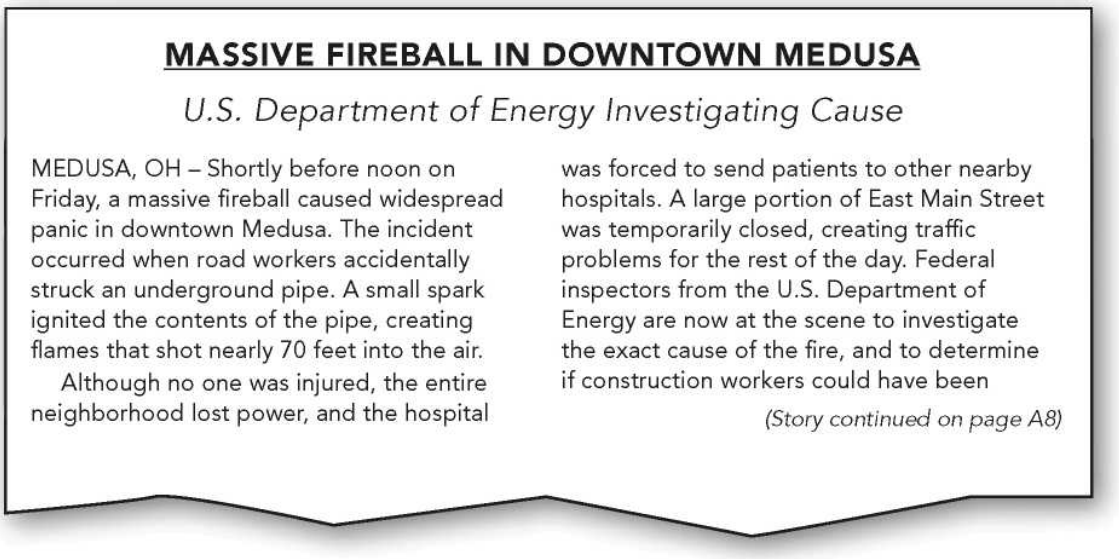
The Pipeline Is Burning

Purpose To balance combustion equations

Materials

- pencil or pen
- paper

Scenario



MASSIVE FIREBALL IN DOWNTOWN MEDUSA

U.S. Department of Energy Investigating Cause

MEDUSA, OH – Shortly before noon on Friday, a massive fireball caused widespread panic in downtown Medusa. The incident occurred when road workers accidentally struck an underground pipe. A small spark ignited the contents of the pipe, creating flames that shot nearly 70 feet into the air.

Although no one was injured, the entire neighborhood lost power, and the hospital was forced to send patients to other nearby hospitals. A large portion of East Main Street was temporarily closed, creating traffic problems for the rest of the day. Federal inspectors from the U.S. Department of Energy are now at the scene to investigate the exact cause of the fire, and to determine if construction workers could have been

(Story continued on page A8)

It's not unusual to have all sorts of pipes, wires, and fiber-optic cables running under our feet without our even knowing it. The wires and cables carry electricity, telephone conversations, and Internet service. The pipes carry crude oil, natural gas, and water (both clean and dirty). Leaks in gas pipes create potential hazards, because even the smallest spark can ignite the gas and cause an explosion like the one in Medusa.

Federal inspectors from the U.S. Department of Energy are investigating the cause of the Medusa fire, and they need your help to complete their report. Part of their report includes a description of the possible chemical reactions that could have caused the explosion. The inspectors have come to you, a chemist, because they need balanced equations showing the combustion of natural gas and some other fuels that could have been in the pipe that the workers struck.

Procedure

1. **What Was Burning?** It turns out that the substance we call natural gas is mainly methane—a simple compound that has a single carbon atom surrounded by four hydrogen atoms. The formula for methane is CH_4. Methane is a highly flammable and odorless gas. The reaction of methane with oxygen leaves behind no ash and very little air pollution. Methane reacts with oxygen to produce heat, light, carbon dioxide, and water vapor. The chemical equation for this reaction is:

$$CH_4 + O_2 \rightarrow CO_2 + H_2O$$

Name_____Date_____Class_____

Procedure *(continued)*

2. **A Balancing Act** Use the method described in your textbook to balance this equation. Write the balanced equation here.

   _____

3. **One Equation Is Not Enough** The inspectors are not certain that the pipe contained methane, so they want to compare the combustion of methane with the combustion of several other fuels. Use the same strategy to balance the following equations:

Gas	Reaction	Balanced Equation
Methanol	$CH_3OH + O_2 \rightarrow CO_2 + H_2O$	
Gasoline	$C_8H_{18} + O_2 \rightarrow CO_2 + H_2O$	
Hydrogen	$H_2 + O_2 \rightarrow H_2O$	

Conclusion

Let's see what you learned about balancing chemical equations.

1. One molecule of methanol (CH_3OH) has how many hydrogen atoms?

   _____

2. For each molecule of propane (C_3H_8) that burns, three molecules of carbon dioxide are produced ($3CO_2$). How many total oxygen atoms are in those molecules?

   _____

3. Is the reaction between methane and oxygen endothermic or exothermic? Explain why we burn fossil fuels, such as natural gas.

   _____

   _____

4. What principle requires that a chemical equation be balanced?

   _____

Write a paragraph for the investigators to add to their report. In the paragraph, write the balanced equations for the reaction of methane and oxygen, as well as the reactions for the three gases in your table above. Predict whether you think each reaction is exothermic or endothermic, and explain your reasoning. Classify each reaction as synthesis, decomposition, or replacement.

SCORING RUBRIC	
SCORE 4	Student's paragraph includes correctly balanced equations for the four reactions and gives a logical reason for classifying each reaction.
SCORE 3	The paragraph includes all information required for a score of 4, but there are minor errors.
SCORE 2	The paragraph contains one significant error, or one required piece of information is missing.
SCORE 1	The paragraph is incomplete or shows minimal understanding of balancing equations.